THE

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AND OF THE

# INSTITUTIONS IN UNION.

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No. 104. FRIDAY, NOVEMBER 17, 1854. Vol. III.

## Journal of the Society of Arts.

*FRIDAY, NOVEMBER* 17, 1854.

### FIRST ORDINARY MEETING.

WEDNESDAY, NOVEMBER 15, 1854.

The First Ordinary Meeting of the One-Hundred and First Session, was held on Wednesday, the 15th instant, Viscount Ebrington, Chairman of Council, in the chair.

The following Institutions have been taken into Union since the last announcement:—

376. Clonmel, Mechanics' Institute.
377. Derby, Working Men's Institute.
378. North Devon, Associated Parochial Lending Libraries.
379. Waterford, Mechanics' Institute.

Viscount EBRINGTON, as Chairman of Council, read the following

### ADDRESS.

If preceding Chairmen of Council, when preparing to deliver the customary Address at the opening of the Session, have felt it necessary to ask your indulgence, how much more must I require it, when, after so short an experience as a member of the Society, I find myself by the kindness of the Council invested with the responsibilities of that honourable office.

Short, however, as my experience has been, I have seen abundant evidence, not only from its older records, how useful the Society has been during the earlier part of its first centenary, accomplished last year, but also from its actual working, how much service it is rendering, and will I trust continue to render, during the next and future centenaries of its existence. My predecessor in this chair, Mr. Chester, to whose energy and ability you owe so much, in opening your hundredth Session last year, gave you a luminous and interesting review of what had been the Society's operations from the first meeting of our twelve spirited founders in Rawthmell's Coffee-house, down to the first meeting of the general Conference of representative members from some 368 Institutions in Union with us in this our present statelier home. That Conference, as you are well aware, was the first fruits of the happy movement made in 1852, under the appropriate presidency of the Marquis of Lansdowne, to change the character of the Society, and to enlarge the sphere of its operations—to make it no longer a merely Metropolitan Society, but the centre of a confederation of once isolated and still independent kindred institutions throughout the United Kingdom,—institutions all, like our own, voluntarily established and maintained without the aid or interference of the State, by men of every rank and degree, of every shade of religious and political opinion.

It will be my duty to start from that point, and shortly glancing at so much of the programme of operations unfolded by my predecessor as has been accomplished within the last year, to lay before you that which the Council proposes for the coming Session.

One of the first points attempted to be gained by this Union, was the interchange among the various Institutions of their several experiences of lecturers and lectures, and the consequent establishment of a register of both. I am happy to say that the plan determined upon in the first instance by the Council after much consideration, has answered extremely well—the plan, I mean, of making the list issued by the Society a simple register of lecturers, their subjects, and in some cases their terms, with the names of the Institutions attached by whom they were recommended, without any note or comment on the part of the Society of Arts. Arranged in a form convenient for reference, and systematically tabulated, this has afforded many facilities both to lecturers and audiences; and if not absolutely approved of by every one in every particular without exception, has certainly met with very general and most encouraging acquiescence. The loan of photographs, nature prints, and objects of art, &c., to different Institutions in turn, has been attended with decided advantage; nor has the arrangement been less successful for cheapening books, maps, instruments, &c., to the members of the confederated Institutions.

But it was soon felt that merely providing facilities for the acquisition of knowledge through the oral instruction of lectures, or through study

in classes, or self-instruction from lending-library books, would very imperfectly answer the ends we had in view. It was felt that for these voluntary students some further incentive was wanting to ensure a course of systematic and continuous application; and that some reward was due to such application, over and above that inward satisfaction which is its necessary concomitant. It was, moreover, felt that, while the whole community could not fail indirectly to profit by the increased knowledge acquired, and the habits of regular study formed by so many of its members; others, besides the students, were directly interested in the proficiency of each student being ascertained and made known. It was felt that employers and landlords were really concerned, not only in the spread of education among the aggregate of those whom they employed, or had as tenants; but also in being able to estimate correctly the amount of education of different individuals appearing, or seeking to appear, on their pay lists or rentals.

For this purpose some system of examination was clearly necessary. Most who hear me will remember the admirable Report, with its valuable Appendices, which emanated from the Committee of the Society upon Industrial Instruction last year. Having in that report so clearly had pointed out to them what was wanting in the way of education in the country, it became the duty of the Council to consider what could be done. They determined accordingly to endeavour to procure a number of persons, whose names would be a guarantee for their pre-eminent fitness for the task, to consent to act as examiners into the proficiency acquired in different branches of knowledge by members of the different Institutions in Union with the Society of Arts. The eminent men thus appealed to, several of them being of European celebrity, with a kindness, liberality, and self-devotion, which I am sure will be appreciated by their countrymen, at once undertook this great and laborious public service, provided a satisfactory scheme were proposed to, and adopted by, the Conference of Representatives from the confederated Institutions.

Thus encouraged, the Council submitted a scheme for the purpose to the Conference last July, and the Conference unanimously adopted it, with one addition, which I had the honour of moving, viz.—

"That the Council be requested to prepare a plan for extending to the inhabitants of rural and other districts, where the establishment of Mechanics' Institutes is difficult or impossible, the benefit of connection with this Society, and of the Local Examinations proposed to be established by the Society in concert with the Local Institutions in Union with it."

I will not fatigue the meeting with any recapitulation of the arguments I urged in the letter I addressed, nominally, indeed, to Mr. Chester, but in reality, through the Journal, to the members of our Confederation, or of those which I pressed *viva voce* upon the Conference. Suffice it to say that the resolutions, which comprised most, if not quite all, that I wished, having been voted, it has devolved upon the Council to carry it out. The Council found that the Hants and Wilts Educational Association afforded a bright example, not only of the useful working of such Institutions in a district for the most part purely agricultural, and sparsely inhabited; but also of a remarkably fair and practical plan for bringing them into union with us. We have accordingly suggested it for imitation in other rural districts, as affording probably the most convenient and equitable mode of extending to the inhabitants of such districts the benefits of membership of our confederation, benefits of which that of examination will, I hope, be henceforth one of the most prominent.

In the country things move more slowly than in towns. A short delay will, therefore, probably elapse before this sort of organisation becomes at all widely extended. I entertain, however, no doubt but that the middle classes of this country, and the *elite* of that next below them, urgently require and keenly feel the want of an educational test, and of some generally recognised certificate of acquirements analogous to the University degrees and the "passing" for various professional positions; and I have therefore equal confidence that this organisation of our Society, if it be properly adjusted, so as really to meet that want, will be equally successful, and will render valuable service to the community.

The next subject to which I am naturally led when speaking of education, is our great feat of last session—that cosmopolitan collection, if I may so term it, of educational appliances, and assembly of educational experts and amateurs—the Educational Exhibition—for starting which we are mainly indebted to the same enlightened liberality as we were for originating the never-to-be-forgotten Exhibition of 1851. Without our Royal President's munificent aid and hearty encouragement, the notion of an Educational Exhibition must have remained a mere vague aspiration, instead of becoming an accomplished fact. Long may that illustrious Prince continue to consult his truest dignity and best interests by associating his name with undertakings like these; giving them the benefit, not only of his Royal patronage, but also of his enlightened and practical supervision, and obtaining from us in return a constantly increasing measure of honour and affection. While thus engaged in cultivating the lofty and safe, yet most fruitful neutral ground of Social and Educational Improvement, of Encouragement to Arts, Manufactures, and Commerce, His Royal Highness may defy the ingenuity of calumny and misrepresentation.

The exhibition itself and the lectures kindly

given in connection with it by many eminent educational authorities, both English and Foreign, surpassed my most sanguine expectations, both as regarded the amount of curious and valuable educational appliances from all parts collected together under one roof; and also as regarded the evidence afforded of the attention now paid to the art of education throughout the civilised world. The interesting collection of results proved, as far as such inanimate witnesses could prove, what we trust will be more clearly and usefully shown by many of the rising generation, that real progress has been made of late years in developing the mental and bodily powers of children while training them up in the way they should go.

If the pecuniary results of the Exhibition as a mere show, may not have come up to the sanguine expectations of some among us; if the apathy of too large a portion of the public prevented their bestowing even half an hour upon an Exhibition, which to parents at least ought to have been irresistibly attractive, the fact that many did visit it with profit, would of itself have in great measure consoled us. But as it is, we are amply rewarded for any sacrifice of money or trouble it may have cost us. For I am happy to be able to announce to you the fact of her Majesty's Government having officially intimated their opinion that a National Museum of Educational appliances is desirable; and their wish that our Educational Exhibition should be rendered available as the nucleus of a permanent Educational Museum for the nation.

The next subject to which I shall call your attention is one of a kindred character in some respects, as bearing upon the acquisition of knowledge and the improvement of the taste of our countrymen, while contributing greatly to their enjoyment for the time, and their store of pleasant and kindly recollections hereafter,—the plan I mean of encouraging members of the Institutions in Union with us to visit the great Exhibition at Paris next summer, by offering them facilities in the shape of reduced fares for the journey to and fro, pre-engaged lodgings, pre-arranged meals, and ready organized guides and interpreters while there. The idea having been submitted to the Conference, and unanimously approved by them, the Council has been requested to take measures for carrying it into effect. It is since been engaged in doing so accordingly. We have found, on the part of some of the Railway authorities a very liberal disposition, and, thanks to our friend Mr. Clark's assistance, we have the prospect of getting cheap and comfortable arrangements made at Paris.

It is obvious, however, that unless the French Government kindly allowed some relaxation of the passport system in the case of such Excursionists, they could not proceed to Paris without considerable inconvenience and delay. But I am happy to be able to announce to you that the Imperial Government has shown every disposition to meet the applications on this subject in a most liberal spirit; and I will venture to pronounce that in so doing it will evince not less wisdom than kindness: for no surer means could be found of converting the happy alliance between the two Governments into a cordial friendship between the two nations, than facilitating to the utmost, intercourse, both social and commercial, between them. And I cannot help anticipating very satisfactory results from the personal experience of a French welcome by hundreds—nay, I hope, thousands—of our countrymen, returning to their homes in all parts of the United Kingdom with quickened feelings of good-will to their neighbours on the other side of the Channel. At the same time, greatly as in our character of Englishmen we should rejoice at thus in any degree contributing to cement that auspicious alliance which is the best guarantee for the liberties, and, therefore, for the progress of Europe; and happy as we should feel in setting the example of an extension to the masses of that exchange of public visits and hospitality with other countries, till now confined to crowned heads and great personages, or at most to the wealthiest muncipalities: yet those objects would hardly have come within the scope of our operations as a Society for the Encouragement of Arts, Manufactures, and Commerce. But those who remember how leading a part this Society took in starting the Great Exhibition of 1851, first conceived in its full comprehensiveness by our Royal President, and, to a great extent worked out, too, under his enlightened superintendence, will not wonder that we should look with peculiar interest and sympathy at the magnificent effort now making in France to equal, if not surpass, that triumphantly successful realisation of a truly grand and noble conception.

Those who have either heard or read the remarkable series of discourses delivered in this Hall on the Great Exhibition's results, considered in their different aspects, will not be surprised that we should have desired to place within reach of the poorer as well as the richer classes of our countrymen the pleasure and advantage of visiting its Parisian successor, the most promising of all those that have yet sprung out of it. But though most, if not all, of its various influences for good have been so eloquently dwelt upon in this spot by those who were preeminently qualified to trace and to appreciate them; yet there is one so peculiarly bearing upon the point under our consideration, that I must venture to call your attention to it for a moment. And in doing so I will borrow the striking language of a most valued friend of mine, for whom I feel the more anxious publicly to testify my

admiration and regard, because he has lately been assailed with the most malignant calumnies. Indeed, as if the misrepresentation of his motives and proceedings were not enough, unimpeachable facts have been actually denied, and official records misquoted against him in Parliament.

"The Exhibition," writes Mr. Chadwick, a real friend but not a flatterer of the labouring classes, "the Exhibition may be treated as a consecration of industry giving an interest to all engaged in it. Our tendency has been to carry on work for the money alone. The anticipation of the results is, of course, sufficiently pleasurable to those who make much money. But, however good the wages may be, the working for them without anything else is a toil and a drudgery." "It is less the masters than the men I look to, making their work interesting to them, and thereby reducing the drudgery and mitigating the toil, which I think an immense object." "Formerly there was a liking for the work apart from the money. It is so now amongst the foreign artizans, where they are required, on admission to the guilds, to produce '*master-pieces.* Now these Exhibitions—the regard and respect paid to work as work, tend to give it, with every class, an interest in addition to the money interest—to relieve toil without diminishing the pleasure from the anticipation of the more tangible reward, the pecuniary payment for it. The competition and juxtaposition of the results (*i.e.* the work) got by Exhibitions, the direction given to exertion by prizes, are suggestive as well as stimulative. If there were nothing else got by them, there is a harmless amusement, which in itself is a great social gain."

One of the most eloquent writers of our day, Mr. Ruskin, repeatedly alludes to this "loving" spirit, both of the artist and of the artizan, as having been one main cause of the great superiority of the decorative work of earlier over that of later times. That love of their work which in the eyes of those engaged in it, as of him who views it aright, dignifies even the humblest callings. As old George Herbert quaintly sings: "Who sweeps a room as in Thy sight makes that and the action fine." Such a spirit put out of the question any such unnatural line of demarcation as that since attempted to be established to determine what kind of work is, and what is not, consistent with the dignity of art,—what is work for an artist, and what only for an artizan. I heard the other day of a needy young artist refusing on such grounds to furnish designs to a spirited wholesale stationer, who offered to pay him handsomely for them, because they were to be used for Valentines, and not as separate pictures or prints. If Valentines are to continue to be published—and I have no reason to believe that his refusal has put a stop to the practice—why should we not have them graceful and refined, instead of coarse and vulgar? Far different was the spirit in which Raphael decorated pottery ware, and gave designs for tapestry; in which Matsys the blacksmith wrought, and Palissy the potter laboured, even building with his own hands the furnace for the exquisite enamel wares which have immortalised his name. Far different was the spirit in which, as Michelet beautifully describes it, hundreds of nameless masons and stonecutters in the middle ages, not claiming, though well-deserving, the loftier title of sculptors, worked away at the decoration of church and cathedral, of chapel and shrine; finishing the hidden back of every figure as scrupulously as the visible front; regardless of anything except the perfection of the result, and indifferent as to human eye ever seeing or appreciating their conscientious labours. Happily in these later times we have had something of a revival of this good old spirit. We have seen many examples latterly of artists of the highest class not thinking it beneath them to furnish graceful designs for household articles in common use. There are many living, but one not long deceased I may be perhaps allowed to mention—the late Mr. Pugin, the stores of whose antiquarian lore and abundant fancy contributed so greatly to enrich the Mediæval Court at the Great Exhibition.

But to return from this digression. No one could fail of being struck in 1851 with the general superiority in design, and more especially in colouring, of the ornamental products of French industry over ours. The principles both of design and colour have with them long been carefully studied. Thanks very much to the exertions of one of our most conspicuous members, much progress has been made here since that time. But we have still much to learn in these respects; and I think we may safely expect the taste of those of our artizans who visit Paris next year, to be improved by seeing the marvels of grace and beauty sure to be exhibited by the French, and the specimens of harmonious colouring likely to be contributed from the East. I venture to hope also that the spectacle of what may be done in a short time by spirited and systematic operations in straightening and widening thoroughfares, and generally in improving the architectural beauty and sanitary condition of a town, will not be thrown away upon the visitors from some of our huge hideous manufacturing towns, or from this monster metropolis of ours, with its filthy quayless river and narrow overcrowded streets. Well may London excursionists to Paris blush at the contrast to that vigorous administration presented by the costly parsimony and obstructive conflict of divided jurisdictions, which have so long paralysed the march of improvement in our incalculably wealthier Capital.

And this reminds me of the Committee ap-

pointed last session by the Society to inquire into the system upon which the Parisian improvements have been conducted, and into their probable ultimate pecuniary results upon the inhabitants. I will mention, as one illustration of the sort of inquiries to be made, a statement I happen to have heard on this subject. I was told that the opening up of magnificent new streets, and the widening of old ones had been greatly, but not unjustly, cheapened by the compulsory purchase (at a fair price) not only of the ground actually required for the street, but also of that to some depth behind; so as to allow of the increased value being obtained by the sale or lease (at frontage price) of the new frontage so created—thus bringing down to the value per foot of the mere back street or mews behind, the actual cost of the ground added in front to the well frequented and therefore valuable street's width. The diffusion of information with regard to such Metropolitan works there, and the formation of public opinion upon them, is, I believe, much promoted by the periodical issue of the *Revue Municipale et Gazette Reunies*, which seems a very instructive publication. The Committee have not yet proceeded far in their interesting investigation, but I can confidently state, as the result of my own studies and enquiries, that the system of exceptional Government for the metropolis, as distinguished from the other cities, of France, which was framed and carried early in Louis Philippe's Government, is deserving of attention; and that the careful mode in which it it is there sought to temper, by a division of Municipal authority, and the introduction of ministerial checks, the naturally undue influence of a wholly self-governing Capital upon the State, would afford some useful hints for thoughtful adaptation, not for servile imitation, to any statesman undertaking the arrangement of a constitution for our metropolis. To frame for London, with its two and half millions of inhabitants, now increasing at the average rate of 50,000 souls a year, Representative Municipal Institutions, so as to render them effective for Local Administration, without giving them a formidable influence over the Imperial Government, is no easy problem.

The Committee upon Industrial Pathology held several meetings last year, but has not yet completed its investigations. I trust they will be vigorously pursued, for the exact knowledge of the extent of disease really due to noxious processes, even if they turned out to be, what they very rarely would be found, really inseparable, would be a great gain. The subject is one deserving every attention on the ground of humanity no less than of science, and it opens a wide field for patient research. Nothing should be taken for granted in it—every statement should be rigorously tested, for the illustrious Parent Duchatelet has demonstrated the utter baselessness of many of the general impressions with regard to the sanitary effects of particular employments. And this leads me to the reflection that the health of the labouring classes is perhaps in general less influenced by the work they are employed on than by the habitations they dwell in and the food and drink they are supplied with. Indeed, the answers to any sanitary inquiries confined to their trades only, without reference to lodging or diet, would obviously very imperfectly resolve the question under consideration. The sanitary condition of our different towns, and the different parts of those towns inhabited by different classes, has now been for some time so energetically investigated by official and philanthropic inquirers that it would be a waste of this Society's energies to enter upon that field. But the question as to the dietary of the masses, and the extent to which their nominal dietary is deteriorated by systematic adulteration, has as yet been very imperfectly looked into, and deserves on every ground more careful research. The *Lancet* has done good service by its able and systematic exposure of some of the more common adulterations, but we still know much less on the subject than we ought.

The line of argument taken upon it by many, including, I regret to say, some statesmen of eminence, has been *caveat emptor*—we must look to competition and public opinion for protection against the tricks of trade. To me, I confess, the political economy seems as questionable as the morality of this view. I can conceive no more reason why knowingly uttering false money should be punished, than knowingly selling verdigrised pickles—money being also equally a commodity, an object of purchase and sale, and its falsification being at least free from any danger of injury to life. The universal practice of civilised nations has established the precious metals as the general standards and measures of value. But the only reason why they are coined, that is, cut out into pieces of certain weight and fineness, each impressed with the Sovereign's image, so that it cannot well be altered without detection, is really to save every individual separately the difficulty and labour of testing the weight and fineness of the silver and gold he is paid in. Every civilised nation has also adopted some legal standard of weights and of measures. *Caveat emptor*, in principle, would apply to the one case as to the other; but the intolerable inconvenience and absurdity of its application to money and to weights and measures, has caused a special exemption from this principle to be universally agreed upon in their favour.

The sanitary Congress at Brussels, comprising representatives from almost every civilised nation, except, if I mistake not, Russia, unani-

mously affirmed, as a general principle, the detection and punishment of adulterations to be a public duty. The extent to which any government could prosecute with advantage such an inquisition would, of course, depend upon circumstances; but I believe the principle to be recognised by the common law of almost every civilised country, not only as regards money, but also as regards meat in a state unfit for food. In many countries it is notoriously carried much further. Of the soundness of the principle on moral and social as well as economical and sanitary grounds, I entertain no doubt. Indeed, I have heard strong statements made on the authority of City Missionaries and others, of the deteriorating influence exercised upon the servants of tradesmen addicted to such practices by the atmosphere of fraud and falsehood, in which they live.

But before quitting altogether the subject of the condition of the classes engaged in working for wages in different branches of industry, I cannot help expressing an opinion that we might before long, well find room for another Exhibition, of which the foundations may, without flattery, be said, like those of the two others already mentioned, to have been virtually laid by our Royal President, in the model cottages he so munificently built in connection with the Great Exhibition, and in the collections shown there by the Society for Improving the Condition of the Labouring Classes, which enjoys the honour of his patronage. I mean what I fear we must call a Working Man's Exhibition, for want of a more appropriate title to imply the simplicity and economy we contemplate—(a simplicity and economy which, however, all classes, to a certain extent, seek in vain at present in the arrangements of their homes)—an Exhibition for the display and comparison of the various kinds of dwellings, internal arrangements and fittings; furniture, beds, and bedding; fuel, grates, and stoves; cooking apparatus, kinds of food, and beverages, and the modes of preparing and using them; materials, and form of clothing, &c.; arrangements for cleansing persons, bedding, clothes, &c., which in different countries, and in different parts of the same country; in different climates, and in the same climate; to answer different purposes and the same purposes; under circumstances essentially different, and circumstances essentially similar, are generally used and approved, and more especially by the classes commonly known in England as the labouring classes.

It is notorious that though obviously not rich, no classes are so wasteful in proportion to their means, none turn fuel or food to so little account. From the want, partly, of the knowledge of "common things," partly of that interchange of views and experience, obtained less by books than by seeing other places and people; and also owing to the low prices they can only afford to pay for what they buy; improvement and economy (as distinguished from self-denial) are slower in finding their way into the poor man's household than into any other. I, myself, think that much good might result from such an exhibition if conducted with judgment and in a right spirit, remote alike from Utopian benevolent twaddle and an indolent acquiescence in "leaving ill alone." Whatever novelty is there exhibited and recommended must be cheap, simple, and strong, serviceable and appropriate. The Exhibition must not be held in a mere dilettante or nostrum-prescribing spirit, as a mere repository for ingenious trifles or complicated and expensive apparatus. Still less must it be held in a patronising or humanitarian spirit. Sad as it is to reflect upon the sufferings and privations endured by so many of our fellow-creatures, the best of them infinitely prefer—and I, for one, heartily sympathise with them in so doing—the cup of self-denial to comforts purchased at the expense of self-respect and independence. This country, having taken the lead, as it long has, in Charitable Institutions, and still does in the far better class of self-supporting Institutions for the masses, and having preceded all Europe in sanitary reforms, for securing to the poor man his chief capital, health, England seems to me to present peculiar advantages for usefully holding such an Exhibition. And I know not by what more appropriate body it could be started than by our Society, comprising as we do among our actual or affiliated members, working men of all classes, from the Prince next below the Throne and the minister in the Cabinet, to the manufacturing operative and the agricultural labourer.

I have learned with great pleasure that the Imperial Government of France is seriously and practically entertaining the notion (first, indeed, suggested by a Member of our Council) of constituting such an exhibition as I have described into a separate department of the *Exposition Universelle* of 1855. Though, from the shortness of the notice, it is not now to be expected that it could be presented there in a very complete state, yet immense advantages would be gained by the general diffusion through the whole civilised world which would be given to the idea if it were thus identified as a distinct, though subordinate feature of that great cosmopolitan undertaking. The way will, I hope, be thus paved for successfully holding hereafter a special Exhibition *ad hoc* in this country. If the Imperial Government should realise these expectations, I need not say that the Society will be most anxious to promote the success of this as of every other feature of that noble work of our neighbours.

Meanwhile, however, we hope that for the benefit of all classes, exertions will be made to im-

prove the arts conducing to an amelioration in the quality and arrangements of our buildings; as by non-absorbent bricks and tiles, and their cheaper production by less expensive and more manageable kilns and drying-sheds, economising time, labour, and fuel; by well-considered plans of ventilation, water supply, and drainage, to be employed in the original construction of houses; by cheaper fire-proof floors, &c.

The Council will continue its efforts to promote the decimalization of coins, weights, and measures, and to urge upon the Legislature some Amendment of the Law of Partnership. I individually look forward to the operation of this last measure as being likely—1st, to call into existence a number of small but valuable local undertakings, not large enough to attract the attention of the wealthy but distant capitalist; secondly, to hold out to the lowest class, the most extravagant of all classes in proportion to its means, more attractive invitations to saving than Savings Banks and Friendly Societies can present; and, thirdly, to diminish the distance and increase the sympathy between the employer and the employed, by converting many workmen into employers in their other capacity of shareholders in industrial undertakings.

The Society took an active part in promoting Postal Improvement; it will continue to do so, and to endeavour to get the great benefit of postal facilities extended to foreign countries and our own possessions beyond the sea. I sorrow in saying that the Honorary Secretary of the Committee, Don Manuel de Ysasi, who was the chief contributor with his purse as with his labour, was among the passengers in the unfortunate *Arctic*, and drowned.

The Council proposes having a Committee upon Parcel Postage. The Government having already, to a certain extent, taken this business into their hands, it will be interesting to ascertain the practical effect of what they have done in this respect; whether the results would seem to indicate that we ought to leave the matter as it is, or whether a retreat from our present position would be advisable, or a further advance in the same direction, as, for instance, in cases where there is and can be no regular commercial conveyance.

And now, having said thus much as to our future proceedings, I will return to the transactions of last year. We held our usual Exhibition of patented and other novel articles, among which I may perhaps mention as interesting to myself, who have before now been obliged to wear a respirator for warming the air on its way to the lungs, an ingenious application of the same principle by Dr. Stenhouse. For the air-warming wires of the old respirator he has substituted a filter of charcoal, to purify foul air on its way either in or out of the mouth. We had besides an instructive supply of fibres exhibited as substitutes either for rags in the manufacture of paper, of which the scarcity has been caused by the increased demand consequent upon extended education and postal facilites, or else for flax and hemp, of which, as the supply used to come in great part from Russia, the scarcity is mainly attributable to our present war with that power. But the most generally useful of all the novelties exhibited here last session, is the capital smoke-consuming open grate, which has been, like all his other valuable inventions, most generously presented to the public as a free gift by my excellent friend Dr. Arnott. You will be, I am sure, rejoiced to hear that the Council of the Royal Society have this year awarded him the Rumford medal for it. Many of you, I dare say, with me, heard his luminous exposition in this Hall of the admirably simple action of his admirably simple contrivance, and saw the specimen grate burning most satisfactorily in the fire-place opposite. Taking the saving of fuel as equal to only 25 per cent., the pecuniary saving from its use would more than compensate for the rise in the price of coals. While the consumption of the generally unconsumed fuel called smoke in the 400,000 private houses about the metropolis would make a difference in the clearness of the atmosphere, and the cleanliness of everything, far greater than anything we have yet seen to result from the Smoke Act, now at last in legal operation. I only hope that the ironmongers will aid in this movement, for without their co-operation little will be done for some time. I trust that, boldly relying on the demand sure to spring up upon such a fuel-economising open fire being offered to the public at a moderate rate, they will forthwith manufacture the Arnott grates in such large numbers as can alone enable them to be sold at a low price.

So much for the inventions of last session. I have now the pleasure of announcing to you that papers have not only been promised but are actually advertised on the following interesting subjects, by the following well-known able writers: "On the useful products of coal, coal gas excepted," by Professor Crace Calvert, on which I would remark that more of these useful products would be placed within our reach if we, with Dr. Arnott's aid, consumed less coal in making that worse than useless product smoke.

Another "On unused and unappreciated articles of raw produce from different parts of the world," by Mr. P. L. Simmonds, treats of a subject specially interesting to England, under whose dominion Providence has placed so large a proportion of the habitable earth. When we remember that not long ago gutta percha and Indian rubber (except as a leadeater) were among those unused articles, we may judge how important may be the

products still lying unappropriated within our reach.

The next, "On British Agriculture," by our ever active and sanguine friend, Mr. Mechi, speaks for itself. He is always to be found in the van of improvement, though sometimes the regulars would say hurrying forward with more eagerness than prudence. But those who remember Tiptree Heath as it was, must acknowledge that Tiptree farm, with its buildings, steam-engine, machinery, tanks, and pipes, is "a great fact." He has, I think, conclusively established, (for he is beginning to have many imitators,) the profitableness, even on an isolated farm, of cultivation by the application of liquid manure. It is the system to which, in the case, at least, of all moderate sized inland towns, I look for the only satisfactory solution of the great problem,—How to make food of what now too often makes fever. How remuneratively to return to the land in the shape of manure the elements of fertility taken from it in the shape of corn and meat, which, after they have been eaten, are now almost universally wasted.

The next, by Mr. Scrivenor, "On the growth and expansion of our foreign and colonial trade in iron, and the fiscal obstacles to its extension," interesting as it would have been even a century ago, to a country with such stores of iron and coal as we have been blessed with, assumes a double importance in these days of iron houses, iron ships, iron roads, &c.

The next, "on the New Bank-note," by Mr. Smee, a confidential servant of the Bank of England, comes most appropriately before a Society which is sometimes complained of as too greedy of new things. Whether we consider the new surface-printed bank-note we are to have, as a beautiful application of a beautiful recent invention, or as a happy means of putting away from our people the temptation, and delivering them from the evils of forgery, it must be equally hailed with satisfaction—and I have no doubt every one present joins with me heartily in the wish that we may each and all of us have plenty of them when they come out.

We have already good grounds for expecting other papers to be read, on the following other interesting subjects:—"On Silk Manufacture;" "Water Supply and Dr. Clark's Softening Process;" "American Iron Manufacture;" "Railway Accidents, being a review of Means for their Prevention;" "Electro-Magnetism as a Motive Power;" "Mining Records;" "Submarine Telegraphs and Telegraphic Instruments;" "Smoke Nuisance;" by gentlemen whose names even to give them would be a guarantee for their ability and value. I only hope the discussions upon each and all of them will be as well sustained as I doubt not the papers will be well done. I trust, therefore, we may look forward to an active and useful Session. And now, though I have already, I fear, detained you too too long, I would ask yet one moment's attention more to speak of our future prospects.

If we look at the history of the Society, and consider both its antiquity and the comprehensiveness of its scope, we shall not wonder that many subjects once only to be dealt with, if of all, in this place, should each in the course of time have formed the special object of a body specially established to deal with it alone. Institutions such as those of the Architects and of the Civil Engineers, the Royal Agricultural Society, &c., are examples of what I mean; and the Royal Society, occupying a position somewhat analogous to ours, has had similar off-shoots springing out of it from time to time. Nor is this cause for regret, but the contrary; for the principle of the division of labour must tell. It is not to be doubted that each of these special bodies has worked more effectively within its limited sphere of action, than our more comprehensive Society could have done. At the same time, though there always must remain a great deal falling under none of the eliminated categories, uncovered by any specialty, to borrow a word from the Tariff, the list of unenumerated articles not coming under any of the other heads will be constantly diminishing.

But no Society can prosper long in the position, so to speak, of a mere residuary legatee. If we trust to that, we shall fall again, as our Records show we were fast falling, when, thanks to the infusion of a new spirit into our Councils, our rapid and sudden revival took place. And to what was that revival owing? How was it effected? Not by coming down to compete with the necessarily greater activity of specialties within their own limits, much less by confining ourselves merely to the constantly decreasing field of unappropriated work, but by taking up the master position of connecting the specialties, and giving prominence to their essential unity—by rising to the higher principles common to all arts and sciences.

I have alluded to the advantage of division of labour. Its drawback is the tendency of the process to hide out the final object, to cause the ultimate end and the mutual relations of the several processes to be lost sight of by those engaged in each respectively. We see, therefore, how necessary it is in everything, in government, in science, in art, in manufacture, in commerce, that both consolidation and sub-division should be constantly going on—each alternately predominating for the moment according as general unity or special efficiency of action may happen to be most required—each, when well-managed, being not only not incompatible, but indispensable to the most advantageous use of the other.

We have just seen a Minister of War appointed, not for the purpose of confounding together, but combining into unity of action the once isolated and still distinct departments, managing respectively the commissariat and ordnance, the payment, the internal arrangements, and the disposition of our forces. On the same principle I venture to hope the Society of Arts may find a course of action at once useful and creditable, neither competing with any one of the many separate organisations for specialities, nor yet superseded by the aggregate of those bodies; but forming, unlike the Secretary of War, an unauthoritative and unobtrusive bond of union and co-operation between them. The proceedings of the Society of Arts with regard to the Great Exhibition of 1851, and the lectures upon its influences and results; the inquiries into the state of industrial education; the formation of a confederation of kindred Institutions throughout the kingdom; the steps taken for the promotion of education in connection with them, and the scheme for testing the education given and encouraging the students in them; and lastly, the Educational Exhibition, which so appropriately signalised the chairmanship of a zealous servant in the educational department of the state, show that for the last few years we have been doing work which no one of those other Bodies, nor all of them together, could have as advantageously undertaken.

While the Society occupies this position, and does work of this sort, I have no fear either for its usefulness or credit; and I venture sanguinely to anticipate for it, in the somewhat altered character it has gradually, from the nature of things, assumed, a second centenary still more serviceable, still more influential, and still more brilliant than its first.

The Secretary announced that at the meeting of Wednesday, the 22nd instant, the following Paper would be read:—"On the Manufacture and Application of Various Products obtained from Coal (Coal-Gas excepted)," by Professor Crace Calvert.

## REPORT ON THE MUNICH INDUSTRIAL EXHIBITION OF 1854.

Consul-General Ward to the Earl of Clarendon.—(*Received October* 16.)

Leipzig, October 8, 1854.

My Lord,—I have the honour to report to your Lordship, that having proceeded to Munich, according to your Lordship's instructions, as the Commissioner appointed by Her Majesty's Government, upon the invitation of the Government of Bavaria, to attend and inspect the Exhibition of German Industry held in that city, I have to lay before your Lordship the following observations upon that undertaking:

1. The States of the German Customs Union came to a resolution in the year 1842, to hold periodical exhibitions of the produce and manufactures of the States composing the Union; and the first of these Industrial Exhibitions (which I visited at the time) took place accordingly at Berlin in the summer of the year 1844. The interval proposed was five years, and the Munich Exhibition was therefore contemplated for 1849; but the political disturbances of that and the previous year obliged the Governments of the Customs Union to postpone their second Exhibition for ten years from the date of the first. At the Toll-Conference of 1853, Bavaria having declared her readiness to proceed with the Exhibition in 1854, the proposal was approved by the other States, with the additional resolution that Austria (whose commercial relations with the Customs Union had been drawn closer by the Treaty of the 19th February, 1853), as well as the small States in the North which are not members of the Union, should be invited to contribute to the undertaking. This proposal was accepted by Austria, as well as by the Principality of Lichtenstein, the four Hanseatic towns, and the Grand Duchy of Mecklenburg-Strelitz; but Mecklenburg-Schwerin and Holstein do not appear to have exhibited anything. Of the thirty-three contributing States, twenty-six were members of the Customs Union (including the five kingdoms of Prussia, Bavaria, Saxony, Wurtemberg, and Hanover), and the remaining seven were non-members of it, as already mentioned. The only foreign countries which contributed were the non-German dominions of Austria, it being contrary to the principles of the German Customs Union to invite contributions from foreign countries generally.

2. The Government of Bavaria, being thus authorised by the Customs Union, issued its notifications and regulations on the 3rd October, 1853; according to which, the time for holding the Exhibition in Munich was fixed for the three months between the 15th of July and the 15th of October, 1854. A Royal Commission was appointed for the chief management of the undertaking, subordinate to which were various Executive Committees. For awarding the prizes, juries were nominated, each group of articles having its separate jury, upon the same plan as that followed at the Great Exhibition in London. The Exhibition was opened in state by His Majesty the King of Bavaria, on the 15th of July last.

3. The building appeared appropriate to its purpose, and was generally admired. It was in the form of a cross, and was constructed of iron, glass, and wood, from the design of the architect, M. de Voit, of Munich, by the contracting builder, M. Cramer-Kless, of Nuremberg. The site chosen was the northern side of the Botanical Garden. The length of the main edifice was 800 Bavarian feet,* and that of the main transept 280 feet. The greatest height was 87 feet. The following is, as I was assured, a correct statement of the space which the building afforded:—

| | | Sq. Ft. |
|---|---|---|
| Superficies of the Glass Hall (main building) | | 216,800 |
| Superficies of the adjoining Engine-room | | 23,210 |
| Superficies of the adjoining room for Agricultural Implements . . . . . . | | 17,204 |
| | | 257,214 |
| Deduct for Offices and Staircases . | | 12,400 |
| Space for the Exhibition . . . . . . . | | 244,814 |
| | Sq. Ft. | |
| Of which the Floor took . . . | 64,556 | |
| the Tables . . . . | 60,672 | |
| the Passages . . . . | 119,586 | |
| | | 244,814 |
| The Walls or Sides took . . . . . . . | | 48,927 |

The average space allotted to each exhibitioner (taking the number of exhibitioners at 6,800) was calculated at about 18 square feet of flooring and tables, and 7 square feet vertically, making in the whole somewhat more than 25 square feet. A drawing and plan of the Glass-hall are annexed. The general effect upon the observer from within was undoubtedly good; but the pillars being of wood, not iron, was a circumstance which rather detracted

* 100 Bavarian feet are equal to 95$\frac{3}{4}$ feet English measure.

from its general elegance and lightness. The entire of the cost of the building is stated to have been 880,000 florins, or about 88,000*l.* sterling.†

4. The articles exhibited were distributed into twelve groups in the following manner:

The first group comprised minerals and combustibles; viz., ores; metals in their first stage of preparation; cements; minerals for plastic works, or for manure; coals; turf, &c.; also models of mines, and geognostic maps.

The second group comprised agricultural produce, either raw or in the first stage of preparation; such as corn, pulse, hemp, flax, tobacco, saffron, raw hides, silk cocoons, honey, and cheese.

The third group comprised chemical and pharmaceutical productions; and dye-stuffs of every description.

The fourth group comprised articles of food and personal use; such as flour, sugar, tobacco, soap and candles.

The fifth group comprised machinery; viz., steam-boilers, locomotive-engines, railway and other carriages, spinning, weaving, and printing machinery, artillery, household and agricultural implements.

The sixth group comprised all sorts of instruments for weighing and measuring; clocks; astronomical, surgical, and musical instruments.

The seventh group comprised textile manufactures and worked articles, whether of cotton, woollen, linen, or silk; yarns, hosiery, waxed-cloth, carpets, lace, furriery, gutta-percha wares, straw wares, leather, and articles of clothing.

The eighth group comprised metallic wares of all sorts, jewellery, and arms.

The ninth group comprised marble-works, earthenware, procelain, and glass.

The tenth group comprised wood-wares and hard-wares of all sorts; ivory, horn-work, papier-maché, and toys.

The eleventh group comprised paper, writing and printing-materials, prints, maps and globes.

The twelth group comprised a selection of works of art suitable to the objects of the Exhibition.

A list of the articles exhibited will be found specified in the Official Catalogue, a copy of which I have the honour to annex. When the Catalogue was first arranged, the number of the exhibitors was 6,588; but, by various supplementary additions, it increased, as will be seen, to 6,977; and some few contributions were still expected, which would raise the number of exhibitors to full 7,000. By far the largest of the groups was the seventh (textile manufactures), which comprised the productions of about 2,200 exhibitors; the next to it was the eighth group (manufactures of metal), comprising about 1,100 exhibitors; than came the ninth group (procelain, glass, &c.), with nearly 800 exhibitors; the other groups ranged variously from the number of 150 to that of 500 exhibitors.

5. The first question that here occurs is whether, considering the description of articles exposed to public inspection, and the countries from whence they respectively came, the Exhibition presented a fair view of the condition of German industry? This question must, I think, be answered in the negative. The produce and manufactures of Prussia, and the Nothern States, were very inadequately represented; while Bavaria occupied above one-third of the whole Exhibition, and encumbered it with a vast number of small articles which do not enter into the consumption of the masses in the great markets. The contributions of Austria were considerable; but though the industry of Vienna, of Moravia, and of Bohemia, stood promiently forward, one looked in vain for adequate specimens of the rich raw materials of Gallicia, Hungary, and Transylvania; and the representation of the Lombardo-Venetian territory was merely nominal. The disproportionate efforts of tho respective German States, will be seen by the subjoined analysis of the countries to which the 6,977 exhibitors belong.

† 1 florin of 60 kreuzers is equal to about 2s. sterling.

| | |
|---|---|
| Of this number the Bavarian Industry alone furnished . . . . . | 2,496 |
| That of Austria . . . . . . | 1,533 |
| That of Prussia, only . . . . . | 823 |
| That of the Kingdom of Saxony . . | 496 |
| That of Wurtemberg . . . . . | 451 |
| That of Baden . . . . . . | 183 |
| That of Hanover . . . . . . | 165 |
| That of the remaining States . . | 830 |
| Total . . . . . | 6,977 |

So that Bavaria may be said to have supplied five-fourteenths, and Bavaria and Austria together four-sevenths of the entire Exhibition, while Prussia contributed less than one-eighth part of it. The contributions of Wurtemberg were also much beyond the scale of the real manufacturing power of that state. The disproportion becomes still more striking when we call to mind the fact, that the population of the Prussian monarchy is about 16,500,000, that of Bavaria 4,500,000, and that of Wurtemberg 1,800,000; so that the Prussian exhibitors were in the ratio of 1 to every 20,000 of the population, whereas the Bavarian were in the ratio of 1 to every 1,800, and those of Wurtemburg in the ratio of 1 to every 4,000, of the population of those states respectively.

6. The Exhibition was, in fact, rather a display of the industrial powers of Southern Germany than of those of the entire country. Austria was glad to seize the opportunity of taking part, for the first time, in an Exhibition of the Industry of the German Customs Union. She made great exertions to be well represented, and was not altogether unsuccessful. The Austrian Government, which ardently desires the incorporation of the whole of Germany into a general Customs Union, was desrious of showing, that the Austrian manufactures were making steady progress and were in some respects already qualified to compete with the Industry of the North and West. This first appearance of Austria within the sphere of the Customs Union* was a step well calculated to increase the practical effect of the Commercial Treaty of 1853, and to dispose the minds of the German public to look to an extension of the principles of that arrangement, in the formation of a complete Customs and Commercial Union between Austria and the Zollverein; an end to which the Governments of Bavaria and Wurtemberg have for some time past, in common with Austria, directed their policy, and which the manufacturers of Southern Germany seem to consider sure of accomplishment at no distant date.

7. The classification of the articles exhibited appeared proper and judicious, and was, with some few exceptions, strictly adhered to within the Glass Hall. In the space allotted for each group respectively, were placed all the articles belonging to that group, from whatever state they came; but the Catalogue was arranged upon a different principle, namely, according to the order of the contributing States and their subdivisions, which proved very inconvenient to the visitors of the Exhibition. The Catalogue recited, not only under the head of each state, but, under the head of each province or district of some of the states, the twelve groups, classifiying the article in each group, contributed by each state or district. Now Prussia was parcelled out, for the purpose of the Exhibition, into twenty-two districts; Austria into sixteen; Bavaria into eight, and Baden into four districts. The consequence was, that the catalogue comprised no less than seventy-eight territorial divisions, under each of which the twelve groups were repeated, or so much of them as was applicable; and when a visitor desired to see any given article specified in the catalogue, it was often no easy matter to discover its actual position in the Glass Hall. It could not interest the public to know whether certain articles were

* Austria sent some articles to a small Exhibition at Leipzig, in the year 1850, but that was not an Exhibition of the German Customs Union.

collected under the supervision of the authorities of the Upper or Lower Enns, or the Government department of Köningsberg, or that of Gumbennen. The best arrangement on these occasions is, I submit, that the catalogue should simply enumerate the articles in the order in which they stand in the respective groups, so that the catalogue may be really a guide to the visitors of the Exhibition; and this principle may, perhaps, be usefully borne in mind in reference to the English portion of the approaching French Exhibition. No attempt should be made to classify the objects by counties or other districts; and the catalogue should correspond, in its order and arrangement, with the Exposition itself. A descriptive or explanatory catalogue is, of course, always desirable when it can be accomplished. The managers of the Munich Exhibition attempted nothing of this kind; but the Wurtemberg Committee published a separate catalogue of their own, which is more descriptive than the general catalogue, and states the prices of various articles, which the German manufacturers have for the most part on this occasion been reluctant to communicate to the public.

8. The great value of this Exhibition to Germany consists, as already mentioned, in the first appearance of the Austrian manufactures within the field of the Zollverein; but as regards the interests of foreign countries, such as England, the material question is, whether the Exhibition affords evidence of any considerable progress in the industrial career of the German manufacturers? My own impression is—and it agrees with the opinions of many experienced commercial men with whom I have conversed on the subject—that the more important branches of manufacture have made little progress in Germany within the last ten years, and that there has been no visible advance in them since the date of the Great Exhibition in London of 1851. The British manufacturer could, therefore, derive but small instruction from the Munich Exposition; and, as I have already observed, its character was so much that of an affair of the Southern States, that in some respects a better picture of German industry is in fact to be found in one of the Leipzig, or other great German fairs. This remark applies especially to the textile manufactures. In machinery, and the working of metallic substances, there are more signs of improvement; and there is a class of objects in which the excellence of the German artisan is very apparent, and where the advance is sufficiently striking—I mean articles of an artistic character, whether belonging to the department of the fine arts, or of a mixed nature, combining beauty of form with subservience to practical utility. In such works, the Teutonic genius is certainly not stationary, and already holds forth many models well worthy of our notice and imitation.

9. According to the published regulations, a full report upon the results of the Exhibition, and the merits of the articles exhibited, is to be made, after its close, to the Bavarian Government by a commission specially appointed for the purpose. A long and elaborate document is, I understand, to be expected, which will be valuable to those who desire a more special and technical insight into the subject than it is in the power of a merely cursory observer to furnish. In the meantime I venture to submit the subjoined remarks, which are of a more general character, and arranged in the order of the twelve groups of articles respectively.

10. *The first group* contained a large collection of minerals, and some coals, the produce of the Bavarian mountains, amongst which the auriferous sand from the rivers Isar, Inn, and Danube, was a surprise to many. The Hanoverian Mining Administration at Clausthal in the Harz sent a valuable assemblage of the Harz minerals, either in their primary state or in the first stage of preparation. Among the latter, the figure of a boy in raw cast iron was deservedly admired. The contribution of ores and minerals from the royal mines at Frieberg in Saxony was both extensive and well arranged, and appeared upon the whole the most important of its kind in the Exhibition. The Austrian mining districts were well represented. The Styrian steel, and the copper from the Salzburg mines, were conspicuous. The Prussian zinc, and the manufactures of it, were very superior. Wurtemberg sent some good articles, both useful and ornamental, of cast iron and zinc. An asssortment of wires, made by Beck and Co., of Augsburg, deserves a mention; their brass sieve wire was some of the finest ever yet produced, being of the fineness of 100,000, and even 120,000 feet to the pound, which is said to have been not yet realised in England. The Carinthian iron was exhibited in bars and axles of extraordinary strength. The copper of Nassau made a respectable figure. It must undoubtedly be admitted that many good specimens of the iron manufacture were presented by Austria, Prussia, Bavaria, Saxony, and Wurtemberg, this last particularly in ornamental objects of cast iron. The tendency of the German iron manufacturers is more than formerly towards production on a large scale; consequently they work less with charcoal, and require more coal. In Westphalia a great development of the production of the iron furnaces may be expected in consequence of the appearance of iron-stone (black-band) and coal in conjunction, as is so often the case in England. This fortunate conjunction is said also to take place not unfrequently in the Austrian dominions, and the art of preparing the cokes is now better understood than it used to be by the Austrian miners. The Munich Exhibition certainly contained much more numerous and various specimens of metallurgy than that of Berlin in 1844 (though some great mining districts, such as Prussian Silesia, were not represented); and of the iron manufacture, if not of the other branches of metallic industry, sanguine hopes are entertained that they are beginning to show signs of future development. The German iron manufacturers must, however, produce cheaper than at present before they can compete successfully with English or Belgian iron, and in order to effect this they must establish many more blast furnaces for production of raw iron in the country itself. Saxony has considerable advantages for working raw iron, owing to the abundance and cheapness of its coal, of which an enormous square block, weighing 23 centners,* was displayed in the engine-room of the Exhibition.

The great importance to Germany of the extension of its iron manufacture is evident enough; but it is also evident that, in so far as the Governments have endeavoured to attain that object by protecting duties, they have taken a wrong course. In the first years of the existence of the German Customs Union, raw iron was admitted duty free, and bar iron at one dollar per centner. On the 1st of September, 1844, raw iron was charged with a duty of 10 groschen per centner, and bar iron, according to the thickness, with 1½ and 2 dollars per centner.† Now the production of iron within the Customs Union appears to have been on the average of the under-mentioned years‡—

| | Centners§. | Ratio per head of the Population. |
|---|---|---|
| 1834 / 1835 | 2,566,661 | 10·50 |
| 1842 / 1844 | 3,438,851 | 13·29 |
| 1845 / 1847 | 4,085,567 | 15·26 |
| 1848 / 1849 | 4,177,257 | 15·42 |

So that the imposition of the protecting duties seems to have decidedly checked the rate of increase of the home production. The effect upon the consumption

* The trade centner, 110 lbs., is equal to 113¼ lbs. avoirdupois.

† The dollar of 30 groschen is equal to 3s. sterling.

‡ See Huber's reliable, and in part official, "Statistical Year Book" for 1852.

§ The toll centner of 100lbs. is equal to 110¼ lbs. avoirdupois.

was still more striking. The consumption of iron for general purposes, (exclusive of railways) within the Customs Union was on the average of the years—

| | Centners. | Ratio per head of the Population. |
|---|---|---|
| 1834 / 1835 | 2,492,736 | 11·60 |
| 1842 / 1844 | 5,788,729 | 21·46 |
| 1845 / 1847 | 4,801,027 | 16·37 |
| 1848 / 1850 | 4,568,995 | 14·55 |

Showing a progressive decrease in the consumption of iron in general since the introduction of the protective duties. Still the protectionist party in Wurtemburg, Nassau, and other parts of Southern Germany, continue to insist upon taxing foreign iron, and the free-traders have not yet succeeded in procuring the repeal of these objectionable duties. Foreign iron is indispensable to the German consumer, and must continue to be so until more capital and energy are applied to the raising of the raw material within the country itself. Without this no improvements in the fashioning of cast iron or in the finer manufactures will be of much avail in a national point of view.

Possibly the energies of the Zollverein may be in this respect stimulated by Austria, which is rich in excellent iron mines, and is paying much attention to the improvement of machinery, as the Austrian portion of the Exhibition has proved. The production of iron seems to have increased more rapidly in Austria than in the other States.

The quantity of raw iron produced in Austria was—

| 1833 | 1847 | 1850 |
|---|---|---|
| Centners. 1,603,755 | Centners. 3,109,202 | Centners. 3,217,064 |

The quantity of cast iron produced in Austria was—

| 1833 | 1847 | 1850 |
|---|---|---|
| Centners. 173,207 | Centners. 485,575 | Centners. 443,871 |

The consumption of iron in the Austrian dominions is, however, comparatively, yet very small. In the year 1848 it amounted to only eleven pounds per head of the population, of which two pounds and a half were for railways, and eight pounds and a half for other purposes; whereas, in the year 1850, the use of iron per head is stated to have been in the Zollverein 21·79 pounds, and in England no less than 94 pounds.

(*To be continued.*)

## NOTES ON VENTILATION AND WARMING.

By Lady Bentham.

The furnishing of warm air to apartments seems to have been lost sight of latterly, though of first-rate importance. In whatever way foul air is extracted, its place must necessarily be supplied with other air, and if this be cold, disease is likely to ensue; but to obviate mischief of this nature the surrounding a common grate with an air-chamber was long ago invented, that chamber having one pipe connecting with the outer air, and another pipe opening into the apartment; but this arrangement has fallen into almost complete disuse. Its abandonment seems to have been caused by a radical defect in the construction of the inlet of air, namely, that no provision was made for varying the entrance of air according to the different points of the compass from which the wind may blow. By way of example of the mischievous consequences of this defect may be stated that in our house, facing the north, a Rumford grate was so fixed as to be surrounded by an air-chamber, fed by a pipe opening outside of the house, and on the south side of the chimney was another pipe, for the delivery of heated air to the apartment. When the wind set from quarters to the northward, the arrangement answered to admiration; but when it blew from southerly points of the compass, the action of the chamber and its pipes was reversed—hot air went *outward*, cold air to supply its place came in from every chink of door and window. Subsequent trials of the apparatus have proved equally defective from the same cause, yet it seems susceptible of being easily obviated, as I have seen it to be at Montpellier. In that town the noted chemist, M. Berard, caused fire-places to be arranged according to our own Cavendish's plan, but surrounded that chemist's stove with an air-chamber, the entrance tube to which opened into a spacious corridor, to which air had access from both ends. The same gentleman's son, Professor Berard, superintended the fixing of several fire-places in the same manner for friends, all the air-chambers receiving their supplies from corridors. Our houses in towns and cities have no such vast corridors as those at Montpellier, but it has occurred to me that the same effect might be produced in houses as here built, and that without considerable cost or inconvenience. According to the idea conceived, a general air chamber might be constructed for the supply of as many rooms as might be desired—the supply pipe from the general chamber to be carried outside of the house, and to terminate in a hood of the same kind as the cowl for chimnies, differing, however, from chimney cowls, as they are made to turn their openings *from* the wind, while those for the supply of air should, by means of vanes, turn their openings *to* the wind, from whatever quarter it might come.

It is evident that were a sufficiency of warm air introduced, both for ventilation and to supply the fire, cold blasts would no longer enter at chinks of doors and windows, and that the general temperature of an apartment might be the same, or nearly so, in every part of a room. It might, indeed, be still advisable to introduce Dr. Arnott's chimney-ventilators for summer use, though they would have less work to do than at present, thus removing in great measure an objection made to them, that of occasionally giving entrance to smoke and soot.

Many attempts have been made to do away with the annoyance of blasts of cold air. For this purpose Count Rumford, as is well known, greatly contracted the opening to a chimney shaft; but this was found objectionable, as dust was thrown into the room instead of being carried up the chimney. The Count's grates give the most cheerful of all fires, partly in consequence of the great surface they expose of radiant heat, they being semi-oval, with bars at every part excepting the back, and partly this advantage results from the shape of the bars;—they are triangular, instead of round, and of such angles as least obstruct radiation from the burning fuel. The coal receptacle advocated by Dr. Arnott might easily be connected with a Rumford grate. Unfortunately, the simplicity of such a grate has prevented its adoption, but where much ornament is desired, it might be introduced in our chimney jambs, which, if of polished steel, would act as reflectors of the fire.

Mr. Simon Goodrich, mechanist in the Inspector-General's office, being much annoyed by cold blasts of air, to feed the fire brought a supply of air from under the boarding of his room, opening a channel for it in front of the fire. In this way dry rot of the timbers was prevented.

The cheerfulness of open fires will long tell in their favour, but much remains to be devised for the perfect combustion of smoke from them. Amongst other means proposed is that of a rotatory grate, which should be reversed on every fresh application of coals. This plan has the great advantage of enabling the supply of fuel to be optional, but against this plan is the trouble of opening or closing the alternate top or bottom of the grate; there

is also the difficulty of rendering durable the hinges or other contrivances that might be employed.

Old-fashioned *register* stoves have been little used of late years, yet the means they afforded of augmenting or diminishing the opening to the chimney shaft at pleasure is desirable.

The best manner of heating and ventilating large public buildings is still disputed, though many thousands of pounds sterling have been expended in apparatus for these purposes. The mode adopted in St. George's Hall, Liverpool, seems to have well answered as to effect; but it must have been costly at its first establishment, and probably a considerable quantity of fuel is consumed by it. The simplest mode with which I happen to be acquainted is that long ago devised by Mr. W. Strutt: it was for heating and ventilating the large cotton mills of himself and brothers at Belper. In this apparatus a very large chamber received air from the external atmosphere, and conveyed it when heated to the several chambers in the mills. Fire was lighted in a simple stove under the chamber, and from this fire the smoke and flame were conveyed around and over the air chamber, the channel for smoke and flame being extremely narrow, so narrow, indeed, as to render a scraper within it necessary. The pipes for furnishing air to the several work-rooms, might have been 8 or 10 inches diameter, if recollection can be depended on; their openings in each room were furnished with a self-acting means of closing more or less the aperture whenever the heat of the room exceeded about 60° Fahr., the temperature Mr. Strutt had found the most conducive to the health of his operatives. That gentlemen in 1806, kindly furnished drawings of his apparatus, as it was intended so to heat and ventilate the Panopticon School of Arts then erecting at Ochta, near St. Petersburgh. In this building the radial wings were each of them 100 feet long, yet when the external air was ever below zero of Fahrenheit, the whole of four storeys of workshops were heated from a single furnace, and the air being distributed in trunks along the whole length of each chamber, the temperature of the air rarely varied more than two or three degrees at the several parts of the 100 feet in length.

When, in 1848 the appalling fact occurred that no less than 73 human beings were lost from want of ventilation on board the *Liverpool*, I suggested the need of calling attention to the invention of air-pumps "cheap, easily fixed and worked, and not liable to be damaged by coarse usuages." This desideratum has been supplied by the invention of Dr. Arnott's curtain-valve pump, with which I was then unacquainted. It is employed, he says, for the ventilation of the Hospital for Consumptive Patients, and would be suitable for all buildings where crowded assemblies meet. This mode of ventilation would have, as I suggested,* in the year 1848, "the advantage of being distinct from, and independent of, any apparatus for heating, so that when the requisite quantity of foul air should be withdrawn, the supply of fresh air might either be heated in winter, or cooled in summer, as might be thought expedient. As to expense, the hire of a labourer to work the air-pump would hardly amount to the cost of fuel where ventilation is procured by means of fire, or to the interest of money expended in apparatus for obtaining a natural draught of air. A crowded church, for instance, might thus have its vitiated air withdrawn, and be supplied with pure air in lieu of it."

Pages 148 and 149 of the "Report on Quarantine" of the Board of Health, contain engravings of Dr. Arnott's curtain-pump of two different varieties. The barrel pump, of three feet square, and three feet stroke of the piston, he says, "delivers easily 1,000 cubic feet per minute." The swing pump, page 149, might possibly be the lightest of the two to work, and the most certain in its effect. Dr. Arnott suggests the placing one of these pumps half in a room and half in a loft above, so as to discharge foul air into it, or to connect pipes so as to carry the vitiated air entirely away. This suggestion led me to reflect on the application of the curtain-pump to domestic purposes, and that it was capable of being efficiently put in motion by clock-work; in consequence, I took the liberty of proposing to the Doctor its application to nurseries of children, hoping, at the same, that he would have enlarged on this general idea, but no notice has been taken of my note. I know, however, that a low-priced clock can be obtained of sufficient power to ventilate a sleeping-chamber by means of curtain valves, but whether or not for more extensive service, I am ignorant; yet I would fain hope that such an easy, certain, means of securing ventilated air might be extended to unhealthy work-rooms, as those of milliners and dressmakers. It is fearful to think of the number of young persons who are yearly sacrificed in such places for want of ventilation—their usual malady, the lingering one, consumption.

* Mechanics' Magazine, 6th Jan., 1849.

But supposing foul air to be withdrawn by the pump, and warm heated air to be supplied to replace it in winter, in summer there is danger, often, in sitting near an open window. To obviate this, no means yet devised seem so good as that first introduced, some seventy or eighty years ago, in St. Thomas's hospital, by Dr. George Fordyce. He caused parts of the windows to open inside, at an angle of a few degrees, closing the sides with triangular pieces of glass, the effect of which was to throw entering air against the ceiling. On the same principle, the upper edge of a sash-window might be provided with a ledge to cast the entering air against the ceiling, that ledge being moveable upwards or downwards, according as the windows might be open more or less.

The close stoves used in cold countries of course do not furnish adequate ventilation, but the apartments are usually spacious, and opening one into the other, the doors being left open. The loss of infant life is considerable in such circumstance, in consequence of the vitiation of the atmosphere. There is a well-contrived and pretty fireplace, called in France, a "cheminée Prussienne;" the like has been sought in vain in London warehouses, for it saves fuel considerably. It is simply an iron case, having its front partially enclosed; this front is more or less ornamented, often of marble, and on the top (but not touching the iron) is a slab of marble; it has a blower, elevated or let down at pleasure, by concealed rack-work, and the blower itself consists of several folds, so as to be out of sight when not in use. The Prussian stove is usually placed partly within a common chimney-opening, and it would be easy to close the open remaining part of the chimney, so as to form an air-chamber. I purchased a Prussian chimney at Montpellier, and had a Rumford grate screwed to its back; the consumption of coals was very small, though the heat given out was considerable, the chimney flue being closed in around the stove.

M. S. BENTHAM.

## RATING OF INSTITUTIONS.

A case was tried in the Court of Queen's Bench on Thursday, November 8, before Lord Campbell, Justices Coleridge, Wightman, and Erle, between the Philosophical Society of Cambridge and the Churchwardens and Overseers of Cambridge.

In this case the Philosophical Society of Cambridge claimed to be exempted from the payment of poor-rates upon the ground that it came within the exemption of the 6th and 7th of Victoria, chap. 36. That statute enacted that no person should be rated to any county, borough, or parochial rate in respect of any lands or buildings belonging to any society instituted for purposes of science, literature, or the fine arts exclusively, provided that such society shall be supported wholly or in part by annual voluntary contributions, and shall not, and by its laws may not, make any dividend, gift, division, or bonus in money unto or between any of its members.

Mr. Watson, Q.C., appeared in support of the rate. The

Society was established in the year 1819, and in the year 1832 received a Royal charter. In the charter it was stated that Mr. Sedgwick and other gentlemen had applied for the same, and intended, by means of the society, to secure the promotion of philosophy and the science of natural history. Nothing was said in the charter about a news-room, which had now become one of the prominent features of the institution. The society had taken from St. John's college a lease of a house at a rental of £161 10s. On the first floor of the house there were two rooms lighted from above, in one of which the meetings of the society were held, and the other was used as a museum of natural history. Other rooms were occupied by the curator, whose duty it was to take care of the house and property, according to certain regulations. Many of these regulations had reference to the news-room and newspapers, and a large portion of the funds of the society appeared to be expended in the purchase of newspapers. Under these circumstances, the learned counsel contended the society was not exempt from the payment of rates. It was not "instituted for purposes of science, literature, or the fine arts exclusively," or, at all events, it had ceased to be so used. The case came within the principle laid down in the case of the Russell Institution, and others of a like kind, and the rate ought to be affirmed.

Mr. Pashley, for the appellants, contended that the society was exempt. It had been originally instituted for the promotion of philosophy and science, and the mere addition of a news-room would not make it rateable. The periodicals purchased by the society, though not, strictly speaking, works on science or art, gave valuable information in respect to the progress of the arts and sciences, and were, therefore, necessarily included in the purchases of the society. They must, therefore, be considered as purchased with a view to promote the chartered objects of the society. The same argument would apply to the purchase of newspapers. The primary object of the society was the promotion of science, and the fact that one room was used for another purpose would not make the whole building rateable.

Mr. Justice Wightman asked what was the primary object of the society, which expended £304 in newspapers, and only £117 in scientific publications?

Lord Campbell said, he was of opinion that the society was rateable to the full extent of the rate. It was necessary to look at the manner in which the institution was conducted when the rate was made. At that time it was not a society instituted for purposes of science, literature, or the fine arts exclusively; but its principal object was the supply of political information for the members of the society. The principal item of the subscription was for the reading-room, and the principal part of the funds subscribed was expended in its support. It was most laudable that in a free country all citizens should desire to be acquainted with what was going on in the world, and newspapers often supplied most useful and edifying information; but could it be said that, when reading them was the main object of the institution, the members of it devoted themselves, when there, to "science, literature, or the fine arts exclusively?" The reading-room, which was, no doubt, crowded on the arrival of the post, was open at all hours; and everything showed that, at the time the rate was made, political information, and discussions thereon, formed the principal objects of the society. That being so, he (Lord Campbell) thought the society was not entitled to the exemption, even in respect of the museum, which formed part of the same premises, and was occupied in common with the reading-room. It would be most unjust that the members of this institution should throw any part of the expenses of procuring political information upon the rate-payers of the parish in which the reading-room was situated. As the case did not come within the exemption provided by the Act, he, (Lord Campbell) was of opinion that the rate was good, and ought to be affirmed.—The other judges expressed similar opinions.—Rate affirmed.

## Home Correspondence.

Sir,—The important subject of the best mode of removing the sewage and other noxious refuse of towns, and its beneficial application to agricultural purposes, has recently occupied much public attention.

I place great value on the suggestion made by one of your correspondents, for making the exuviæ of every house the *perquisite of the servants*, on condition of their storing it in a suitable receptacle to be provided for that purpose.

It is a fact, that the system of ash-pits and privies in connection with each house now prevails almost universally in this country; and it is equally true that, in every case, such places are not only highly prejudicial to health, but the agricultural value of the excrementitious matter is, by the mixture of rubbish, cinders, &c., so reduced as not to be worth carting away.

The question to be solved is, what is the best and cheapest practicable mode of preventing the nuisance and loss occasioned by the present practice.

The plan of substituting waterclosets, and thereby carrying the offensive matter into the sewers, is open to the most serious objections, arising from the sewage having, in many cases, to pass through long lengths of drains, whereby it not only contaminates the atmosphere of our streets from the gully-holes and ventilating shafts, but poisons our rivers and brooks, rendering them little better than open cesspools.

I can fully bear out the assertion of another of your correspondents, "that all that has yet been done in manufacturing a concentrated manure from the liquid sewage of towns, has failed, or resulted in the spending of a *shilling* in labour and chemical materials, to produce an article worth *tenpence*;" and, as the experience of this company may possibly be found useful in some measure to Local Boards of Health or other parties following in the same direction, and as there is a wide field open for similar undertakings, I have been authorised to communicate to you the result of our operations.

We several years ago incurred considerable expense in testing the value of liquid sewage by the erection of suitable charcoal filters, and the precipitation by lime water and other means of the solid matters of the sewage; and succeeded in arresting all the feculent and organic matters, except that which was in a perfect state of solution.

The sewage operated upon was of the best description, and had been reported, according to chemical analysis, to contain an unusual amount of highly fertilising matters.

The result obtained, after long and expensive trials, was the perfect filtration of the water, so that, after it had passed the filter, it was clean and transparent, thus effectually obtaining one of the objects in view; but the other equally important point, viz., the securing of the agricultural value of the sewage matter, was very unsatisfactory, as the most valuable chemical salts, &c., passed off through the filter in a state of solution with the clean water.

Various chemical expedients were adopted to arrest them, but the expense of doing so, in consequence of the bulk of water to be treated, was found to be much greater than their agricultural value.

The sewage manure made by the process of simple filtration was only worth 25s. per ton, or little more than the value of the charcoal, and consequently during the years of 1850 to 1852, we sold at considerable loss all the manure so manufactured at that price.

We have carried out, to a limited extent, the plan of furnishing houses with water-tight boxes, partially filled with charcoal, to place in the present privies, and have removed the matter in a perfectly disinfected and inodorous state every few days. This system prevents any nuisance, and secures its full value for agricultural purposes. But it is evident that it can only be carried out profitably

on a large scale, and we have been unable to persuade the owners of property generally to adopt it, although we have offered to provide any quantity of houses, not less than twenty in one locality, with disinfecting charcoal (if the owners provided the boxes), and to empty the receptacles every three days free of expense.

Having relinquished the attempt to manufacture a portable manure from liquid sewage, we have, since 1852, prepared manure by the dessication of fish, blood, flesh, bones, and other animal matters, and the evaporation of urine, night soil, ammonia, water, &c. These concentrated products, with other chemical materials, are mixed with charcoal, in fixed quantities, and form what is now known as the Manchester Sewage (or compost) Guano, which is sold in a dry inodorous powder, at £5 5s. per ton.

In China, France, and other countries, the value of all excrementitious matter is understood and appreciated, and it is hoped that the time is not far distant when the progress of sanitary reform in this country will make it imperative on the owners and occupiers of property to make such arrangements as will prevent the further long continuance of the present wasteful and unsanitary system of privies and cesspools.

I am, sir,
Your obedient servant,
JOHN THOMPSON,
Secretary to the Manchester Sewage Guano Company.

Manchester, Nov. 15th, 1854.

## Proceedings of Institutions.

Bolton.—The twenty-ninth annual report of the Mechanics' Institution states that, compared with the previous year, there has been an increase of five honorary members, of twenty general members, and of one in the number admitted by transferable cards, or a total increase of twenty-six. The average total number is 329, or of each class respectively, 63, 222, and 44. The reading and news room is found to be one of the most attractive features of the Institution. The number of volumes added to the library during the year is 148—138 by purchase and ten by donation; the total number now in the library is 4,013. The number of issues averaged, in the four quarters, 3,578, being an increase of 880 volumes over the previous year, which also exceeded the preceding one by 500 volumes; thus indicating a continued progress, notwithstanding that a Free Public Library has recently been opened. The average number of members attending the several classes has been as follows: writing and arithmetic, 71; grammar, 11; mechanical drawing, 26; French, 24; essay and discussion, 54; making a total of 186 against 98 in the preceding year. Two public lectures were delivered gratuitously during the year, one by Sir John Bowring, on "China and the Chinese," the other on "The Ottoman Empire," by the Rev. A. F. Kemp. The favourable reception accorded to the cheap concerts given during the previous year, led the committee to arrange for a few similar entertainments during the winter season of the past year, but they were not equally successful—financially. The receipts during the year amounted to £200 7s. 4d., the expenditure to £206 10s. 4d., leaving a balance due to the treasurer of £6 3s. The increased expenditure was consequent upon the improved arrangements for the classes, and the efforts made to adapt the institution to the requirements of the increased number of members.

Bradford (Wilts).—The second annual report of the Literary Institution states, that the number of subscribers at the end of the year was 160, being an increase of 16. The attendance at the reading room has exceeded that of the first year. The number of issues from the library was 1,777, being an increase of 977. A mutual improvement class was organized in the early part of the present year, and was in successful operation during the winter months.

## Miscellanea.

Success of the Liverpool Free Public Library.—According to the annual report of the committee of the Free Public Library, great care is taken of the books by the readers generally. Scarcely any case of wilful injury has been noticed; and out of 30,000 volumes lent only one, of the value of 2s. 6d., has been lost without replacement. Eight books have been lost by borrowers and replaced, and only in two instances has a guarantee been called on to pay for the defalcation of a reader. Some of the working classes are great readers. A labouring man in the north district has read, since the library opened, Gibbon's Rome, Universal History, Macaulay's England, and is now going through Lingard, as he says he wishes to know both sides of the question. Another in the same district has read Macaulay, the Universal History, and is now reading Alison. At the south two working men have read Moore's and Scott's Poetical Works, and one Byron. Another has read Rollin's Ancient History, and is at present going through Alison. A poor man at the extremity of Toxteth-park has been reading the "Mirror;" he has now reached the 33rd volume. To obtain this one book, it is calculated he has already walked upwards of 100 miles. It is a noticeable fact that the larger proportion of solid reading is among the really working classes, the lighter literature more among the young men in offices and shops.—*Liverpool Albion.*

## MEETINGS FOR THE ENSUING WEEK.

Tues. Civil Engineers, 8.—Renewed discussion "On the Prevention of Opaque Smoke," and "Description of the Coffer-Dams used in laying the Pipes from Richmond to Twickenham, crossing the Thames," by Mr. G. J. Munday, Assoc. Inst. C.E.
Wed. Society of Arts, 8—Prof. Crace Calvert, "On the Manufacture and Application of various Products obtained from Coal—Coal-gas excepted."
Arch. Assoc., 8½.
Thurs. Antiquaries, 8.
Fri. Philological, 8.
Sat. Botanical, 3¾.
Medical, 8.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Nov. 10th*, 1854.]

*Dated 4th September*, 1854.
1927. J. Parker, Birmingham—Smoke boxes of locomotives.
*Dated 4th October*, 1854.
2127. J. Kershaw, Stockport—Self-acting mules.
*Dated 11th October*, 1854.
2175. W. H. Tayler, 19, South-row, New-road—Cartouch belts.
2177. R. Cruise, Manchester—Stopping railway carriages.
2179. T. Shaw and R. Dixon, Preston—Stubbing, roving, and jack frames.
*Dated 12th October*, 1854.
2181. W. White, Kensington-park—Manures.
2183. A. A. Routledge, Neath—Detonating railway signals.
2185. A. Parker, New Milns—Ornamental weaving.
*Dated 13th October*, 1854.
2189. Sir J. C. Anderson, Bart., Fermoy—Locomotives.
2191. C. F. Stansbury, 17, Cornhill—Heating buildings. (A communication.)
2193. W. J. Barsham, Stratford—Crushing machinery.
*Dated 14th October*, 1854.
2195. J. Harrison, Brighouse—Millstone bosses.
2197. J. C. Haddon, Chelsea—Cannon and projectiles.
2199. S. Hjorth, Copenhagen—Electro-magnetic machine.
2201. R. Pinkney, 26, Long Acre—Bottles, jars, &c., and stoppering same.
2205. J. H. Pape, Paris—Boots and shoes.
*Dated 16th October*, 1854.
2207. T. E. Moore, 3, Great Titchfield-street—Apparatus for sharpening edged tools.
2209. N. Thompson, jun., New York—Life-preserving seats.
2211. W. Rossiter, Goswell-road, and M. E. Bishop, Cannon-street West—Paper pulp.
2213. W. Wain, Brunswick-street, Stamford-street—Screw propellers.
*Dated 17th October*, 1854.
2215. W. H. Child, 21, Providence-row, Finsbury—Brushes.
2217. J. Coghlan, Craven-street, Strand—Signalling on railweys by electric telegraph.
2219. J. L. Cole, Henry-street, Limehouse—Portable drill.
2221. A. and H. Illingforth, Bradford—Combing machinery.
*Dated 18th October*, 1854.
2229. G. Hamilton, 26, Great Tower-street—Obtaining soundings.
2231. B. F. Coote, Boston, U.S.—Caulking ships.
2233. H. A. Holden, Birmingham—Roof lamps for carriages.

*Dated 19th October*, 1854.

2235. B. Nicoll, 42, Regent Circus—Shirt fronts.
2237. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Grates. (A communication.)
2239. T. Biggart and A. Loudon, Dalry, N.B.—Regulating motive-power engines.

*Dated 20th October*, 1854.

2241. W. Marsh, 11, Bywater street, Chelsea—Rocking and lounging chair.
2243. T. Allan, Adelphi-terrace—Applying electricity.

*Dated 21st October*, 1854.

2245. J. Smith, Gainford-place, Barnsbury-road, and F. S. Thomas, South-terrace, Walworth—Steering apparatus.
2247. W. A. Edwards, 87, Brooke-street, Lambeth—Separating iron or steel from other metallic filings.
2249. A. G. Brade, Paris—Gas fittings. (A communication.)
2251. W. Green, Howard-buildings, Brick-lane, and J. Pickett, Duke-street—Ornamenting textile materials.

*Dated 23rd October*, 1854.

2253. H. Hales, Brighton—Propelling machinery.
2255. A. G. Brade, Paris—Manufacture of plate and thread for gold and silver lace and bullion. (A communication.)
2256. J. Maddox, Thomas-street, Brick-lane, E. Gardner, Buxton-street, and G. D. Green, Weaver-street—Weaving fringes.
2257. G. Simmons, 10, Liverpool-street—Railway bearers and sleepers.
2259. J. Scott, M.D., Edinburgh—Apparatus for surgical operations and teaching anatomy.

*Dated 24th October*, 1854.

2261. C. Cowper, 20, Southampton-buildings—Spinning silk waste. (A communication.)
2263. G. A. Somerby and C. W. Fogg, Massachusetts, U.S.—Railway brake.
2266. F. C. Warlich, Suffolk-street—Generating steam.
2267. J. Welsh, Greenock—Extracting liquids from saccharine and other matters.

*Dated 25th October*, 1854.

2269. J. Spencer, Bilston—Fence.
2271. A. S. Stocker, 11, Poultry—Tubes.
2273. W. T. Smith, New Hampstead-road, Kentish-town, and G. Hill, City-road—Winnowing, washing, sifting or separating corn, gravel, minerals, &c.
2275. C. Mather, Manchester—Boring machinery.
2277. E. Pechenard, Monthermé Canton, France—Roofs.
2279. J. H. Johnson, 47, Lincoln's-inn-fields—Circular looms. (A communication.)

*Dated 26th October*, 1854.

2281. R. A. Brooman, 166, Fleet-street—Alcohol from wood, &c. (A communication.)
2283. J. Eccles, Blackburn—Brick machinery.
2285. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Bleaching, dyeing, &c., hemp and flax. (A communication.)
2287. J. Griffiths, Wolverhampton—Iron.

*Dated 27th October*, 1854.

2289. A. E. L. Bellford, 16, Castle-street, Holborn—Operating trip hammers. (A communication.)
2290. J. Turner, B. Holdsworth, and R. H. Beamer, Burnley—Power looms.
2291. A. P. Price, Margate—Calcination and oxidation of metallurgic compounds.
2292. W. Ashton, Preston—Safety valves.
2293. W. B. Wilkinson, Newcastle-on-Tyne—Fire-proof buildings.

*Dated 28th October*, 1854.

2294. H. Adcock, London—Strengthening metal castings.
2295. J. Morgan, Kidderminster—Machinery for cutting metals.
2296. G. Mumby, 9, Hunter-street, Brunswick-square—Reservoir penholders.
2297. E. Lindner, New York—Revolving breech fire-arms.
2298. J. P. Savouré, 2, Catherine-street, Strand—Gold coin detector.
2299. C. Blake, St. Leonards—Lessening effects from collisions at sea
2300. C. F. Vauthier, Dijon—Blowing machines.
2301. R. A. Brooman, 166, Fleet-street—Centrifugal machines. (A communication.)

*Dated 30th October*, 1854.

2302. O. Maggs, Bourton—Portable steam-engines.
2304. J. Mainwright, Birkenhead—Fitting up shops, offices, &c.
2305. J. C. Haddan, Chelsea—Projectiles.
2306. P. B. Chapius, Lyons—Harness used for weaving. (A communication.)
2308. R. S. Newall, Gateshead—Electric telegraphs. (A communication.)
2309. J. H. Johnson, 47, Lincoln's-inn-fields—Axle boxes. (A communication.)

*Dated 31st October*, 1854.

2311. W. Reid, University-street—Galvanic batteries.
2315. J. H. Johnson, 47, Lincoln's-inn-fields—Lithographic printing presses. (A communication.)
2317. B. Blackburn, Clapham-common—Pipes.

*Dated 1st November*, 1854.

2321. J. Rae, 1, Alpha-road, New-cross—Propelling vessels.
2323. A. V. Newton, 66, Chancery-lane—Forging wheels. (A communication.)
2325. J. Francis, New York—Waggons, caissons, &c., for transport of military stores.

INVENTION WITH COMPLETE SPECIFICATION FILED.

2319. G. Taylor, Holbeck, Leeds—Mills for grinding corn.—1st November, 1854.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed November 10th*, 1854.

1075. Richard Clarke Burleigh, 27, Northumberland-street, Charing-cross—Improvements in steam-engines and other engines worked by the pressure of gaseous or other fluids, which are also applicable to pumps.
1143. Thomas William Atlee and George Jobson Atlee, Birmingham—Improvements in printed or other forms applicable for bankers' cheques, orders for goods, wharfingers' and carriers' receipts, taxes and rates collectors' receipts, and various other parochial, commercial, or private purposes, whether such forms be bound up into books or not.
1213. John Whitaker and James Pickles, Todmorden—Improvements in machinery or apparatus for opening, cleaning, and preparing cotton, wool, or other fibrous substances.
1243. Richard Archibald Brooman, 166, Fleet-street—Improvement in screw propellers.
1945. James Eden, Lytham—Improvements in apparatus for drying fabrics.

*Sealed November 14th*, 1854.

1089. Anguish Honour Augustus Durant, Esq., of Tong Castle, Salop—Improvements in apparatus for sweeping chimnies and flues, and for extinguishing fires therein.
1099. Christopher Catlow, Clitheroe, and Thomas Comstive, Burnley, Lancashire—Improvements in shuttles for weaving.
1114. Joseph Hinchliffe, junior, Dam Side, near Halifax—Certain improvements in apparatus for regulating or governing the speed of steam-engines.
1115. Charles Barlow, 89, Chancery-lane—Improvements in the manufacture of metallic capsules for covering or securing bottles and other vessels.
1116. John Cunningham and William Ashley, Liverpool—Improved apparatus for ventilating ships.
1184. Thomas Bazley, Manchester—Improvements in and applicable to furnaces and vessels used in connection therewith for the manufacture of glass.
1193. Richard Tomlinson, Sale, Cheshire—The application of a new material or fabric to the manufacture of plasters for medical or surgical purposes.
1206. William Edward Wiley and Edward Lavender, Birmingham—Improvements in the manufacture of certain kinds of metallic pens.
1224. Earl of Aldborough, Stratford Lodge, county Wicklow, Ireland—Improvements in locomotion on land and water, part or parts of which are applicable to the raising of weights and the working of machinery.
1242. James Bowman Lindsay, Dundee—A mode of transmitting telegraphic messages by means of electricity through and across a body or bodies of water."
1046. Hippolyte Bordier, Orleans, France—Improvements in the manufacture of alcohol.
1262. John Wilson, 3 Albert place, High street, Stratford, West Ham, Essex—An improved pump, applicable to mines, wells, ships, fountains, and domestic purposes, and raising melted metals in foundaries, so constructed that it cannot lose water, draw grit, draw air, or freeze.
1324. George Holloway, Stroud, Gloucestershire—Improvements in sewing and embroidering machines.
1337. Joseph Oliver, Wapping, Middlesex—An improved construction of signal lantern.
1584. John Collis Browne (Physician), 2, Rodney-terrace, Cheltenham—Invention of improvements in the manufacture of camp bedsteads.
1683. Jean Chrilottome Denis Demay, 19, Leicester-sq.—Preventing the accidents on the railways with the aid of a right line of iron, and in stopping the trains almost instantaneously.
1969. Henry Robert Ramsbotham, and William Brown, Bradford—Improvements in preparing to be spun wool, cotton, hair, tow, and other fibrous materials.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| Date of Registration. | No. in the Register. | Title. | Proprietors' Names. | Address. |
|---|---|---|---|---|
| Nov. 13. | 3656 | Carriage Lamp ................................ | Robathan and Son ............ | Birmingham. |
| „ 14. | 3657 | Sacking of Bedstead ........................ | Thomas Bryan .................. | Wolverhampton. |

Journal of the Society of Arts.

*FRIDAY, NOVEMBER* 24, 1854.

## IMPROVEMENTS IN PROGRESS IN PARIS.

The Committee appointed to consider and report on this subject held their first meeting on Tuesday, the 21st instant. Present: H. T. Hope, Esq., in the chair; Mr. Ashton, Mr. J. B. Bunning, Mr. E. Chadwick, C.B., Mr. H. Cole, Mr. Lewis Cubitt, Mr. G. Godwin, F.R.S., Sir Hector Greig, G.C.B., Mr. S. Redgrave, and Mr. Tite, F.R.S.

The Committee proceeded to arrange the course of proceedings to be adopted. It was said that in the carrying out improvements in Paris there was not only no loss, but that profit actually accrued; whilst, on the contrary, in London, it was admitted by all the members of the Committee, such improvements are always calculated to entail a loss of one-third their cost.

It was the general opinion of the Committee that this heavy cost was due in a very great measure to the very costly and inefficient modes of procedure in this country for the compulsorily obtaining possession of houses, lands, &c., for the purpose of public improvements; and numerous instances were cited exemplifying the monstrous results of the English system. The Committee considered it to be most desirable to obtain, in the first instance, authentic data as to how these matters are managed in France, and with what results as to cost, &c., with a view, if such results should appear favourable, to ascertain how far the French system, or any portion of it, consistently with the habits of the people of this country, could be introduced into our system.

The Committee instructed the Secretary to enter into communication with the municipal authorities in Paris, to endeavour to obtain from them particulars as to the mode of procedure for compulsorily obtaining possession of property for public improvements, with such details as to the practical working of the system there, in reference to the cost of making them, as will enable a comparison to be made between that and the system in operation here.

## VISITS OF ARTIZANS TO PARIS.

This Committee met on Friday the 17th inst. Present, Viscount Ebrington, in the chair, Mr. George Clark and Mr. T. Twining, jun. The Committee proposes that a card shall be issued by the Society, under certain conditions, entitling the bearer to such privileges as the Railway and Steam-boat Companies may be disposed to grant to these excursionists, and to the benefits of the arrangements the Committee may make for the boarding and lodging of the excursionists, and of interpreter guides, &c., such card to serve also as a passport to the holder, and as a ticket of admission to public buildings, galleries, &c. in Paris. The Committee are taking steps to obtain from the French government the recognition of this card as a passport, and to obtain for the holder ready access to the sights of Paris. The Committee has reason to believe that the Railway and Steam-boat Companies are inclined to deal liberally with the excursionists. The Committee is engaged in completing the arrangements for ensuring to the excursionists comfortable board and lodging. This the Committee has little doubt of obtaining, for the ten days proposed for the excursion, at a cost not exceeding two pounds, and possibly it may be less. This will include not only the board and lodging, but all the services of agents on arrival in France and Paris, and of interpreter guides during the stay.

To this will have to be added the cost of travelling to Paris and back, and the Committee from communications they have received, have no reason to doubt but that the Railway and Steam-boat Companies are disposed to act liberally on the occasion, and make a very considerable reduction on the ordinary rates of fare in favour of these parties.

## SECOND ORDINARY MEETING.

Wednesday, November 22, 1854.

The Second Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 22nd instant, Dr. Lyon Playfair, C.B., F.R.S., Vice-President, in the chair.

The following Candidate was balloted for, and duly elected:—

Kennedy, James.

The following Institution has been taken into Union since the last announcement:—

380. London, Great Western Railway Literary Society

The Paper read was

### ON THE MANUFACTURE AND APPLICATION OF VARIOUS PRODUCTS OBTAINED FROM COAL (COAL-GAS EXCEPTED).

By Professor F. Crace Calvert, F.C.S., &c.

Mr. Crace Calvert commenced his paper by stating that there were two distinct theories by which the formation of coals was explained; and in consequence of the geological influences to which they had been submitted, the coals presented great differences in their composition; as, for example, some were entirely composed, as anthracite, of nearly pure carbon, whilst others contained but a small proportion of fixed carbon, and a large proportion of tarry substances or hydro-carbons; such, for example, as cannel, bog-head, and Albert coal, from New Brunswick, and this led Mr. Crace Calvert to divide coal into three distinct classes, having regard to the distinct applications which they received in manufactures: the first class being employed as fuel in generating steam; the second for making coke; and the third kind chiefly for pro-

ducing gas. The most valuable researches which had been published upon the composition of coals, and the relative value of different kinds, principally for generating steam, were published in a voluminous report of experimental investigations on coal for the steam navy, by Sir H. De la Beche and Dr. Lyon Playfair, and presented to the House of Commons, by Royal command. The results of those investigations exemplified that most valuable information might be obtained from scientific researches on the relative value of different kinds of this important fuel for generating steam in manufactories, the steam-navy, &c. In fact, the English navy had already derived great advantages from the elaborate researches of the scientific gentlemen before-mentioned, to whom, no doubt, was due the credit of anthracite coal being now extensively used by our large steamers in their voyages to the Cape and Australia. That great improvements were yet to be made in the construction of the apparatus for generating steam, and of economy in the use of particular kinds of fuel, was evident from the fact (mentioned in the report before alluded to) that the combustion of one pound weight of coal in the best-constructed boilers of the present day converted into steam only 10lbs. of water at a temperature of 212°, instead of 14½lbs., which was the quantity demonstrated to be practicable of realisation.

The following Table is an abstract of the researches contained in the report above-mentioned:—

ACTUAL AND THEORETICAL DUTY OF COALS.

| | *Practical.* lbs. of Water converted into Steam at 212° by one lb. of Coal. | *Theoretical.* lbs. of Water at 212° converted into Steam-Coke left. | *Theoretical.* Total lbs. of Water converted into Steam by one lb. of Coal |
|---|---|---|---|
| Graigola . . . . | 9.35 | 11.31 | 13.563 |
| Anthracite . . . . | 9.46 | 12.554 | 14.593 |
| Pentrefelin . . . . | 6.39 | 10.841 | 13.787 |
| Powel's Duffryn . . | 10.15 | 11.134 | 15.092 |
| Three-qr. Rock vein. | 8.84 | 7.081 | 13.106 |
| Pontypool . . . . | 7.47 | 8.144 | 14.295 |
| Ebbw Vale . . . | 10.21 | 10.441 | 15.635 |
| Dalkeith Jewel Seam | 7.08 | 6.239 | 12.313 |
| Fordel Splint . . . | 7.56 | 6.56 | 13.817 |
| Broomhill . . . . | 7.30 | 7.711 | 14.863 |
| Slievardagh (Irish) . | 9.85 | 10.895 | 12.482 |

Another fact ascertained by the researches and experiments of the same gentlemen was that certain kinds of coal were superior for generating steam rapidly, by their quick combustion; while other kinds were better employed for steaming on long voyages, from their slow combustion.

The ordinary kind of coal was, generally speaking, divided into two classes; the best quality being employed for household use, while the inferior was used for generating steam. Great economy had resulted of late years in the use of household coal, owing to the extensive use of coke in manufactures; this class of coal being sifted at the pit's mouth, the small, and less valuable part, was used for making coke, while the lumps and larger pieces were employed as household fuel.

It was necessary to say a few words on the manufacture of coke. The best coals for making coke were those which would yield from 60 to 75 per cent. of coke, with but a slight trace of sulphur, and which had the property of caking or melting together, so as to form a solid mass in the oven. This superior quality of coal was found near Newcastle-upon-Tyne, and in Lancashire; the best coke being made from what was called "Mountain Mine." These superior cokes were characterised by their high density, the brilliancy of their appearance, and the superior power of generating steam. He had noticed, from long observation of the manufacture of coke, that the best kind was made when three or four feet in depth of coal were introduced into moderately large ovens, allowed to cake for 60 to 90 hours, and cool for 24 hours previously to being drawn.

He had succeeded of late years in discovering a simple process for removing sulphur from coke, thereby greatly enhancing its value for melting cast iron in the cupola, and increasing the bearing strength of the metal. This was proved by the results obtained by Mr. William Fairbairn, and Messrs. Fox and Henderson. The application of the same process to blast furnaces had enabled Mr. Crace Calvert materially to improve the quality of the iron obtained. Mr. Crace Calvert next drew attention to the third class of coals, namely, those employed principally for making gas. These coals, viz., cannel and boghead, although for commercial reasons Newcastle and other coals of that character are used, were remarkable for yielding in addition to about 30 per cent. of an inferior coke, a large quantity of gas, and numerous other products of greater or less value. The accompanying table would give an idea of the numerous products which chemists had ascertained to exist in the substances distilled from coal:—

| Gases. | Liquids. | Solids. |
|---|---|---|
| Bicarburetted hydrogen | Bisulphuret of carbon | Napthaline |
| Propyline | Ammonia | Para napthaline |
| Light carburetted hydrogen | Eupion | Paraffine |
| Hydrogen | Paraffine oil | Pyrene |
| Oxide of carbon | Aniline | Chrysene |
| Sulphuretted hydrogen | Leukol | |
| | Carbolic acid | |
| | Benzine | |
| | Napthine | |
| | Napthole | |

It will be perceived from this table that the products obtained from coals were divisible into three classes, namely, gases, liquids, and solids. He did not intend to dwell upon the first class—the gases—which subject was so extensive that it would require to be treated in a separate paper. With respect to the solid products of coal, he would first allude to the coke which was obtained in making gas.

The coke generally obtained from gas works was very inferior. Great efforts had lately been made to obtain the various products of coal, and also to manufacture good coke for cupola and railway purposes, at the works of the London Gas Company, but he was not aware of the exact results obtained.

The liquid products from coal could be divided into two distinct classes, the aqueous portion and the tarry portion. The aqueous portion was valuable chiefly for the ammonia which it contained, and which was put to the following amongst other uses: In the first place, it was bought by chemical manufacturers, who obtained from it sulphate of ammonia for agricultural purposes, sal ammonia for soldering, and which was also used in calico and print works in the production of a style of prints called "steam goods." From these two salts was obtained hartshorn, which was extensively employed in pharmacy.

Ordinary coal gas liquor was often employed to obtain by distillation common ammonia, which was much used in dye works; also to produce, with lichens, beautiful colouring matters called orchill and cudbear, valuable for the production on silk and wool of delicate purple hues. The production of this colour and the influence of ammonia was exceedingly interesting, on the ground that the colouring principle called orcine was colourless until acted upon by the oxygen of the air and ammonia. If to this ammonia a fixed alkali be added, then no more orchill or cudbear was produced, but litmus, which was now much used in chemistry as a test for acids and alkalis.

One of the most interesting and useful of the applications of ammoniacal liquors was in the preparation of ammoniacal alum. The manufacture of this substance had become very extensive of late years. At the chemical works of Messrs. Spence and Dixon, near Manchester, 800,000 gals. of ammoniacal liquor were annually consumed in the manufacture of ammoniacal alum, the ammoniacal liquor being obtained from the extensive gas works belonging to the

corporation of Manchester. The manufacture of this substance, which was so valuable as an astringent, and also to the dyer and calico printer, furnished such a remarkable illustration of the value of chemistry in aiding manufactures and commerce, that he would explain briefly the method of producing it. To obtain this substance called ammoniacal alum, a refuse product of coal pits, known as aluminous shale, was heaped into small mounds and slowly burned. Shale was generally found in hard masses, which fell from the roofs of the coal mines, and the object of burning it was to render it porous and friable. The calcined friable mass was then placed in large leaden vessels, with sulphuric acid, having a specific gravity of 1·65, being the strength in which it was obtained from the leaden chambers. It was a curious fact that this sulphuric acid could be produced from another refuse found in coal mines, namely, pyrites.

The calcined shale and sulphuric acid were heated in these leaden chambers for about forty-eight hours, the liquor was then drawn off and put into another vessel, into which the ammonia generated from another refuse of coal, namely, the gas liquor, was introduced in a gaseous state. Thus these three substances, the alumina from the shale, the sulphuric acid obtained from the pyrites, and the ammonia from the gas liquor, combined to produce ammoniacal alum, which then only required purifying by successive processes of crystalization to give it that remarkable purity in which it was furnished to the commercial world by Messrs. Spence and Dixon, and other manufacturers.

A great boon would be conferred upon agriculturists if the ammonia which was produced when coke was made in common ovens, were saved, as recommended by Dr. Lyon Playfair, who estimated that every hundred tons of coal would yield, on the average, about six tons of sulphate of ammonia. The quantity of coke made annually in England amounted to at least 1,000,000 tons, yielding, therefore 60,000 tons of sulphate of ammonia, which might be made a cheap and valuable agent in agriculture. When the minimum advantages which manufacturers had derived from saving the ammoniacal products in gas works were remembered, it ought to encourage coke manufacturers and engineers to exert themselves to effect the same. In so doing they would confer a great benefit on the public, as coke would thus be enabled to be sold at a lower price. It was interesting to reflect that, no doubt, at the present day, tons of salts of ammonia were made, where formerly pounds were imported into England, from a district called Ammonia, in Nubia, in Egypt, and which, in the form of sal-ammonia, was derived from heating in glass vessels the soot which had been produced by the burning of camels' dung. The same line of thought might also be applied to alum, which formerly came entirely from the East, then from the environs of Rome, and now, through the application of chemistry to manufactures, the progress of human intelligence, the undaunted perseverance of our countrymen, was manufactured in England from what had been hitherto noxious and refuse products.

Mr. Crace Calvert next spoke of tar. This substance was generally sold to the tar distillers, who obtained from it a volatile fluid called coal naphtha, a light oil, composed principally of carbolic acid and a heavy oil of tar, a solid substance called pitch being also left in the retort. Mr. Crace Calvert then proceeded to state the applications which these various materials received. Pitch had of late years been used successfully by the corporation of Manchester in assisting to pave the streets. When the streets were repaved, a large quantity of this pitch, to which was added tar and asphalte, was heated in portable boilers in the street, and was poured, when in a hot liquid state, upon small pebbles or gravel between the interstices of the paving stones, which were thus firmly bound together and became so durable that the most frequented thoroughfares in Manchester, when thus paved, had not required repaving for several years. There was, however, this important sanitary advantage connected with the plan, and to which he wished to draw special attention, namely, that no impure matter and stagnant water could percolate through the impervious pavement and collect beneath, giving forth noxious effluvia to the injury of the health of the inhabitants of large cities, and even causing dangerous epidemics. The importance of this process would be the more apparent when it was calculated what a vast surface area was presented by the streets of a large city.

This pitch had also of late been submitted by Mr. Bethell to a further distillation in retorts, which enabled him to obtain a porous, but at the same time a dense coke, and the oils which were distilled in this operation appeared to be such as might be employed to advantage as lubricating agents for common and heavy machinery. Before passing to the various volatile products obtained from the distillation of tar, Mr. Crace Calvert stated, that tar had been applied lately, when mixed with gutta-percha or India rubber, to insulate telegraph wires, and to prevent metals from being acted upon by the atmosphere.

One of the first products which came over in the distillation of tar, was a mixture of very volatile hydrocarbons, which had received the name of crude naphtha, and this, when again distilled, was sold under the name of naphtha, and was chiefly burned by the keepers of stalls in streets and markets. When naphtha had been mixed with turpentine, it was called camphine, and was burned in lamps in private dwellings.

When it was intended to apply this naphtha to more particular purposes, it was purified by mixing it with ten per cent. of its bulk of concentrated sulphuric acid, and when the mixture was cold, about five per cent. of peroxide of manganese was added, and the upper portion was submitted to distillation. The rectified naphtha found in the receiver had a specific gravity of 0·85. This rectified naphtha was used to dissolve caoutchouc for making garments impermeable to water, known as Mackintoshes; and when sulphur was added, and the mixture submitted to steam having a temperature of from 400 to 500 degrees, vulcanized india-rubber was produced.

Rectified naphtha was also used for mixing with wood naphtha, to render the latter more capable of dissolving resins for the production of cheap varnishes. When this rectified naphtha had been submitted to a series of further purifications, it had received from an eminent French chemist named Pelouze, the name of "benzine," which had the property of removing with great facility spots of grease, wax, tar, and resin, from fabrics and wearing apparel, without injuring the fabric, its colour, or leaving any permanent smell or mark, as was the case with turpentine. Benzine had, through his (Mr. Calvert's) exertions, been introduced into England, and had been found most valuable in brightening velvets, satins, &c. The numerous uses to which this valuable product could be applied in manufactures, must in time render it of extensive employment in place of alcohol and other fluids, which were generally speaking too expensive for common commercial purposes. As an instance, he cited that at the present day in Yorkshire there was a large quantity of wool dyed before it was spun, principally for carpet manufactures. It was then necessary to oil this dyed slubbing wool, as it is called, and up to the present time no means had been discovered of removing the oil without injuring the colour, and thus this oil remaining in the fabric materially injured the brilliancy of the colour, as well as rendered the carpets thus manufactured liable to become sooner faded or dirty. Now by the employment of benzine, which had not the property of dissolving colours, the oil could be removed from such fabrics, and the full brilliancy of the colours fixed on this slubbing wool be restored. He also stated that this benzine could be employed with advantage in photography, in removing the grease from daguerreotype plates. When this benzine was treated with strong nitric acid, it gave rise to a sub-

stance called nitro-benzine, which was every day becoming more and more employed as a substitute for essence of bitter almonds, was used for flavouring dishes, and communicating scents to perfumery, soaps, &c. It was interesting to observe that thus, by the triumphs of chemistry, a delicious perfume had been produced from the noxious smelling refuse of coal.

The next products he should mention which were distilled from coal, were those which had the name of light oils of tar, which remain on the surface of water, and which had been applied, conjointly with the heavy oils, with great success by Mr. John Bethell, to the preservation of wood from rotting. Wood which had been treated by Mr. Bethell's process, was extensively employed as railway sleepers, and wherever wood work was exposed to the influence of moisture and the atmosphere. The introduction of the fluid into the wood was effected by placing the wood in close iron tanks, exhausting the air, and then forcing the oil into the whole substance of the wood, under a pressure of from 100 to 150 lbs. to the square inch.

There existed in these light oils of tar a product highly interesting, called tar creosote, or carbolic acid, which possessed extraordinary antiseptic properties; such, for example, as preventing the putrefaction of animal substances. He (Mr. Crace Calvert) had applied it with success in preserving bodies for dissection, and also in preserving the skins of animals when intended to be stuffed. Owing to its peculiar chemical composition, he had also employed it successfully of late in the preparation of a valuable dye-stuff, called carboazotic acid, which gave magnificent straw-coloured yellows on silk and woollen fabrics. The carboazotic acid prepared from the above-mentioned substance could be obtained very pure, and at a cheap rate, thus enabling the dyer to obtain beautiful yellows and greens, which were not liable to fade by exposure to the air, as was the case with most of the yellows and greens which were obtained from vegetable dyes. The advantage of the carboazotic acid, so prepared, was, that it was entirely free from oily or tarry substances, which had the property of imparting a disagreeable odour to the dyed fabric. The intense bitter which this acid possesses had induced him to have it tried as a febrifuge, and Dr. Bell, of Manchester, had succeeded in curing several cases of intermittent fever by its aid, in the Manchester Infirmary. He had also placed some of this substance in the hands of eminent physicians throughout the country, and he hoped shortly to ascertain that it was of real value as a substitute for that expensive medicine, sulphate of quinine.

He had lately applied carbolic acid in a manner that offered advantages to dyers and calico printers. It was well known that extracts made from tanning matters could not be kept for any length of time without undergoing deterioration, in consequence of the tanning matter which they contained becoming decomposed, and transformed, by a process of fermentation, into sugar and gallic acid; which acid, he had ascertained, not only had no dyeing properties, but that, on the contrary, it was injurious, from having a tendency to remove the mordants which were employed to fix the colours on the cloth. It was also known that gallic acid possessed no tanning properties. By adding a small quantity of carbolic acid to the extracts of tanning matter, they could in future be kept and employed by the dyer as a substitute for the substance from which they were obtained—by which would be gained the double advantage of saving labour, and obtaining a better effect from the tanning matters.

The third substance which passed off in the distillation of tar was called heavy oil of tar, which was used by Mr. Bethell as above stated. This substance contained a ingular organic product, first discovered by Dr. Hofmann, of London, and called by him "kyanol" or "aniline," which possessed the property of giving, with bleaching powder and other agents, a magnificent blue colour. This fact led him (Mr. Calvert) to observe that this last mentioned substance, as well as carboazotic and indigotic acids, being produced as well from indigo as from coal-tar, proved the great similarity and chemical connection which existed between the products of tar and those of indigo, and induced him to believe it extremely probable that those products would be employed within a few years as substitutes for indigo and madder. Laurent had succeeded in obtaining two products from naphthaline which had a great analogy to the colouring principles of madder. A substance, for instance, called chloronaphthalic acid had the same composition as the colouring matter of madder, and would be identical if the hydrogen gas was substituted for the chlorine which the acid contained. Hence the chloronaphthalic acid had the property of giving with alkalies a most superior red colour.

When the colouring principle of madder was treated with nitric acid, a substance called alizaric acid was obtained, which was identical with a substance also obtained from naphthaline, called naphthalic acid. Naphthaline was a solid white substance, which distilled in large quantities during the distillation of tar.

An interesting fact had been discovered by Mr. James Young, of Glasgow, namely, that if coals were distilled at a low temperature, the products obtained were different from those which were produced when coals were distilled at a high temperature, as was the usual custom in the manufacture of gas. Without entering into all the details on this point, he would mention one of the most striking differences of results, namely, that Mr. Young obtained in place of the naphthaline, a valuable lubricating agent, called paraffine, a solid substance, and a large quantity of carburetted hydrogens were also distilled, which, being free from smell, were valuable for commercial purposes, and had received the general name of paraffine oil; or, as Dr. Lyon Playfair remarked in his report of the Great Exhibition of 1851, it was "liquified coal gas." This paraffine oil, when mixed with other oils, was now most extensively employed in the cotton-mills of Manchester and the neighbourhood. Solid paraffine was also obtained in the distillation of peat, and was employed for manufacturing candles, there being added to it about 20 per cent. of wax. These candles were remarkable for their transparency and the pureness of their flame. Mr. Crace Calvert exhibited specimens of these candles, and of the various substances mentioned in his lecture, and by which he had illustrated his remarks throughout, and exemplified the truth of his facts and statements. He stated that he was indebted to Mr. Edward Binney, of Manchester, for the collection of coals which were on the table, and to Mr. Clift for most of the valuable specimens of products obtained from coal-tar.

## DISCUSSION.

The CHAIRMAN said it now became his duty to invite discussion on the very interesting paper just read, and he was sure all must be pleased with the animation and vigour with which the subject had been brought before them. Mr. Crace Calvert was a bright example of the importance of that happy alliance between England and France which they were all anxious to encourage. Mr. Calvert studied chemistry under the first French chemists, Chevreul and Dumas, and so long did he remain abroad, and so assiduously did he devote himself to his studies, that when he returned to England he had lost his native tongue. He was glad however now to find that he had regained the proper use of his own language, and that he still retained all the animation of our neighbours. The subject which Mr. Crace Calvert had brought before them was not only of great practical importance, but of great philosophical interest. When lecturing in this room on the Results of the Exhibition of 1851, he (Dr. Playfair) declared that the great end in modern civilization was to effect an economy of time, or to make the most refuse

products conducive to the advantage of manufactures and arts. When coal gas was first introduced into use, it was contended that there was an intolerable quantity of refuse for which no use could be found, but now there was not one particle of that refuse with the exception of the naphthaline which was not already of great commercial importance. So important indeed had the waste products become, that many of their manufactures could not get on without the oils and dyes produced from them. Mr. Crace Calvert in alluding to the various products from coal, with the exception of the gases, had divided them into aqueous and tarry, and if he (Dr. Playfair) alluded to them, it was only to call their attention to some points which Mr. Crace Calvert had not noticed. That gentlemen had showed them how alum was obtained, and had spoken of it with a fondness as though it were a child of his own, and he had pointed out its importance in dyeing; but whilst dilating on the importance of ammonia in its general applications, he did not tell them that it was from that fetid mass that ladies' smelling-bottles were filled, and that they derived sal volatile. Then, again, benzine had a most extraordinary effect in cleaning white kid gloves, as he could testify, and that, too, without leaving that roughness which generally attended the operation. Then with regard to carbolic acid, it was expected to prove a most valuable antiseptic, though it had hitherto not been much employed, excepting in the preservation of wood. Mr. Crace Calvert, in speaking of several of these discoveries, had referred to a certain gentleman in Manchester, but he had too much modesty to tell them that that gentleman was Mr. Crace Calvert himself; and with reference to carboazotic acid, should it prove as valuable a febrifuge as he anticipated, it would stamp Mr. Crace Calvert as one of the greatest benefactors of mankind. He had next referred to naphthaline, the odour of which chemists had not yet been able to get rid of—though it would yet be got rid of, and the substance rendered useful in dyeing. He had also shown them how the refuse of coal might be made useful in the manufacture of solid paraffine and paraffine oil. Paraffine obtained from other sources had been long known as a most useful lubricator, and was originally proposed for the works of chronometers. Paraffine had this advantage—it would not combine with the oxygen of the air, and thus become rancid. Paraffine oil from coal possessed all the advantages of solid paraffine, and was now used almost all over the country for lubricating machinery. The reason why the beautiful paraffine candles they had been shown that evening were not brought extensively into use, was, that the manufacturers of the article had a demand for it in its liquid state beyond what they could meet, and therefore it was not to their advantage to manufacture it into candles. He had only thus run through the principal heads in order to point out the subjects for discussion, and should now be happy to hear any gentleman upon it.

Mr. Winsor trusted that he might be allowed to express the deep debt of gratitude which they must all owe to Mr. Crace Calvert for the pleasure, entertainment, and information they had derived from his paper that evening. He had had the honour of being a member of the Society of Arts for upwards of thirty years, and being the son of the introducer of gas lamps into England, if not throughout the whole world, he trusted he might be excused for presuming to address them. He certainly had felt somewhat astonished at what he had heard that night. He recollected when Dr. Playfair was lecturing on the Great Exhibition, in alluding to his father, he spoke of the indomitable perseverance of Mr. Winsor, and he now begged to thank him for that testimony to his father's memory. He now wished to call their attention to the evidence given before Parliament in 1809, when the Chartered Gas Company was applying for its Act of Incorporation. In the preamble of their bill it was set forth that the products of coal were gas, pitch, tar, essential oils, and ammoniacal liquor, and they then produced in the House of Commons specimens of those products of which since so much had been made. He now had great pleasure in moving a vote of thanks to Mr. Calvert for the mass of information which he had laid before them, and for having shewn them how the various products of coal would benefit the whole country,—as gas had for several years. He should be happy at any time to render any information to the Society on the gradual progress of gas manufacture, and he hoped ere long to embody in a work which he would lay before the public, the history of gas-lighting for half a century, leaving it to the scientific world to determine upon its value.

Mr. Varley seconded the motion, and expressed the great satisfaction with which he had heard the observations relative to extending a knowledge of science amongst the people.

The Chairman said, that before putting the question, he would ask if any gentleman wished to make any observation, and he particularly alluded to Mr. Bethell as having had his invention noticed.

Mr. Bethell said, that it was most difficult to touch the various questions brought before them that evening without occupying several hours of their time. Mr. Crace Calvert had brought the subject before them in a very lucid and talented manner, though he had been obliged to notice very cursorily many points for want of time. The possibility of the preservation of wood by tar oil had struck him whilst seeking for some material to preserve wood for railway sleepers. The stone sleepers originally laid down were found to destroy the carriages very quickly—and it being desirable to use some softer material, wood naturally presented itself. How to preserve it then became a question, and it was proposed to use solutions of various chemical salts. It was considered that the decay of wood was principally caused by the albuminous nature of the sap, and that if some matter could be obtained to coagulate it, the decay would be stopped. Corrosive sublimate, and sulphate of copper, were therefore tried for this purpose. It was found, however, in practice, that this process was too expensive, and besides, although it prevented the putrefaction of the sap, it had no effect on the fibrous matter of the wood. He then determined to try the oil of tar, and he was induced to do so from finding that the agents used to preserve the Egyptian mummy were of an asphaltic nature—asphaltic oils being collected in great quantities on the Persian Sea, and in different parts of Egypt, where, in consequence of the heat, it exuded through sandy rocks, &c. Finding that this substance was used for making mummies, he considered that what would preserve animal flesh would preserve wood. He, therefore, determined upon using oil of tar, and then came to be considered the mechanical method of making the wood absorb it. He found that where wood had been used perfectly dry it stood uninjured, if protected from the weather, for ages, as was to be seen in the roof of Westminster Abbey; and he determined so to saturate the wood with oil of tar as to render it impervious to water. The result had far exceeded his expectations. A few days ago some sleepers were taken up between Manchester and Crewe, which had been laid down in 1838, in order that they might be replaced by some of a heavier description, when it was found that the old sleepers were perfectly sound, and they were about to be used on parts of the line where there was less traffic. The unprepared sleepers never lasted more than four or five years. A great many improvements in this country were stopped by the prejudice which people had against anything bearing the smell of gas. For instance, pitch and other products of tar were highly-important in ship-building, yet, so prejudiced were the English shipwrights against coal-tar and pitch, that they would only use the tar and pitch from Archangel or Stockholm, though it cost ten times as much as the English. In the Mediterranean the native vessels which were not coppered suffered very severely from the worm, and the

Maltese and Sicilians found that the Archangel and Stockholm pitch would not protect them, but with the coal pitch and tar no worm would touch the vessels, and there was, therefore, a great demand for the English pitch and tar in the Mediterranean, the boat-builders of which would readily give more for it than for the vegetable pitch or tar; but there was a prejudice against it in England because it was to be obtained cheaply at our very doors. In fact all pitch and tar from the mineral kingdom was much better and stronger than that from the vegetable, and much more of a preservative. By the injection of the carbolic acid from tar, mixed with a little olive oil, into the veins of the body, they might keep anatomical subjects fresh for many weeks, and it would have no effect upon the scalpel, which showed the great power and usefulness of the carbolic acid; and the only reason why it had not been extensively used for the preservation of meat was that the gaseous smell would be more or less retained.

In answer to a question from Mr. Winkworth, Mr. Crace Calvert stated that there could be no doubt that when they wished to disturb the streets, paved as Manchester was, for the gas or water pipes, that as the stones had to be raised by the pick-axe there was considerable labour required beyond that for removing the ordinary pavement. The reason why it was not more generally used he could only suppose was that each locality had its own peculiar manner of doing things; but any one who rode over the streets of Manchester could not fail noting how free they were from the jolting and reverberation felt in London and other cities.

The Chairman, in putting the motion, said he could not help remarking how deeply he sympathised with the remarks of Mr. Crace Calvert relative to the popularising of science; and he might take that opportunity of informing them that so desirous were the Government to aid in that object that they had prevailed on Dr. Hofmann, one of the most eminent chemists of the day, to deliver a course of lectures on chemistry at the School of Mines, for the almost nominal charge of 5s. the course—instead of about £5—and sure he was that it was as little as it could be done for to remunerate the professor at all.

Mr. Crace Calvert returned thanks, and expressed the gratification he felt at what he had just heard from Dr Playfair, trusting that the same advantages would shortly be extended to Manchester, Birmingham, and other places. Sure he was, if Dr. Playfair had but a few coadjutors as enthusiastic in extending a knowledge of science as himself, it would soon become as popularised as the most earnest lover of science could desire.

The Secretary announced that at the meeting of Wednesday, the 29th inst., the following paper would be read:—"On various Unused and Unappreciated Articles of Raw Produce from different parts of the World," by Mr. P. L. Simmonds."

## REPORT ON THE MUNICH INDUSTRIAL EXHIBITION OF 1854.

Consul-General Ward to the Earl of Clarendon.—

(*Concluded from page* 13.)

11. *The Second Group* nominally comprehended a great variety of articles under the denomination of agricultural produce, but which were not all to be found in their places. However, of wool, flax, hemp, and tobacco, there were sufficient specimens. The Silesian as well as the Saxon wools appeared to have lost nothing of their ancient reputation. The Central Agricultural Society in Stuttgardt sent a collection of no less than 216 specimens of clothing and combing wools, of different degrees of fineness, from which the progress of wool-growing in Wurtemberg might be fairly judged of. The number of sheep possessed by that State, on the 1st of January, 1853, was 458,488, comprising the several kinds of sheep—fine-woolled, middling fine, and ordinary woolled. This figure comes near to that of Saxony, whose stock of sheep in the year 1850 amounted to 547,334 head. But according to Dieterici,* the number of sheep possessed by these two states in the year 1842 was—Wurtemberg, 681,159; Saxony, 681,594; which confirms the opinion that the production of the finer wools in Germany is on the decline; partly, perhaps, owing to the increasing importation of the fine wools of Australia into Europe. The entire stock of sheep possessed by the states of the German Customs Union can at present little, if at all, exceed the 22,000,000 head, at which it was rated by Dieterici, in 1842. The number of sheep in the Prussian monarchy was, in the year 1849, 16,296,928.†

The cultivation of flax in Germany is said to be increasing, and the spinning it by machinery is fast expelling the old method of spinning by hand. But the flax spinneries will never be able to compete with those of England and Ireland, until they have a better material to work upon, for the German flax is at present generally deficient both in length and tenacity. Some specimens were, however, exhibited, which deserved commendation; such as the flax sent from Hirchberg, in Prussian Silesia, with the yarns spun from it, Nos. 60 to 120; and an assortment sent from the Austrian establishment at Hannsdorf, in Moravia. A few specimens of Hungarian hemp, sent from Pesth, were much approved.

Of tobacco (the opium of Germany) there were numerous specimens. The culture of the tobacco plant has been very successful in the Palatinate, the Uckermark, and in Franconia; and the increasing consumption has also led to the growth of it in many other districts less favourably circumstanced. The silk cocoons were chiefly from Bavaria, where the breeding of silk-worms is extensively pursued. In this group were also placed a number of fine pearls, from the streams of Upper Franconia and Lower Bavaria, which gratified the national feelings of many good Bavarians; and certainly the Saxon pearls found in the Elster could not compete with them, either in size or beauty.

An agricultural map of Bavaria, on the scale of 1 to 400,000, a botanical map of the country on the same scale, and a table of information relative thereto, constructed by M. Ohnmüller, of Munich, at the desire of the Government, were perhaps the most complete works of the kind ever yet executed. The geognostic state of the country, with all particulars of the soil and its productions, are admirably depicted. At least 1,000 plants, of the size of half-an-inch, are drawn true to nature in the botanical map.

12. *The third group*, comprising a great variety of articles and stuffs used in chemistry and medicine—dyes, gums, resins, oils, &c., does not appear to require particular notice, as the specimens exposed in the Great Exhibition in London sufficiently notified the progress which the German manufacturers were making in this department. The excellent chemical instruction given in the industrial and polytechnic schools has here produced good fruits; and the influence of science has led to many improvements, especially in dyeing and colouring. Some specimens of garancine, from Mannheim, were pointed out to me as worthy of approbation; and the preparations of madder were considered generally excellent of their kind. The jury appointed for this group was so fortunate as to have for its chairman Professor Liebig.

13. The substances composing the *fourth group*, viz., those prepared for food and personal use, are likewise not such as to call for particular mention. The preparation of

* "Statistical Review," &c. Berlin, 1844.

† In the same year the quantity of wool brought to all the summer fairs in Prussia was 191,534 centners; and in 1851 it was 196,199 centners.

flour in the American way has come much into use in Germany; and steam flour-mills are now very common. A large quantity of soap was exhibited; some of it in great masses, and in fanciful forms, such as obelisks and altars. The consumption of this article in Germany is not yet by any means so extensive as it ought to be, but the fault lies rather in the habits of the people than in the manufacture itself. Of beet-root sugar there were samples enough. The production of native sugar is well known to have greatly increased of late years. There were raised within the Zollverein, on an average of the years 1840 and 1841, 241,487 centners; on that of the years 1846 and 1847, 281,692 centners; and on that of the years 1850 and 1851, 736,215 centners of beet-root sugar.* The loss to the revenue consequent upon throwing the colonial sugar out of consumption has been something enormous; but the inland duty on beet-root has recently been considerably raised, and foreign sugar will therefore have a fairer chance of competition than was formerly allowed it.

14. *The Fifth Group* contained a variety of engines, carriages, machinery of all sorts, and agricultural implements. There were three large locomotive steam-engines, manufactured respectively at Munich, Vienna, and Hanover; and two from Esslingen, in Wurtemberg. The fabrication of steam-machinery has greatly extended itself in Germany within the last ten years. Russia alone had in 1849 no less than 1,961 steam-engines for manufactures, railways, and other purposes, with 67,859 horse-power.† Locomotives are constructed not only at the places above mentioned, but at Borsig's, in Berlin (the largest of all these establishments), at Chemnitz, at Cassel, and elsewhere. Formerly England supplied the German railways with their locomotives and tenders, but now an English engine is seldom to be seen. The prices of the two Esslingen engines were stated to be—for the locomotive "Wurtemberg," with tender, 28,500 florins; for the tender locomotive "Sonnenstein" (built for the Austrian line over the Semmering), 40,000 florins, which latter is the 254th engine constructed under the direction of the eminent mechanic Kessler. A number of machines for spinning, weaving, and other purposes, were exhibited by Hartmann, of Chemnitz: Bollinger, of Vienna; Fouquet, of Stuttgardt, and others; but Borsig's establishment furnished no contribution. Some cannon, founded at Munich, occupied a conspicuous place. Among the new inventions were pointed out to me a so-called universal turning-bench, from Saxe Meningen; a new machine for lithographic copying, used in mapping by the Bavarian Surveying department; a burning apparatus, of unusual force, from Carolinen. That in Bohemia, the model of a brick-making machine, constructed to effect a vast saving of labour; a machine for making barley-grits, from Saxe-Gotha; and the model of a military cooking apparatus, from Augsburg, fixed upon a carriage, and capable of providing for 1,200 men. Although I consider the German machinery to be generally inferior in execution to that of England, yet the inventive powers of the Germans are continually at work; and those machine establishments which have the advantage of large capitals have mostly had a successful career. The agricultural implements made a large display, and many of them would, no doubt, excite attention in England. The contributions from Munich, Dresden, and Leipsic, proved the increasing interest that is felt in the promotion of agricultural improvements. The Royal Agricultural Institute at Hohenheim, in Wurtemberg, which is in good repute, both as a practical and educational establishment, published a descriptive list of its models and machines, with the prices annexed. Among the numerous carriages exhibited those of Vienna were considered as occupying the first rank. They combined elegance with solidity, and in this respect were superior to the carriages of Bavaria and Baden, which were often deficient in taste as regards the details of their workmanship.

15. The objects comprised in the *sixth group* were chiefly of a scientific character, and their merits would consequently be less easy of appreciation to the ordinary visitor. Physical, geometrical, optical, and chirurgical instruments, competed with each other from different parts of Germany. A prominent object in the glass-hall was the great refracting telescope, made by Merz (the successor of Frauenhofer), at Munich, valued at 30,000 florins. The optical instruments of Merz, as well as the mathematical and optical instruments of Ertel, in Munich, have a wide and deserved reputation. In music the Germans have made great progress with their pianofortes, which, not merely in cheapness, but in goodness and durability, vie successfully with those of London. From Vienna, Leipsic, Stuttgardt, &c., many excellent pianos were exhibited, and several organs. The horns and wind instruments from Vienna and Bohemia excited the surprise of many by the perfection of their very complicated mechanism. Of clocks and watches there were many good specimens. The cheap wooden clocks of the Black Forest, so generally used by the lower classes of people, are among those articles which have undergone the greatest improvement in their construction in the course of the last ten years.

16. The most important of all the groups, as respects both the nature of its contents and the great number of articles displayed to view (having in it about 2,200 exhibitors), was *the seventh*, being that assigned to textile manufactures, yarns, worked stuffs, and articles of clothing. In the states of the German Customs Union and Austria, there are at least 300,000 weavers employed in factories, and the number of those who are occupied either wholly or partly in weaving at home is probably three times as great. The Prussian Monarchy had, in the year 1849, 2,208 spinning factories, with 25,471 workmen, and 2,837 weaving establishments with 141,412 workmen.* For Austria we have no statistics so recent. In the year 1846 the number of factories in that country for the various branches of textile manufactures is stated to have been 2,297. But the number of looms worked out of the factories must remain in a great degree conjectural.

The yarns exhibited did not, perhaps, form a collection complete enough to warrant a positive conclusion that no progress had been made in Germany in that respect; but no yarns were shown that denoted the power of successful competition with the yarns of Great Britain. The specimens of cotton yarn exhibited were in general under No. 60, and the yarns chiefly produced, both in Austria and the other German States, range between Nos. 20 and 40. In the Nos. 30 to 40 the yarns of Augsburg and Chemnitz were the best; but Prussia was very inadequately represented, for the only Prussian spinning factory which sent specimens was that of Carlsthal, in the Principality of Hohenzollern. Of linen yarn little was known. Of woollen yarn Prussia might have sent the best, but did not. The Austrian was not worth much, though here, as in other instances, Austria and Bavaria were the largest exhibitors.

The fact is that the German cotton manufacture is and must be dependent upon English yarns for many years to come. The protective system has in this instance failed, and the additional duty of a dollar per centner, lately imposed, has only had the effect of injuring the weavers, whilst it has conferred no benefit whatever upon the spinning establishments.

The German linen manufacture is a branch of industry from which many complaints have of late years been heard, and undoubtedly among the hand-spinners and weavers of flax, in Silesia and the mountains of Saxony, great misery and distress prevail. Formerly the Germans used to set the example in their fabrics of linen, but now

* Hubner's "Statistical Year Book."

† From a calculation of Dieterici, quoted by Hubner.

* Hubner's "Statistical Year-Book."

they imitate foreigners, and some of the best linen exhibited at Munich was copied from Irish patterns. From the whole Prussian Monarchy there were not above twenty linen exhibitors. The Westphalian linen was generally thought the most perfect; and Bielefeld sent some excellent pieces. The specimens of hand-work sent by an association at Herford served to show that hand-work, in the middling and finer qualities, could not be made so fine as that produced by machinery, and that the latter was both more durable and cheaper. Saxony, as usual, sent the best damask, but the plain linen stuffs were upon the whole better represented than the damasks; and the opinion of experienced persons was, that Germany could have exhibited better linen than that which actually appeared. Bavaria sent specimens of fustian, which were very inferior.

The woollen manufactures of Germany were in every branch fully represented in the exhibition. From the commonest blankets to the finest cassimirs and woollen velvets, specimens of all were to be seen displayed. The Rhenish provinces sent their cloth, buckskins, cassinets, molton and flannel, satin de laine, croisées, serge de Berry, and half-woollen waistcoat and hosiery stuffs. The best cloths were from Aix-la-Chapelle and Duren. The fine cloths and buckskins of Saxony, and generally the woollen manufactures of the Saxon kingdom and duchies, and the principalities of Reuss, made a most respectable show. But it was the cloths of Austria that undoubtedly made the most sensation, for it was not generally known that the Austrian manufactures had arrived at that degree of perfection of which the numerous specimens sent from Bohemia and Moravia gave evidence. The collections from Brunn and Reichenberg were very remarkable; the specimens were well chosen, and, in the opinion of good judges, the thick cloths of Brunn stood without a rival. The buckskins and half-woollens of Brunn were also generally superior to those of the Zollverein; so that, whenever the duties are abolished, Austria will enter as a formidable competitor in all but superfine cloths, in which the Rhenish and some of the Saxon cloths are still superior, both in colour and stuff. The merinos, Thibets, and mousselines de laine of Austria, are likewise inferior to those of the Zollverein. Of these latter articles the specimens contributed by the different states were neither numerous nor varied, and what were exhibited were in their quality below mediocrity.

The woollen manufacture is undoubtedly one of the most flourishing branches of German industry. It has, less than the cotton manufacture, been impeded by the effect of the protective system, for the duties on foreign woollens do not average more than from twenty to thirty per centner, *ad valorem*, and it has not been exposed to the vicissitudes to which the linen trade has from other causes been subject. Woollen clothing has now, in many articles, taken the place of cotton; for women's dresses, light woollens and worsteds are now generally preferred.

The specimens of cotton stuffs were sufficiently numerous, embracing calicoes, shirtings, jacconets, *piqués*, the so-called white wares, satteens, tops, and coloured and printed stuffs in great variety. There was, however, nothing in them which requires any particular notice. It is well known by what means the Zollverein has succeeded in driving out of her markets all the inferior and middling foreign cottons, and of forcing the population to supply themselves with what is often a much worse article of home fabrication. The protective duties on cotton manufactures range from 50 to 150 per cent. What has been the result? The consumption of cotton within the German Customs Union increased very slowly, and of late years has actually fallen off. In the year 1834, it was 350,884 centners; in 1845, it was 886,252 centners; and in 1850, only 834,985 centners; which figures are respectively in the ratio of 1·5, 3·1, and 2·8 per head of the population.*

* Hubner's "Statistical Year-Book."

The silk manufacture displayed itself in great variety, and occasionally in brilliant specimens. From spun silk to the richest shawls, dresses, and furniture stuffs, every description was to be found. Prussia, indeed, sent but few contributions, of which the best were from the Rhenish provinces. Crefeld exhibited its velvets, plain silks, ribbons, and rich church stuffs. The old established house of Diergards, at Viersen, was, as usual, distinguished for its velvets, ribbons, waistcoat stuffs, and plush. From Barmen, Uerdingen, Ronsdorff, &c., there were many good specimens. I heard, however, that the silks exhibited attracted no one in the way of purchasers. The prices were, as a general rule, refused to be stated, and even some of the Liepsic dealers, who applied for prices with a view to business, had difficulty in obtaining them from the manufacturers. Austria made a large display, and her velvets, plush, and embroidered stuffs were generally good, but in plain silks and ribbons, she stood below the Zollverein. The Austrian silks are dearer than those of the Zollverein, which exports to the value of 10,000,000 or 12,000,000 dollars yearly, and in part to America, in competition with France and Switzerland; whilst Austria exports only to her own non-German dominions. It is true that ribbons are imported from Switzerland into Germany, because labour is cheaper in Switzerland; but silk-weaving is certainly one of the most important branches of German industry, and Prussia alone had, in the year 1849, no less than 24,042 silk-looms at work. The manufacturer does not require protection, and, in fact, the present custom duty of 110 dollars per centner does not average more that six or seven per cent. *ad valorem.*

The excellent velvet made in the Rhenish provinces forces its way into France by means of the smuggler. The light velvets at low prices are the best; few heavy velvets were exhibited. The cheapness makes up for the difference between the German and the French velvet; the Rhenish weaver can work cheaper than the weaver of Lyons. In taffeta, lustrine, satin, and furniture stuffs, the productions of Berlin and of Saxony were strong. Wurtemberg, as well as Bavaria, have, in some kinds of silks, manufactured too much and exhibited too much. Austria was very superior in the rich brocades of silk, and mixed silk and cotton, which are used in church services and for priests' vestments; but her velvets were considered behind those of Crefeld and Viersen. The Austrian plain silk stuffs want firmness. The Italian silk is rather too woolly. But the Austrian ribbons would probably find a large vent in the Zollverein states if the duties were removed; though the patterns want originality, and are often, like many other things in Germany, imitated from the French.

Although the German states are exporters of silk manufactures, yet it would seem, from some recent calculations, that the consumption of silk at home has rather declined. The quantity of silk consumed within the German Customs Union was, in the year 1834, 3,890 centners; in 1845, 9,135 centners; and in 1850, 7,056; being in the ratio respectively of 0·015, 0·032, and 0·0237 per head of the population.* For Austria we have not the same statistics; but we know that the production of silk in the Italian provinces has greatly increased, and now exceeds 5,000,000 pounds annually. There were, however, but few specimens of Italian silk exhibited; from the Tyrol and Vorarlberg there was a better supply.

The embroidered silk and cashmir shawls of Vienna were well represented. The Austrian coloured and variegated cloths for tables, &c., and the felt manufactured at Prague for articles of clothing, also excited attention. A new invention appeared called *Glanz Percal*, being silk or other stuffs, printed with gold or silver, so as to resemble brocade, by Schreibmayer, of Munich. The hosiery from Chemnitz, Apolda, &c.,

* Hubner's "Statistical Year-Book."

offered no novelty; its cheapness is its only recommendation, for in durability it cannot compete with the hosiery of Derby or Nottingham. Of leather and gutta-percha there were a great many specimens, worth little notice. There was some fine Morocco leather, made at Vienna; but the saddlery, trunks, and other articles of manufactured leather, were of a very inferior description. Of the lace exhibited, that woven by hand, from Bohemia and Chemnitz, was the most admired. The display of articles of clothing and shoemakers' wares occupied a considerable space.

This group was quite unnecessarily large, and a great number of ordinary and trifling articles might very well have been excluded from it. If a selection of the best and most interesting specimens had been made, the group might have been reduced to one-third or one-fourth of its actual dimensions, and the object attained with a saving of expense—and convenience to the public. But taking the department as it stood, with the productions of 2,200 exhibitors, there was really little in it to show any advance in the branches of industry which it represented, much less to excite any well-grounded fears on the part of the British manufacturer lest his exertions should be outstripped by German competition.

17. In *the eighth group* were placed the manufactures of iron, steel, and other metals, jewellery, gold, and silver wares, and arms. It comprised, of course, a great variety of objects—from the coarsest iron pots to the finest gold leaf, from the cheapest tin wares of the Saxon ore mountains to the most costly jewels from Vienna or Munich. A silver table service, made for the Crown Prince of Saxony, from the designs of Professor Reitschel, possessed much artistic merit. A large collection of tools sent from Werthiem's great establishment, at Vienna, was purchased by the Bavarian Government for the School of Trade at Fürth. Among the good specimens of cast iron, there was an open fire-place, gilt, and stoves from Dusseldorf; an English stove, and figures from the Einsiedel Iron Works at Lauchhammer; and some bookcases and mirror-frames from Luxemburg. The guns of Suhl, Solingen, Prague, and other places, are in good repute, and their prices lower, from being less highly finished than those of London. The German cutlery, though still inferior to the English, has really improved; and the locks are likewise something better than they were; but in fine steel work, needles, and pins, Germany is much in the back-ground. Upon the whole, the articles in this group made a respectable figure, though their number might also have been much reduced. The cast-iron manufactures were those which excited the most attention.

18. The marbles, earthenware, porcelain, and glass *in the ninth group* formed some of the most striking objects in the Exhibition, and in many of them a great deal of artistic beauty was observable. Works of coloured marble were to be seen, distinguished by their architectural forms and neatness of execution. The Silesian marble quarries, now so generally known, were first opened by a Frenchman, M. Laverdure of Breslau, from whose manufactory several good specimens of workmanship were sent. His marble vase, with a glass grey ground, and green veined, distinguished itself for its noble form and accurate execution. Its height, including the pedestal, was about ten feet. His table plates of marble and granite were very large and fine, as well as his marble blocks of fragments from the Silesian quarries. There were also some fine marble plates from the Salzburg; a granite table from Lusatia, and green porphyry; a handsome table in stone veneer work from Berchtesgaden; a slate table from Franconia, with numerous marble plates, consols, &c., with and without mosaic; also a malachite table, and mosaic table plates, by Ganser the sculptor, of Munich, one of which, with figures of Ulysses and Penelope, was considered a masterpiece of classical art. There was a new invention of artificial stones for pavements; also specimens of Munich sand-plaster worked into polished marble and mosaic; a new and remarkable invention of chemically printed lithographic stones, with colours let in, from Sohlenhofen in Upper Bavaria; good imitations of old Egyptian vases; an altar and a table of gypsum marble by Viotti of Munich; some good figures and vases in burnt pottery by Professor Folz; also excellent specimens of building ornaments and other figures in burnt pottery from Charlottenburg and from Vienna; and some tasteful marble floorings from Nassau.

Of porcelain there were, as might be expected, many beautiful specimens sent from the Royal Manufactories of Munich, Berlin, Dresden, and Vienna. The Royal Factory at Nymphenburg, near Munich, is under the direction of an eminent artist, M. Neureuther, who has done much to improve the style of porcelain painting. He belongs to the German romantic school, and his conceptions are in that spirit, and worship national traditions and national poetry. A porcelain hunting-service, designed by Neureuther, was shown, which gave some idea of the new direction of the forms which the Bavarian porcelain is now taking. The Berlin manufacture is also getting out of the old Rococco fashion of the last century, and shows a taste for the models of classical antiquity, and the pure style of Winckelmann, Carstens, and Thorwaldsen. There were several large vases, from two to seven feet high, of Berlin porcelain, with views of the Royal Palaces, which proved very attractive. The Berlin imitations of the old Tuscan china have been also successful, and are not dear. The Dresden porcelain is now considered rather old-fashioned; it adheres too exclusively to the Rococco style. The same is the case at Vienna; and, indeed, the Vienna porcelain is very much in arrear in point of taste, and shows less signs of improvement than any of the other manufactories. However, there was a very handsome chimney piece from Vienna, with paintings on porcelain, which was a good deal admired. From the porcelain factory at Zell, in Baden, some good specimens were also sent. The Berlin earthenware stoves continue the best in Germany; those of Hamburgh are considered to stand next to them.

The Bohemian glass, and its rival the Bavarian, both now so well known, imparted a lustre to this, as they have done to other Exhibitions. The glass fabrics of Hofman, at Prague, and Count Harrach, at Neuwell, in Bohemia, take the first rank in this department; but the Bavarian factory at Steigerwald, occasionally surpasses them in elegance of form. A glass, with flowers let into it by a new method, the invention of Reinsch, of Munich, was classed in the seventh group. Some painted sheet-glass, by Irmer, of Coburg, combined beauty with cheapness, which may also be said of the glass transparencies made by Schaller, of Nürnberg.

19. The manufactories of wood and hardwares, which formed *the tenth group*, comprised some tasteful, as well as curious articles. German furniture is not generally remarkable for beauty of form; nevertheless, from Vienna, as well as from Munich and from Bamberg, there was furniture at once substantial and not inelegant. The Munich Trades Union (Gewerbe-Verein) contributed a variety of articles, under the head for which a separate locality was assigned: mosaic tables; wooden parquet floorings, by Kuhler, of Munich, newly invented and cheap; handsome altars, by Maier and Strathaus; curiously cut ivory; a prize beer table and cups from Wursburg; improved beds; and a richly carved stand and case for King Louis's album, by Possenbacher of Munich; the cork model of a Roman amphitheatre; and tables of rosewood inlaid with flowers, painted in burnt porcelain, by Theyer, in Vienna, were among the prominent objects. Of Nürnberg wares there was an abundance, with many curious productions from other parts of the country cut in wood, such as a chessboard, purchased by the King of Prussia. The best carved Meerschaums were from Vienna; and there was a beautiful carved ivory cup, by Hagen, in Munich. Looking at those articles which are not exactly artistic, but are yet distinguished for tasteful forms, we shall

find in the tin and pewter work, as well as in the joinery of Munich, much deserving of commendation. To the former belong the drinking-cups of Kreitmann and Peucker; to the latter, the wood mosaics of Förtner, which are superior to those of the middle ages as well in execution as in design.

20. *The eleventh group* displayed a great variety of paper, writing, drawing, and printing materials, with specimens of books and bookbinding. The literary activity of Germany makes the materials of literature an important consideration; but in these materials cheapness rather than excellence is the object aimed at. The writing paper generally is of a very thin texture, and in so far an inferior article to that in use in England; the paper on which books are printed is also below that of England, both in quality and whiteness. A well-bound book is seldom seen. However, in the article of pencils, those manufactured in Nürnburg and elsewhere in Germany compete successfully with the English; and the art of printing is greatly improved. The method of printing off oil pictures by the printing-press, as practised at Munich, and at Haase's large establishment in Prague, is found very successful, and cheap pictures are thus diffused, to the great improvement of the popular taste. The collection of lithographs called "King Louis' Album," was here exhibited; also some marble-paper, of which the colours were excellent, from Vienna; and some pieces of gold and of silver-paper made in Munich, which reached the extraordinary length of thirty feet. Specimens of old prints, cleaned after a new method by Heigl, of Munich, and a collection of animals stuffed in Munich, were also placed in this group; to which, however, the most remarkable contribution was a collection of the manifold and interesting productions of the Austrian State printing-office in Vienna, consisting of plates, stamps, and specimens of photography, galvanoplastics, chalcography, stylography, steel engraving, wood-engraving, stenography, &c. In this collection were plates and impressions produced by the new invention called the "Natural Printing Process," by the director of the State printing-office, M. Louis Auer, which creates by means of the original itself, in a simple and expeditious manner, plates for printing copies of materials, plants, lace, embroidery, &c. These plates are capable of effecting two results upon paper; the one a coloured copy of the original upon a white ground —the other a white copy upon a coloured ground; and in both instances without the aid of drawing or engraving. The proceeding is very simple, viz., by placing the object between a plate of copper and one of lead, and driving it forcibly between two firmly fixed rollers, when the original object leaves a perfect impression of itself (however fine or delicate its structure or mechanism), upon the plate of lead; and this is done without almost any cost, and with the utmost rapidity of execution. The Natural Printing Process is, without doubt, an important discovery, and will probably play a great and useful part in the future career of typographic industry.

21. The department of the fine arts, (*twelfth group*), comprising the contributions of about 150 exhibitors, contained statuary, casts, and bronzes of great merit. The strict rule of Industrial Exhibitions properly excludes pure works of art, and the first artists would rather shrink from being represented in them. Plastic productions, however, principally those of cast iron, and having a monumental character, easily find their way into such Exhibitions, and belong to them more properly than pictures, even those on porcelain or glass. The Munich Glass-hall displayed a variety of artistic works, and not only those which, though strictly speaking manufactures, verged upon the province of art, but such as had no subordinate object, and whose merit lay in their beauty alone. Among these artistic works may be favourably mentioned—

The three fountains belonging to the building, by the architect, De Voit.

Colossal statues of the Americans, Henry and Jefferson, cast in iron ore at the Royal Foundry in Munich; also a Madonna and other figures of cast iron ore, some chiselled, and others not; bronze casts and medallions; and a beautiful case for "King Louis' Album;" all from the Royal Foundry.

Plaster models by Brugger, of Munich; among which a fawn playing with a panthress was considered excellent.

Arms and other utensils made to resemble those of olden times, by Fortner, of Munich.

A Madonna, in relief, of Tyrolian marble, by Hauptmann, of Munich. The Loreley, in plaster, by Herold, of Munich.

Cups, arabesques, boxes, figures, &c., of carved ivory, by Hagen, of Munich.

Figures in plaster of Amor and Psyche, Bacchus and Ariadne, by Hönig, of Munich.

Models of fountains; the Four Seasons, in terra cotta; a candelabrum of granite, &c. by Leeb, of Munich.

Figures of the poets, by Schaller, of Munich, with a bas-relief after Shakspeare, in ivory, and busts.

A magnificent painted-glass window, from the Royal manufactory at Munich, destined for a church at Hamburgh. The celebrity of the Munich painted glass is now so great that it requires no particular description here. Some of the best specimens are the new windows in Cologne Cathedral, which were presented by King Louis. The Munich painted glass is, however, expensive. That made by Kellner, of Nürnberg, of which specimens were exhibited, is good of its kind, and comparatively cheaper. There were also contributions of painted glass by Hildebrand, and other manufacturers, which had great merit.

Xavier Schwanthaler's marble gable group, for the Athenian Propylœa, representing the Enthronement of King Otho; also other figures, the Salvator Mundi, Venus and Amor, &c., in plaster, and several statuettes by the same master.

The medallions of Voigt, of Munich, viz., Psyche and Amor, a Medusa's Head, and one of Thorwaldsen, with copies of medals, and some works in onyx.

A hunting group, by Professor Widnmann, cast in zinc, and Hercules' shield in galvanoplastic copper, by the same eminent sculptor.

Specimens of Dyck's newly-revived old leather-plastic for binding books, an apparently valuable invention.

A porcelain mosaic of the Madonna dal Sisto, by Neureuther.

A noble group of St. George and the Dragon, cast in zinc; figures, flower-stands, and a summer-house, of cast iron; from Prince Salm's foundry in Vienna.

A fountain and other objects in cast iron, by Professor Kalide, of Berlin.

A pastoral group, in zinc, cast, chiselled, and bronzed, by Julius of Berlin.

A table-service, goblets, &c., by Burgschmiet, of Nürnberg, a sculptor who has successfully executed several colossal statues in cast iron and bronze.

The Twelve Apostles, in cement, by Bichl, of Munich.

The above are cited as a few instances of artistic productions which struck me favourably, and which were commended by more competent judges. An examination of these, and of the many other works of the same class displayed in the Exhibition, would be more than sufficient to show that art is not stationary in Germany, and that those branches of it which are partly dependent upon manufactures (such as the modelling in cast iron and zinc) are steadily and rapidly improving.

Plastic modelling offers a wide field of exertion to the numerous class of sculptors who, though possessing talents, find it impossible to obtain employment in the higher and more costly branch of sculpture in marble or stone. There are in Germany, as in other countries, a number of wealthy people who have a taste for art, and would willingly decorate their houses and gardens with good plastic figures, but are reluctant to go to the expense of marble statues or reliefs. It seems, however, that a

suitable material for plastic art remains yet to be found. Gypsum is too chalky, and looks poor; burnt clay is too fragile; sandstone is both too heavy and too dear for the purpose; the galvanoplastic imitations of cast iron, if of any size, are unattainable on account of their price; zinc is, indeed, cheaper; but still the substance has not been discovered which is well suited for casts, and combines fineness with cheapness in the requisite degree to enable copies of the best ancient and modern pieces of sculpture to be made to any considerable extent. In such copies, the Munich Exhibition is entirely deficient, and however credible are the casts in iron and zinc which appeared in it, it is evident that the plastic art wants the means of diffusion which the existence of a better material for casting would at once afford it. Possibly the close communication and connection which exists between artists and manufacturers in Germany, and which the Munich Exhibition was well calculated to promote, may bring about this, among other improvements, before very long.

22. *The prizes* were not publicly awarded when I was in Munich. I learned, however, that they were to be divided into three classes, viz., 1st. a large medal; 2ndly. an honorary medal; 3rdly, a laudatory mention. Of the large medals there would be 267 distributed, of which the seventh group (textile manufactures) would take no less than 97, and the next greatest number of them was to be awarded to the fourth and fifth groups (articles of food and machinery), which were to have 29 each. Of the smaller or honorary medals, 960 were to be distributed, and the laudatory mentions were expected to be very numerous. There was a natural desire on the part of the exhibitors to obtain prizes; but I have heard it doubted whether public opinion attaches much weight to such distinctions. The jury commissioners are supposed to be rather too solicitous of giving general satisfaction, and the number of prizes does certainly seem much greater than the circumstances could properly require.

23. I have thus endeavoured to state succinctly to your lordship the principal points which struck me in visiting the Industrial Exhibition at Munich. Its chief faults were, that it was so much overloaded with trivial and unimportant articles, and that it did not fairly represent the manufacturing industry of the whole of Germany. In the department of the textile manufactures, it did not rise above mediocrity; but in respect of machinery, as well as artistic objects, much improvement was visible. If the Great Exhibition in London has given Germany the spur in some branches of her industry, the approaching French Exhibition will naturally have a similar effect; and, considered in the light of a trial of strength for Paris, the Munich Exposition will not be without its utility. If compared with the Berlin Exhibition of 1844, it rises certainly in apparent magnitude. At Berlin there were about 3,000 exhibitors, and the goods exposed were valued at 1,000,000 dollars, or 150,000*l*. sterling; at Munich there were 7,000 exhibitors, and the total value of the goods was stated to be 14,000,000 florins, or 1,448,276*l*. sterling.

As a financial speculation, the Munich Exhibition has proved signally unfortunate. Even during the first month, when Munich was filled with strangers, the number of visitors did not often exceed 3,000 daily, and was some days much under that mark. The ordinary price of admission was only 12 kreuzers (4½d.), except on Mondays and Fridays, when it was 30 kreuzers (1s.) This did not promise a large revenue; but in the second week in August the cholera unhappily broke out in Munich, and strangers in general were intimidated from approaching it. For several weeks the place was actually deserted by a large portion of its inhabitants in order to avoid the disease. The consequence was that the number of visitors to the Exhibition greatly diminished, and there were many days when the persons who paid for admission were not equal in number to that of the servants of the establishment. Now, as it was necessary to maintain a staff of from 500 to 600 employés for a period of three months, it will be easily understood that the charges of management, added to the cost of the buildings, amount to a very large sum of money, against which the receipts form but a trifling item. The loss to the Bavarian Government will, it is supposed, amount to at least 2,000,000 of florins. The long and severe visitation of cholera could not of course be anticipated; but even if this calamity had not occured, the frequency of the visitors would probably not have been nearly sufficient to defray the expenses of the undertaking.

24. The question how far it may be desirable to obtain admission for British goods at any future German Exhibitions is not likely to occur, since by the regulations of the German Customs Union, these Exhibitions are strictly confined to the produce and manufactures of the German States only.

25. I ought in conclusion to acknowledge the courtesy with which I was received by the Bavarian Minister for Foreign Affairs, the Baron von der Pfordten, as well as the attentions paid to me by the President of the Managing Commission, Dr. de Fischer, Councillor of State.

I have, &c.,
(Signed) J. WARD.

## THE SMOKE QUESTION.

At the meeting of the Institution of Civil Engineers on Tuesday week, the paper read was "On the means of avoiding Smoke from Boiler Furnaces," by Mr. W. Woodcock.

The Author commenced by explaining the nature of smoke as existing in furnaces, the cause of its formation, its component gases, and the temperature at which they became inflammable, and then pointed out a method of preventing the evolution of opaque smoke, by simple and apparently effective means. It was stated, that ordinary pit coal, under the process of destructive distillation, gave off various volatile substances, some of which were gases, such as 'Hydrogen,'—'Marsh gas,'—'Olefiant gas,'—'Carbonic Oxide,' &c.; these and others existed in the furnace only in a gaseous state, becoming liquid or solid when in the external air, and of such coal tar was composed; and amidst them the carbon, in minute subdivision, was held in suspension, giving to the smoke its sable hue. All these gases were combustible at given temperatures, provided a certain amount of oxygen was present. It was then shewn that the air containing this oxygen, if imparted to the gases after leaving the fuel on the bars, must be administered so as not to reduce the temperature of the gases below their "flame-points." The arguments on the chemical composition of smoke, were enforced by extracts from a letter by Mr. Mansfield, published in the "Mechanics' Magazine,"* in which the subject was fully investigated.

The formation of smoke, or visible carbon held in suspension, was stated to depend entirely upon the insufficiency of the supply of oxygen in the furnace, as the heat of the furnace would cause the various gases to be given off more rapidly than their combustion could be supported, by the quantity of oxygen passing through the fire-bars in the same period of time; this evil being much aggravated by the heat of the air, as usually supplied from the ordinary ash-pit, generally ranging from 200° to 300° Fahrenheit, and the air, at that heat, containing less oxygen by about one-third than at the usual atmospheric temperature, and consequently that the combustion of the fuel to which it was supplied must be one-third less perfect.

The simplest means of preventing the formation of smoke, were shewn to be by providing for an ample supply of oxygen in a condensed state, in the form of cold air, to the fuel on the fire-bars, and by administering such further supply of oxygen to the heated gases, as might be necessary for their complete combustion whilst in contact

* *Vide* "Mechanics' Magazine," October 14, 1854, page 365.

with the boiler, this latter supply being given at such a temperature as would insure the successive ignition of the gases as they were evolved. Thus, by establishing nearly perfect primary combustion, the quantity of smoke evolved was shewn to be reduced to a minimum, of which no visible trace ever reached the summit of the chimney.

The apparatus by which this desirable end was attained was described to consist of two parts, each being the addition of a very simple apparatus to the ordinary boiler-furnace. The first of these was a double set of thin iron bars, lying horizontally in the direction of their length, parallel to each other, immediately beneath the grate in the ash-pit. Each set of bars resembled a Venetian blind in its arrangement; the bars being inclined at an angle of 45° to the horizon in the direction of their width. The bars of the two sets were thus inclined in opposite directions, and being so close together that a vertical straight line could not pass between any adjacent pair of them; yet far enough apart to allow all cinders to fall freely through, and the air to pass freely upwards to the fire. The bars were of the same length as the grate, so as to extend from front to back. It would be perceived that the effect of this arrangement must be to screen the ash-pit completely from the heat radiated directly downwards from the grate, and so that scarcely any would pass through by reflection. In fact, not a ray of heat could reach the ash-pit from the furnace, without suffering four reflections from rough iron surfaces, which would leave a mere shadow of a ray for further progress.

Thus a large quantity of heat, which otherwise would be radiated out of the furnace into the ash-pit, thence reflected, and so lost, was saved for the boiler. The ash-pit, also, was only slightly heated by the cinders which fell through; and this source of heat might be reduced to any extent by frequently removing the rubbish from the pit. Another consequence was, that the air passing from below through the grate, not being heated in the ash-pit, entered the fire cold, and therefore not, as it did from ordinary ash-pits, in a rarefied condition. By its coolness, this air prevented, to some extent, the burning of the grate-bars; and, by its unrarefied state, it produced a more intense and rapid combustion of the fuel after it had passed the bars.

Another part of the contrivance was more especially the smoke-burning apparatus. It consisted of a set of tubes, open at both ends, passing through the furnace horizontally from front to back, and terminating within the wall of the front of the bridge; with valves to regulate the access of air into the tubes. The fire-bridge differed importantly from that of an ordinary furnace. It was hollow, and was divided into two parts, the larger of which stood up from below; the other, which was shallower, was in contact with the boiler. Between them all the products of combustion passed from the furnace. The two parts communicated with each other by channels at the sides, and thus formed together an annular chamber. The tubes before mentioned entered the front wall of this chamber, and thus established a communication between its interior and the outer air. The back wall, or plate, both of the upper and of the lower part of this chamber, or bridge, being perforated with numerous holes, opening from the interior of the bridge to the space beyond it, established a direct communication between the outer air and the throat of the flue. There was a second solid bridge beyond the first, descending from the upper side of the flue; this, by interrupting the direct channel through that part of the passage, retarded the flow of the smoke and gases, and caused their perfect mixture with each other within the space between the bridges.

The result of this arrangement was, that a current of highly heated air, which passed through the tubes in the furnace, escaped at the bridge, through the perforations in the back wall, and mixing with the gases from the furnace, which held the smoke in suspension, converted the smoke into flame.

It was contended, that by the adaptation of this apparatus to marine boilers, the high temperature of the stoke holes and boiler rooms would be obviated, and that the steam vessels would not be so evident from a distance as they now were, by the volumes of smoke they gave out; and by having a telescopic sliding funnel, and substituting, during the period of being in action, a horizontal tube, with a small fan blower, any injury to the main funnel would be effectually prevented.

It appeared that the results of this apparatus had been very satisfactory; that at Messrs. Meux's brewery there was not the slightest appearance of opaque smoke from the chimney, and that the money saving, resulting not only from the more perfect combustion of the fuel, but from the use of an inferior quality of coal at a lower price, amounted to full twenty per cent. This success was so great as to warrant the introduction of the apparatus to the more general notice of the profession and the public, through the Institution of Civil Engineers.

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The discussion was renewed on the evening of Tuesday last, when it was shown that, although critically precise experiments for determining the amount of evaporation had not been previously made, there was no doubt of the fact of its being possible to use a lower-priced fuel, and to do the full amount of work with the boiler, without evolving any opaque smoke from the chimney; and thus, whilst complying with the requirements of the Legislature, a pecuniary saving could be effected. Recently, however, by experiments on a cylindrical boiler, seventeen feet long by three feet diameter, it had been shown, that 8 9-16ths lbs. of water injected at 42 degrees of Fahrenheit were evaporated by 1 lb. of Newcastle small coal, when Mr. Woodcock's apparatus was in use. It was found, that with small bituminous coal, a better evaporation was maintained than when Llangennoch coal was used, and without any appearance of smoke. The cast-iron bridges of the furnace did not appear to suffer from the effects of the fire; the passage of the air keeping the metal comparatively cool.

As soon as the valves of the apparatus at Messrs. Meux and Co.'s brewery were closed, there was a dense smoke; but on the instant of opening them, the heated gases combined with the oxygen of the air, and flashed into bright flame. Llangennoch coals had been generally used at Messrs. Meux and Co.'s brewery, not from any economy they offered, as they were not so strong as the Newcastle coals, but for the sake of the neighbourhood, as they did not give out opaque smoke; however, with the apparatus described by Mr. Woodcock, small Newcastle slack could be used, and as it could be purchased at fourteen shillings per ton, while the Llangennoch coal cost twenty-eight shillings, there must be a money-saving, and the boilers worked quite as efficiently.

As to the general similitude between the principles advocated by Mr. C. Wye Williams, and those brought into notice by Mr. Woodcock, almost the only difference appeared to be, that the former insisted on the necessity for the coldness of the air admitted, whilst the latter contended for the advantage of heating the air prior to its mingling with the gases. On this point many conflicting opinions were given, and examples quoted. It was, however, allowed, that the arrangement of the Venetian-blind screens below the grate bars, was novel, and was likely to be beneficial in preventing radiation into the ash-pits, and thence into the boiler-rooms of steam-vessels, and there would not be any inconvenience from not being able to introduce prickers from beneath the bars, as good stokers always cleared the bars from above, by the use of the T head tool, and none but idle or bad stokers allowed the clinkers to accumulate, so as to run between the bars, and require the use of the pricker.

The use of heated air was practically contended for, because, when the air was admitted at a low temperature, there was a certain amount of loss from the chilling effect of the stream, or film of air, before it mingled with the gases; whereas this effect was not perceived when the air was admitted at a certain temperature. Under

Mr. Williams's system, this had been attempted to be provided against by multiplying the number and diminishing the individual area of the apertures for admitting air; but it was argued, that by extending the number of apertures still more, and previously raising the temperature of the entering air behind the bridge, the object would be more certainly attained. The system of supplying air at a very elevated temperature under gas retorts, had been very advantageously employed for many years, in conjunction with the hollow bridge, originally introduced by Mr. Farey, the father of the late Mr. John Farey. In corroboration of these views it was stated, that on board one of the "Citizen" steam-boats on the Thames, by a free admission of air, only through a series of parallel wire gauze screens in the fire-door, so as to distribute it in minute jets, the exhibition of opaque smoke had been prevented, whilst a saving of fuel was effected, without any loss of speed, or any extra labour to the stoker. A hollow bridge was also used, and a blast-pipe being extended from the base of the funnel, and opening into the bridge, further beneficial effect had been produced.

A model was exhibited of a hollow cast-iron bridge plate, with a series of vertical ribs, so arranged as to form tubes, leading up from the ashpit to the apex of the bridge, where the air mingled with the heated gases, and passed away in flame. The currents of air up these bridge tubes preserved the iron from destruction, by carrying off the caloric, and it became heated in its upward course.

The introduction of cold air was advocated, on the ground that a mass of air, once broken up into films, or minute jets, would not again unite, but that each particle would pursue its independent course, until it combined with the heated gases. Therefore, the system of admission by the perforated fire-door, so as to pass over the incandescent fuel, had been so strongly advocated.

It was urged that mechanical or other means should be adopted for regulating the proportion of oxygen, according to the state of incandescence of the fuel on the bars. This, it was contended, was virtually accomplished through the side tubes of Mr. Woodcock's apparatus; as it had been shewn that the velocity of the passage of air through the tubes was exactly in proportion with the demand for oxygen by the fuel. That the air was really heated in its passage had been shown by inserting a thermometer, protected from radiated heat, into a flue in connexion with the hollow bridge.

The question of the applicability of most of the systems of preventing the exhibition of opaque smoke was shown to depend, to a great extent, on the area of the fire-grate and the size of the boiler; for if both were restricted, so as to demand an excessively rapid draught, there could not be a sufficient mingling of the gases to insure perfect combustion.

## THE VENTILATION OF APARTMENTS AND HOSPITALS.

(Abridged from the *Moniteur.*)

Recent experiments have established that a man of ordinary stature, when in a state of good health, and in a calm attitude, alternately exhales and inhales in one hour from 50 to 75 cubic centimetres of air.* But if the same man be subjected to some strong exertion, so as to emit a larger quantity of air, he will take in at least three cubic metres (about 3ft. 4in.), and breathe out at the most eight or nine cubic metres. The same individual consumes also 11 grammes 0·3 of carbon, the whole forming 271 grammes, in 24 hours, a quantity which, represented by its equivalent in carbonic acid, amounts to 20 or 22 litres in an hour, and 500 litres in one day. The air which we expire contains about four parts of carbonic acid out of 100. Now, as the air in its normal state contains of the same acid four parts in 10,000, we must infer from thence that the carbonic acid exhaled by man is in proportion to the pure air as 400 is to 4, or as 100 is to 1. It is upon the above figures, which are confirmed by the most positive facts, that is grounded the whole theory of ventilation in houses and public establishments. A middle-sized dog consumes a quantity of carbonic acid almost equivalent to that absorbed by a man, and exhales about 18 or 20 litres every hour, thus becoming a deleterious cause of consumption in an apartment of an ordinary size.

* 50 centimetres = 20 inches, or 1ft. 2-3rds.

But domestic animals are by no means the only cause of vitiation in the air. The latter originates likewise with many domestic habits, such as flowers constantly kept in an apartment, where their speedy withering shows an evident want of oxygen; the perfumed elements for the toilet, the combustion of large lamps, or of numerous candles, as well as the absorption of noxious gases by woollen or silken hangings, when placed against doors and windows.

Thus, when all these things are taken into consideration, it will be seen that if the lower classes, who generally tenant the upper stories of our houses, are not overburthened with children, when also they faithfully adhere to habits of cleanliness, without which the largest apartment soon becomes a focus of infection, they may be in more healthy conditions even than the rich themselves. But, on the other hand, there is an end to salubrity whenever the airing of a room is not completely effected, and when the number of individuals is larger than a small apartment would allow. Thus in Paris, and some other French commercial cities, the lodging-houses at five sous, three, and even two sous a night, are often little better than sinks of impurity; and the police should vigilantly require that the number of beds does not surpass the quantity of air necessary for a normal state of breathing. In a city like Paris, there are but few buildings adapted to procure a sound and refreshing sleep. The owners can only command such lodgings as are totally deficient of a continuous ventilation, and contain in general about three times as many people as they ought to do. The philanthropic spirit which gave rise to infant schools would do well to establish likewise sleeping wards for the poor and working classes.

Inhabited dwellings are always liable to some sort of ventilation, either through the doors and windows, or in consequence of artificial draughts. Let us suppose a place occupying 300 cubic metres, and inhabited by ten persons; the volume of air required for each person will be thirty cubic metres—a quantity absolutely necessary for the regular support of life, particularly if the apartment be closed for a certain number of hours. At the end of eight hours the cubic metre of air will contain 2½ grammes of carbonic acid; but it will require the constant action of a ventilation affording at least 27 cubic metres, to counterbalance the noxious influence of the gas resulting from the act of breathing, from perspiration, and the very ventilation itself. In hospitals, infant and other schools, workshops, &c., a ventilation of that kind is far from being sufficient; indeed, it ought to be doubled. We are acquainted with certain hospital wards recently built, where every sick person receives at least sixty cubic metres of air per hour, and even that is not enough.

But, indeed, in regard to the latter question, observes an eminent French physician, Dr. Boudin, it has not hitherto been solved in a satisfactory manner. The cause of this non-success is of a complex nature. In some cases the attempts to determine the quantity of pure air to be introduced into such places were made by physicians who were not good natural philosophers; in others, by philosophers who had not enough of the physician within them. As far as the latter are concerned, they appear to have taken too exclusive a view of the vitiation of the air by the carbonic acid which was exhaled, leaving completely out of the question *the mode by which the vitiated air is to be extracted*, when they had to appreciate the

quantity of pure air which must be introduced in a given time. Every one will, indeed, easily understand that in a ward where the small-pox or the typhus rages, the danger of breathing such air does not at all consist in the proportion of carbonic acid which the atmosphere may contain. Thus, henceforward, when we have to determine the quantity of pure air allowable to each individual, we must take into consideration the quality of the patient, and the mode of extraction of the impure air. Nay, more—the conditions laid down for contractors, instead of merely stipulating the quantity, must needs determine the quality of the pure air to be introduced into a ward. And, in the meantime, until we arrive at some better system of analysis, it will be necessary to use the eudiometer no less than the anemometer.

Dr. Arnott, whose ideas upon ventilation have been adopted at the hospital of York, prefers to any other means a mechanical force of propulsion combined with the spontaneous draught of a chimney shaft. His system of introducing external air into an edifice, corresponds exactly with that by which the carburetted hydrogen gas runs through the condensed pipes of a city. He simplifies the propelling power by substituting for the steam-engine, the pressure of a column of water, which is alternately introduced and sent back by a plug. The pump which brings from without the air into the edifice is set in motion by a minimum of power, amounting only to one horse, whilst the shaft established in order to ventilate the House of Lords requires a twenty-horse power to operate. The former pump works almost without any noise whatever, and with the greatest regularity, seldom requiring repair. The propulsion of the air through the room where it is warmed, and from thence through the edifice, is far preferable to the method of ventilation by exhaustion, because the former system tends to fill up rather than produce a vacuum, and prevents the regular ventilation from being interrupted by an irregular draught of air penetrating through accidental apertures. But the better an unforeseen irruption of air is prevented, the more does it become necessary to secure a sufficient quantity of air for its object. Now, one of the principal merits in Dr. Arnott's plan is that the propulsive pump, being constructed according to the well-known system of a gasometer, is a precise measure of its own task. Without entering into technical details, let it suffice to say that it supplies 2550 cubic feet of air in a minute, or 135,000 every hour; so that, taking the number of patients in the hospital to be seventy, every one of them would enjoy 1,982 cubic feet of pure air in an hour.

To the above propulsive system, M. Léon Duvoir, a French architect, has substituted one which might be called the *sucking* or aspirative system, which has been adopted by several public establishments in Paris, and among the rest, by the two hospitals Necker and Beaujon. The problem to be solved was the following:—1. To keep up in the wards a permanent temperature of 15 degrees centigrade. 2. To procure, day and night, a minimum ventilation of 60 cubic feet during the cold seasons. 3. To maintain an equivalent ventilation during the night in every other season. 4. To provide every patient with 15 litres of water warmed to the extent of 100°. M. Duvoir has succeeded in the undertaking. He first established a focus or furnace in the cellars, but soon after suppressed it by turning to account the heat of the fire used for medicinal preparations. The external air was brought in by means of reservoirs placed in the garrets, and which offered a large surface, proportioned to the system of general circulation of warm water. Speaking of this combined system of airing and warming at the Necker hospital, the Commissioners named for examining the works express themselves thus:—"The contact of the reservoirs of hot water is sufficient to warm the air in the chimney, and to determine the expulsion of the air from the wards, which is impelled along large shafts or rather sheaths communicating with the main-shaft or chimney. Again, these same sheaths receive the above air from all the vertical chimneys carried along the walls immediately behind every patient's bed. The apertures of these chimneys through which the vitiated air escapes are placed behind each bed, and on a level with the floor. Both in winter and summer the air penetrates into the wards, either through openings in the floor which communicate with the external air, or through a tube likewise corresponding with the central stoves and the ambiant air. In winter the latter, of course, is warm, on account of its previous contact with the tubes for hot water; but it is always kept out of the rays of the sun. This is an indispensable condition, for every one is aware that the solar action from without would prove an obstacle to the free introduction of fresh air into the wards."

The above system of warming and ventilating buildings is now applied to many hospitals, prisons, and churches of Paris; among others we may name the Madeleine and St. Sulpice, the Conservatoire des Arts et Métiers, the Institut, the Imperial Mining Institution, the Institution for the Blind, &c.

## PLANTAIN FIBRE.

About forty years ago, the Honorable John Lunan, published in an excellent work, entitled "*Hortus Jamaicensis*," a description of all the indigenous plants hitherto known, as well as of the most useful exotics in this country, from which we extract the following:—

"A great deal has been said and written lately as to the possibility of manufacturing a good hemp from the fibres of the different plants of this genus; and rewards of two hundred pounds have been paid, under an order of the Assembly, for the best specimens produced of this hemp in each county of Jamaica. This is, however, no new discovery; for the Indians have been in the habit, since the first discovery of the New World, and no doubt long before, of making cloth from these fibres. The celebrated circumnavigator, Dampier, notices the process, more than a century ago, as follows:—'They take the body of the tree, clear it of its outward bark and leaves, cut into four quarters, which put into the sun, the moisture exhales; they then take hold of the threads at the ends, and then draw them out; they are as big as brown thread; of this they make cloth in Mindanao, called *saggen*, which is stubborn when new, wears out soon, and when wet is slimy. The natives of the Phillipine islands give the name *abacca* to the vegetable fibres of a species of the plaintain, of which they make their cordage, and of which they have considerable manufactories."

The following is an account of the means made use of for obtaining this hemp, as laid before the committee of the House of Assembly, by Dr. Stewart West, who gained the premium for the best specimen produced in the county of Surry:

### MANUFACTURE OF HEMP FROM THE PLANTAIN TREE.

"In order to fulfil the intention of the honourable House of Assembly, I proposed to myself to find out the most simple and expeditious process possible for manufacturing hemp from the plantain tree, that the general adoption of it might not be prevented by complex machinery, or tedious and difficult manipulations.

"I have now to give the result of my inquiries, and have to describe such a simple and easy process as will enable any person to set on foot a manufacture of hemp, without much trouble or expense. The instrument I have employed is so simple, that a carpenter may make it in half an hour, and the whole process is so expeditious, that the hemp may be rendered fit for sale in a few hours after the trees are cut down,—I mean the *undressed* hemp; for to dress it with a heckle, unless it were likewise spun and wove in the country, would be quite foreign to the purpose. The process of heckling is by no means so simple as it appears to be; and I can truly affirm that

if a person, not bred in the business, attempt to heckle flax and hemp, he will convert the greatest part of it into two; besides, different modes of dressing are necessary, according to the manufacture to which the hemp is to be applied. That part of the process, therefore, can be executed better, and to much greater advantage, in Britain. But if the instrument be in good order, and proper attention be paid to the manufacture, the hemp will be rendered so clean as, in a measure, to supersede the use of the heckle, especially for cordage.

"Though the filaments of the plantain tree are naturally large, yet they are divided, and they may, therefore, by dressing, be adapted to the manufacture of the finest fibres, perhaps, to which flax and cotton can be applied. The division of the filaments, however, would be prejudicial in the manufacture of cordage, for it appears, from an experiment of Count Rumford, that the agglutination of the fibres greatly increases their strength.

DIRECTIONS FOR MAKING THE CRAMP.

"Take a plank, six feet long, one foot wide, and two inches thick; set one end two feet deep in the ground, and apply a brace before, to keep it steady; cut a notch on the top, six inches deep and eight inches wide; notch the two uprights half an inch wide, to admit the jaws, which must be made of hard wood, the lower one twelve, the upper twenty, inches long; the lower is fixed, the upper is moveable on a pin at one end, and has a weight suspended at the other, which may be increased or diminished at pleasure. The upright in which the upper jaw turns on the pin may have a mortice, five inches long, in place of a notch, and two inches may be cut off from the other upright. The jaws are half an inch thick, and two inches wide, brought to an edge where they meet, which must be slightly serrated. If the jaws are made of steel, a quarter of an inch in thickness will be sufficient."

PROCESS FOR PREPARING THE HEMP.

"1. Cut the plantain coats into lengths of four feet.

"2. Separate the stems of which the stems are composed, and split the outer coat into ribbons about an inch and a half wide.

"3. Separate the internal parts of the ribbons with a wooden knife, then

"4. Draw them through the cramp till the filaments are clean.

"5. Hang them to dry in the sun as soon as possible.

"When the hemp is thoroughly dry, let it be plaited into pellets, of about half a pound, and tied up into bundles of twenty pounds each."

From experiments tried on the hemp made from the plantain-tree fibre, which was manufactured into rope at her Majesty's dockyard, Port Royal, the following results were obtained:—

| | cwts. | qrs. | lbs. |
|---|---|---|---|
| King's nine thread inch rope broke by the weight of | 6 | 1 | 14 |
| Dr. West's specimen | 6 | 2 | 0 |
| Specimen from the parish of St. Andrew | 6 | 1 | 0 |
| Ditto, Portland | 4 | 2 | 0 |
| Ditto, St. George | 3 | 2 | 0 |

The above specimens were made of the same size as the King's rope.

It appears, also, from several experiments, that the inside fibres are stronger than the outside, but spun together have a good average strength. This hemp incorporates freely with tar, and its goodness greatly depends in completely evaporating the sap; otherwise the least fermentation greatly impairs its strength: it cannot, therefore, be too thoroughly dried before it is packed for use or for exportation.—*Jamaica Cornwall Chronicle.*

## Proceedings of Institutions.

BARKING.—On Thursday week a lecture was delivered at the Mutual Improvement Society, by Mr. W. N. Froy, of Hammersmith, on the "Life and Character of Oliver Cromwell." This was his second engagement by the Society, by whom he is considered a very able lecturer.

DUNMOW.—The members assembled in unusual numbers on the 15th instant, to celebrate the opening of the enlarged Town Hall. The Viscountess Maynard occupied a handsome chair, presented for the use of her ladyship on such occasions by the ladies of Dunmow. An address was delivered by the President, the Rev. C. Lesingham Smith, who congratulated the members on having exchanged their late stinted habitation for the present comparatively spacious and lofty hall, in which their institution might attain to its full development, and discharge all its appropriate functions. The hall itself was a noble monument of their success, and a proof of their prosperity. In the course of his remarks he asserted, that the unanimity existing between all classes with respect to the momentous events now taking place in Europe, was partly to be traced to such establishments as these, which alone enabled the working man to hear of the valour and self-devotion which had been displayed, and the glory which had been won, by his fellow-countrymen. Such knowledge was the just inheritance of every one of England's sons. The meeting was then effectively addressed by several other gentlemen, and concluded with an admirable lecture on "Humourous Characteristics," by George Grossmith, Esq. The military band of the Hon. East India Company played at intervals during the evening, and also for the dancers, who, after the close of the various addresses, kept up the gaiety of the joyous meeting till a late hour.

SEVENOAKS.—On Thursday, the 16th, Mr. E. Mottley, of Margate, delivered an interesting and instructive lecture, at the Literary and Scientific Institution, on the "Chemical Elements of the Munitions of War." Mr. Mottley commenced by introducing several specimens of the early implements of war, leading his audience on to the important discovery of gunpowder. The qualities of nitrogen, its combination and law of definite proportions, were fully and simply explained. Implements of modern warfare were then described—the rifle and Lancaster gun having the greater share of time. This was the seventh engagement Mr. Mottley has received from the Committee of this Institution.

## MEETINGS FOR THE ENSUING WEEK.

MON. Actuaries, 7.—Mr. Jellicoe, V.P., "On the relation which should obtain between the amount assured upon lives and the sum reserved, at the expiration of given terms, to meet it."
Geographical, 8½.—1. Mr. Anderson, "Explorations in South Africa, with route from Valfish Bay to the Lake, and ascent of the Teoge River." 2. "Despatches from the Foreign Office, enclosing accounts of the Niger Chadda Expedition, from Commander Miller, R.N., Dr. Baikie, and Mr. Macgregor Laird, F.R.G.S." 3. "Despatches from Acting-Consul Gabriel to Lord Clarendon; also from Commodore Adams and Commander Philips to the Admiralty, announcing the arrival at Loanda of Dr. Livingston, with remarks on the same, by Lieut. Bedingfield, R.N.

TUES. British Meteorological, 7.—Mr. F. W. Doggett, "On the relation found to exist between the weather and the crop of hops, particularly in respect to the fall of rain."
Medical and Chirurgical, 8.
Civil Engineers, 8.—Mr. G. J. Munday, "Description of the Coffer-Dams used in laying the pipes from Richmond to Twickenham, crossing the Thames."

WED. Society of Arts, 8.—Mr. P. L. Simmonds, "On various unappreciated and unused articles of raw produce from different parts of the world.
Geological, 8.—1. Captain Brickenden, "On a new species of Ptericthys from Morayshire." 2. Mr. C. Heaphy, "On the Coromandel Gold Diggings in New Zealand." 3. Major Chatteris, "On the geology of the neighbourhood of Nice."
Botanical, 8.

THURS. Royal, 4.—Anniversary.
Antiquaries, 8.

SAT. Medical, 8.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Nov. 17th*, 1854.]

*Dated 4th September*, 1854.

**1936.** J. F. H. H. de Lavaur, Paris—Waterproof wrappers for packing goods.

*Dated 8th September*, 1854.

**1959.** S. Frearson, Glascote—Buttons. (A communication.)

*Dated 3rd October*, 1854.

**2118.** W. Tatham, Rochdale—Spinning machinery

*Dated 10th October*, 1854.

**2167.** J. B. Jackson and W. Bowler, Sheffield—Prevention of smoke.

*Dated 14th October*, 1854.

**2203.** L. Monzani, Greyhound place, Old Kent road—Brushes and brooms.

*Dated 31st October*, 1854.

**2310.** T. F. Tyerman, Weymouth street, Portland place—Hoop iron bondings.

**2314.** T. Prosser, Birkenhead—Steam-engine condensers.

**2316.** A. Craig, Paisley—Railway wheels.

**2318.** T. Osborne and W. Eldred, Leicester—Stopping railway carriages.

*Dated 1st November*, 1854.

**2320.** J. and W. Bradshaw, Blackburn—Time-pieces.

**2322.** J. B. Robb, Boston, U.S.—Railway brakes.

**2324.** H. Brinton, jun., and R. Smith, Kidderminster—Carpets.

*Dated 2nd November*, 1854.

**2326.** J. Gedge, 4, Wellington-street south—Grinding machinery. (A communication.)

**2328.** L. H. Dewey, New York—Means of putting out fire.

*Dated 3rd November*, 1854.

**2332.** N. Topp, J. Holt, and J. Partington, Farnworth—Hand-mules for spinning.

**2334.** E. Alexandre, Paris—Organ-pianos.

**2336.** W. C. T. Schaeffer, 11, Stanhope-terrace, Hyde-park-gardens—Treating waste wash-waters of mills.

*Dated 4th November*, 1854.

**2338.** J. Adcock, Dalston—Application of tobacco-stalk to useful purposes.

*Dated 6th November*, 1854.

**2340.** H. Bordier, Orleans—Alcohol from plants of a farinaceous nature.

**2342.** J. Shaw, Dukinfield—Guns and firearms.

**2344.** F. R. Ensor, Nottingham—Bobbin-net or twist lace machinery.

**2346.** W. Childs, jun., Brighton—Pipes and tubes.

**2248.** F. J. W. Packman, M.D., Puckeridge—Air-gun.

*Dated 7th November*, 1854.

**2352.** E. Hogg, Gateshead—Shot and shell.

**2354.** W. H. Woodhouse, Parliament-street—Water meter.

**2356.** E. Simons, Birmingham—Candlestick.

**2358.** J. Bird, Dudley—Reverberatory furnaces.

**2360.** J. Blackie, Glasgow—Driving-belts, straps, and bands.

*Dated 8th November*, 1854.

**2362.** L. Gluckman, Dublin—Electric communications in railway trains.

**2364.** J. Whitehead, Patricroft—Self-acting mules.

**2366.** C. W. Siemens, John-street, Adelphi—Electric telegraphs. (A communication.)

**2368.** W. E. Newton, 66, Chancery-lane—Saws. (A communication.)

**2372.** C. D. Cranstoun, Elgin—Railway couplings.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed November 17th*, 1854.

899. Moses Poole, Avenue-road, Regent's-park—Improvements in drying and weighing fibrous and other substances.

1140. Robert Oram and William Oram, Salford—Improvements in hydraulic presses.

1141. Charles Bostock and Stephen Greenwood, Manchester—Improvements in machinery or apparatus for cleaning and doubling silk.

1148. Ernest Radigon and Raimond Gabriel de Grimouville, Paris—Improvements in glasses, shades, and smoke plates used in gas and other lighting.

1223. Charles Maschwitz, Birmingham—Improved instrument for paring and slicing apples, potatoes, and other fruits and roots.

*Sealed November 21st*, 1854.

1144. Frederick Jenks, Handsworth, and Thomas Brown, Birmingham—Improvements in saddle-trees.

1152. John Lawson, 4, Sidmouth-street, Gray's-inn-road—Improvements in the manufacture of cut piled fabrics.

1159. Thomas Clarendon and Owen John Gilsen, Dublin—Improvements in the means or apparatus for working breaks on railway carriages.

1161. Josiah George Jennings, 29, Great Charlotte-street, Blackfriars, and Robert Davenport, Jonathan-street, Vauxhall—Improvements in the construction of kilns for burning pottery and other ware.

1165. Edward Everall and Thomas Jones, 2, Henrietta-street, Brunswick-square—Waterproofing all kinds of cloth, silk, and leather, without injury to their respiratory properties, flexibility of fabric, colour, or appearance.

1169. John Packham, 68, Western-road, Brighton—Improvements in boilers for heating and circulating water.

1177. James Lord, Farnworth—Improvements in the manufacture of articles of ladies' under-clothing.

1191. Joseph Risdale, Minories—Improved means and methods of communication between different parts of ships and other vessels.

1222. Thomas Greenshields, George-street, Derby—Improvements in railway chairs.

1232. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in the construction of umbrellas and parasols.

1256. David Atkinson, Seaham Harbour—Improvements in printing, and in the machinery or apparatus to be employed therein, or connected therewith.

1330. George Mears, Bell Foundry, Whitechapel-road—Improvements in machinery or apparatus for obtaining sound.

1331. David Clovis Knab, Rue Rosini, Paris—Improvements in the production of carburets of hydrogen.

1398. Joseph Davies, Bristol—Improvements in propelling vessels.

1415. Richard Leicester Antrobus, Birmingham—Improved method of printing oil-cloth for floor and table covers, paper hangings, and other surfaces.

1544. Robert James Maryon, 37, York-road, Lambeth—Improvements in the construction of, and application of, steam-engines for the better means of transmitting motion, and of applying steam or other motive power.

1551. James Derham, Bradford—Improved machinery for combing wool and other fibrous substances.

1554. Elijah Henry Brindley, Longton—Improvements in printing or ornamenting china, earthenware, and glass.

1594. Joseph Barnes, Church—Improvements in furnaces or fire-places.

1756. Thomas Lawrence, Birmingham—Improvements in the manufacture of bayonet blades, and in machinery or apparatus to be employed for that purpose.

1850. Theodore Schwann, M.D., Neuss, Prussia—Improvements in machinery or apparatus worked or actuated by helicals or spirals.

1853. Matthew Curtis, Manchester, William Henry Rhodes, Gorton, and John Wain, Greenacres Moor, Oldham—Improvements in certain machines for spinning and doubling cotton and other fibrous substances.

1872. John Gedge, 4, Wellington-street South, Strand—Improvements in boring instruments known as augers, bits, or gimlets. (A communication.)

1950. George Printy Wheeler, 4, Bellevue-place, Cleveland-street, Mile End-road, and Samuel Bromhead, 38 Holford-square, Pentonville—The production of new fibrous materials capable of and suited for the manufacturing of string, rope, matting, and various fabrics, with or without the combination of cotton, wool, or flax, or for pulp for the manufacturing of paper, papier mache, millboard, &c.

1994. Henry Crosley, Camberwell-grove—Improvements in the manufacture of paper, millboard, and felt from materials not hitherto so used.

2005. George Frederick Evans, Hanover-lodge, Kew-bridge, and Frederick John Evans, Gas Works, Horseferry-road—Improved apparatus to be used in the distillation of coal and other bituminous and resinous substances.

2012. John Ashworth, Bristol—Improvements in sizeing and stiffening textile materials or fabrics.

2013. Nathan Thompson, junior, New York—Improvements in life preserving seats.

3014. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in machinery or apparatus for manufacturing cards employed in the preparation of fibrous materials. (A communication.)

2071. The Honourable James Sinclair, commonly called Lord Berriedale, 17, Hill-street—Improvements in treating, cleansing, and ornamenting paper and other surfaces.

2090. Moses Poole, Avenue-road, Regent's-park—Improvements in cylinder paper machines.

2104. George Fergusson Wilson, and George Payne, Belmont, Vauxhall—Improvements in the manufacture and application of rosin oil.

2114. John Penn, Greenwich—Improvements in the bearings and bushes for the shafts of screw and submerged propellers.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| Date of Registration. | No. in the Register. | Title. | Proprietors' Names. | Address. |
|---|---|---|---|---|
| Nov. 18. | 3658 | Wain's Improved Pulley Block ............ | George Henry Wain ......... | Britannia-terrace, Haigh-street, Liverpool. |
| | 3659 | Elbow for Gas, Water, and other Pipes | Samuel Bentley ............... | Birmingham. |
| | 3660 | Improved Cricket Bat Handle ........... | William James Page and Edward Joseph Page | Kennington-common. |
| | 3661 | Gloves ........................................ | Brochier Père et Fils ........ | Grenoble, France. |

Journal of the Society of Arts.

*FRIDAY, DECEMBER* 1, 1854.

## THIRD ORDINARY MEETING.

Wednesday, November 29, 1854.

The Third Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 29th instant, William Hawes, Esq., in the chair.

The following Candidates were balloted for, and duly elected:—

| | |
|---|---|
| Acworth, Rev. Dr. | Larnach, Donald |
| Adams, John | Mason, George |
| Andrews, John | Moore, Robert R.R. |
| Barnes, Thomas, M.P. | Murray, James |
| Bath and Wells, Bishop of | Neale, Robert |
| Berger, Edward | Oxley, John Timothy |
| Buxton, Charles | Paul, Benjamin H. |
| Cobbett, Arthur | Powell, Francis |
| Cockshaw, Albert | Prowes, Rev. John Mervin |
| Corbett, John | Sadler, Charles James |
| Cornwell, James, Ph. D. | Scott, John B., M.A. |
| Cracknell, Edward Charles | Spon, Francis Nicolas |
| Creed, Henry | Sykes, John |
| Deane, John C. | Symonds, John |
| Ferguson, William | Symons, Jelinger C. |
| Fitch, Joshua G., M.A. | Tartons, Charles |
| Fogerty, William | Van de Linde Monteuuis, Rev. G. |
| Fowke, Capt. Francis, R.E. | Waddilove, Alfred, D.C.L. |
| Fraser, Sir Wm. Augustus, Bart., M.P. | Waley, Jacob, M.A. |
| Gray, John, M.D. | Watson, Thomas, M.D. |
| Grierson, J. B. | Wickham, Henry Wickham, M.P. |
| Hale, Rev. Edward | Willis, Henry Brittan |
| Harrison, Henry | Wood, John |
| Henderson, John | Wood, John |
| Hodgson, Kirkman Daniel | Wood, William |
| Hullah, John | Woolley, Rev. Joseph, LL.D. |
| Jones, Evan | |
| Klein, William | |

The first paper read was

### ON SOME UNDEVELOPED AND UNAPPRECIATED ARTICLES OF RAW PRODUCE FROM DIFFERENT PARTS OF THE WORLD

By P. L. Simmonds.

The improvements in arts and sciences which are taking place day by day, the new manufactures which are starting up, the increase of population, the extension of colonisation, the greater demands made by manufacturers, and the continual waste occurring, are creating urgent wants for New Materials of Commerce, and a larger supply of old staples than are at present available. So bountiful is Nature, that the want has but to be expressed, and diligent investigation and inquiry set on foot, and the demand is soon satisfied. The student in his library, the scientific inquirer in his laboratory, the cultivator in his distant field of operations, the botanist and geographical explorer in their travels in distant lands, and the manufacturer in his workshop, testing and proving the value of some new commodity,—each and all of these may and do contribute more or less to the general good of mankind.

Each one may lend his aid, therefore, to add to the general stock of information,—to point out or suggest some pathway to discovery, some new unappreciated product, seemingly fitted for a particular purpose, or to direct attention to some neglected staple which was formerly useful, and has been latterly overlooked. I possess, probably, some facilities which have given me advantages over others in the investigation of Commercial Products, from having devoted my special attention for a considerable time to this peculiar object of study, both as a Colonial planter in former years and a literary investigator in a later period. Recently I have laid before the public, in a voluminous work, the extent of my researches into the history of the cultivation, manufacture, and consumption of some of the *principal* staple articles of Commerce, obtained from the Vegetable kingdom, but, from want of space, I was unable in that work to allude to a large number of *minor* products, and was obliged to pass unnoticed altogether the subject of vegetable fibres, of gums and resins, of timber and furniture woods, of fruits and vinous and fermented drinks, and a great variety of miscellaneous matters. In the preparation of a companion volume, on the Commercial Products of the Animal Kingdom, on which I have since been engaged, I have had my attention drawn to many articles which appeared to me deserving of special inquiry and scientific investigation, and some of these Undeveloped and Unappreciated Products of Commerce, at the solicitation of the Society of Arts, I desire now to bring under notice, in the earnest hope that out of the multitude of suggestions some one or other may possibly result in individual and general benefit to merchants, manufacturers, and the community at large.

An extensive correspondence with cultivators, producers, and scientific men in all parts of the world, has kept me perhaps better advised on new articles of Commerce than many other persons less favoured by circumstances.

The obligations of Commerce to Science are numerous, and the various nations of the earth are each helping on the progress of mankind towards greater comfort and towards general civilisation. The petty monarchs of Africa now find the trade in palm oil more profitable than that in human beings—the Zulu and Kaffir tribes, instead of waging exterminating wars with each other, are settling down more readily into the peaceful pursuits of stock-breeding and cultivating the soil; the fierce natives of Madagascar carry on a profitable cattle trade with the Mauritius and Bourbon. The islanders of the Pacific, by intercourse with missionaries and whalers, find a demand created for cocoa-nut oil, for shells, for sandal wood, for arrowroot, and other commodities, which bring them in valuable manufactured goods in return. The Malays and Dyaks of Borneo are stimulated to commercial pursuits by Rajah Brooke, and abandon, to a considerable extent, piracy and head-hunting, as less profitable than the disposal of gutta percha, antimony, and other staples. The skilled and industrious Chinese, driven by internal revolutions from their own country, carry their arts and intelligence to the Straits Settlements, to Australia, California, Central America, and the West Indies. The Coolies, after years of experience in planting and manufacturing sugar and coffee in Mauritius and Ceylon, return to India with improved ideas, and a large acquired stock of industry and knowledge for the advancement of their kindred. When we perceive the new and vast fields which are laid open to investigation and enterprise—the empires of China and Japan being no longer sealed countries—the interiors of the vast continents of Australia, Africa, and America, being ransacked by Commerce—the island groups of the Pacific and Eastern Archipelago, especially Borneo and New Caledonia, being now fast peopled by Europeans—who shall set a limit to the new and useful products which may be there developed and brought in to the aid of the merchant and manufacturer?

It has been well observed that the bounty of Nature is inexhaustible. The world went on a long time indifferently well without the potato—still longer without tea or coffee. There was a civilisation before the silkworm was discovered, or cotton produced to the extent it now is; and sugar, as a general article of consumption, is a modern improvement in diet. Nature, beyond doubt, has many

wonders yet in her storehouses, awaiting the discoveries of man, and fitted for the rapid advancement of civilisation and common comforts. Each one (as I have already observed) in his own range of operations, adds to the general stock of improvement, and discovers something new, calculated to sustain and support man, and to benefit the progress of the world at large.

When we see how suddenly we have been drawn into hostilities with a powerful country, with which we had long maintained peaceful relations, and from whence we had derived valuable supplies of timber, tallow, hides, fibres, and other products of Commerce, we should consider the position in which our manufacturers might possibly be placed were a war to arise with the United States; from a stoppage of our supplies of that grand staple of our manufacturing trade—Cotton. In the last fifty years we have paid Russia one hundred and ten millions sterling for flax and hemp alone, exclusive of our purchases of grain, timber, and animal products, and probably we have paid her about six millions sterling per annum. Last year we received 41,819 tons of hemp from Russia, and 21,323 tons from other countries; and 64,400 tons of flax from Russia, against 29,770 tons from other parts. Surely, with a little attention and enterprise, these figures might easily be reversed in a year or two, and the whole or a greater quantity obtained from Ireland, and Canada, India, and other British possessions.

When we consider the changes of the seat of production in Sugar, and the variety of plants furnishing saccharine juices, we cannot say that there is no room for experiment here. For a long period the common sugar-cane was solely depended upon, but some varieties of this plant were soon found to be more productive than others; and countries in which the cane could not, from the nature of the climate, be raised, drew portions of their supplies of sugar from other plants. The sugar maple furnishes the home supply in British America and some parts of the States; the sugar beet furnishes about 160,000 tons to the Continent. In the East and in Africa, sugar is obtained from the palm tribe. In America it was found that the stalk of the maize furnished a good supply of saccharine juice; and very recently a friend of my own (Mr. Leonard Wray), who has had great experience in sugar planting in the East and West, and who has published an excellent work on the cultivation and manufacture of this valuable staple, has patented processes over England, Europe, and America, for producing sugar from another species of reed or cane, which, from its early maturity and suitability for cultivation in temperate climates, bids fair to work a complete revolution in sugar manufacture.

It is singular to watch the mutations that take place after a few years in the fields of production of various staples, and the rapidity with which they are transplanted to distant quarters, as local facilities of fresh soil, cheap land, labour, and colonisation are found to exist. The West Indies and British Guiana once produced large quantities of cotton, but the production there has almost ceased, and has been since taken up by the planters of the East Indies. The coffee of the West Indies, once a considerable item of production in Jamaica, Trinidad, Cuba, and Demerara, has now been almost monopolised by Ceylon and Java, and has also been taken up by Brazil. Ceylon now produces more than 22,000 tons. Sugar cultivation is declining in the west, and centring in the east, where the little island of Mauritius produces enormous crops, and the Indian presidencies and the Straits Settlements are fast increasing their cane plantations. The field of indigo culture has also changed from the west to the east. The geography of Commerce is a curious and interesting field of study. Gutta-percha has only come into use ten years, and yet it has become one of the most important products of Commerce for the purposes of Science and the arts. The extensive trade in cocoa-nut oil, palm oil, and nut oil is but of recent origin. The trade in pine-apples was started but a few years ago, and even our vast cotton trade from the United States dates but from the present generation, the man being now alive who shipped the first bale to Liverpool, which was reported on as unsaleable, and he was advised to ship no more; and yet the production of this article has risen to three million bales per annum in the United States, and we consume five thousand bales a day in this country! If by any sudden convulsion our supply of cotton from America should be cut off, how wide-spread would be the resulting destitution and ruin to many of our merchants and importers and to a large class of the population in the manufacturing districts. And yet we have every facility of soil and climate for producing in our own dependencies of Africa, India, and Australia, more than sufficient for our wants.

Notwithstanding the occasional failure of our potato crop from disease, arising in a great measure from degeneracy, we have done little towards renovating the stock or experimentalizing on new tuberous roots, and yet there is a large field open. Now and then we hear of one or two trials by the French and others, but they are seldom followed up or persevered in. Many potato-like plants, producing edible tubers, exist in Peru, Mexico, and other parts of America, approaching very near to the common species, and only requiring culture to enlarge or improve them. There is the mendo, or wild sweet potato, and the crane and prairie potatoes of the North American Indians, the saa-ga-ban and musquash of the Mic Mac Indians of Nova Scotia and New Brunswick, the oca and milloco of Peru, the *Lathyrus tuberosus*, and many fine species of yams, which might be naturalised. How little, also, has yet been done in the foreign commerce of feculas and starches, so largely used in the arts, as well as for articles of diet, and for which, therefore, a considerable demand exists in England. Within the last year or two arrowroot and sago have figured more largely in our returns of imports, but their production is unlimited and of a most remunerative character, besides being attended with little expense in the manufacture.

Attention has recently been prominently directed to the means of procuring *supplies of vegetable fibre* as a substitute for hemp in the preparation of cloth and cordage, and for rags in the manufacture of paper. Population increases so rapidly that the demands for linen and cotton clothing, as wealth and civilisation progress, become most extensive, and the destructive waste is yearly very considerable. The demand for sails and cordage for the immense mercantile fleets of the different maritime nations is also considerable, besides the demand for sacking and bales, nets, &c. The consumption of paper for the general purposes of literature is so enormous that the ravenous maw of the printing press has, in many quarters, produced a scarcity of material bordering on famine. The subject of fibres was recently so ably and fully discussed before your Society, by Dr. Royle, that any further observations are scarcely called for.

I will, however, briefly allude to one or two substances which may, probably, be new. I believe there is no part of the world which produces so many plants capable of yielding serviceable fibre as the Indian Archipelago, including the Malay peninsula. The bark of several trees, such as the baru-baru—a species of Hibiscus—is used by the Malays for cordage, and the fibres of many smaller plants are applied to the same purpose. A correspondent of my own (Mr. W. C. Oondatje), an excellent botanist, in the interior of Ceylon, has called my attention to very many suitable plants indigenous to that island.

The Malay sempstress finds, in the plantain stem that grows beside her hut, an excellent and unlimited supply of thread. It is this last article that appears best adapted for an immediate supply of fibre in quantities sufficient to make it an important article of import to this country—for it possesses all the essential requisites of abundance, cheapness, and suitability.

There are numerous varieties of tropical and other plants whose barks and fibres are admirably adapted to sup-

ply not only the place of flax and hemp, but to form good and cheap substitutes for silk.

Manilla hemp and pita, the common pinguin, the Agave or American aloe, the anana or pine-apple fibre, and Bromelias, Indian hemp, jute, plantain fibre, the ochro, mahoe and other species of Hibiscus, the trumpet-tree or snake-wood, various specimens of Resteo in the Cape Colony; the Rheea and plants producing the China-grass cloth, New Zealand flax, and many others, furnish valuable materials applicable to our various textile manufactures, for paper-pulp and cordage. They can all be obtained in our colonies and dependencies, and can be imported so as to yield a large profit both to the producer and the home manufacturer, and yet at a price that will advantageously compete with hemp and flax.

Dr. Hunter, of Madras, has recently taken a very active interest in promoting the preparation of fibres of the plantain, aloe, pine apple, marool, and yucca. Within the last few years he has devoted special attention to experiments in the preparation of fibres of different plants as substitutes for flax. A flax dresser has pronounced the fibres of the marool to be superior to any flax, and the plantain fibre he sent home prepared, was stated to be worth 70*l*. per ton. He is having many of the indigenous fibres of the Madras presidency prepared with great care for use in imitation of silk, or fine linen, to sew ladies' collars, and for crotchet work, for which it is suited, as also for the manufacture of ornamental braid for lining carriages. It is a very silky material, of considerable strength, and far too valuable for the manufacture of string or tow, which was the first use it was put to. It takes dyes beautifully, and is much improved in appearance by attention to one or two little parts of the process of preparation.

The valuable qualities of the plantain fibre for the manufacture of several descriptions of textile fabrics for which flax, hemp, and even silk are now used, as well as cordage and paper, have led to many experiments in the construction of a suitable machine by which the fibre could be prepared in the most simple, cheap, and expeditious manner. These, hitherto, have always failed when brought into operation, owing partly to the peculiar nature of the substance to be acted upon, and partly to ignorance respecting its nature and qualities. The Hon. Francis Burke, the puisne judge of Montserrat, who has been conducting experiments for several years, has at last completed a small machine which perfectly cleans the fibre, and leaves a beautiful white, silky substance, resembling flax, only that it is three times the length of flax, capable of being manufactured into any description of textile fabric, from the finest cambric to the coarsest sail-cloth.

Persons who have witnessed the operations of the machine in the colony, declare that its simplicity of action, the ease with which it can be worked, the impossibility of its going wrong and injuring the fibre, and its extreme cheapness are surprising. A piece of the stem of the plant is held by one end in the hand, passed into the machine through the feeder, and being still retained in the hand, is drawn out again perfectly clean and white. It can be worked either by hand or any other motive power, according to size. A small hand machine, which will cost little over three guineas (irrespective of any patent right), will, with the assistance of a mere child to feed it, clean about 150 lbs. per day—and it is so portable (being contained in a box about 18 inches square), that it can be taken to the spot where the plantains grow; they may be cut down, prepared, and the fibre carried home in the evening ready for shipment.

The machine can be made on any scale—large enough to clean a ton a day if requisite. So small is the waste, that from 75 to 80 per cent. by weight of prepared fibre is procured from the plant, irrespective of its watery particles. And the waste substance, which comes from the interstices between the fibres, is a valuable pulp that requires only to be washed to fit it for manufacture into the finest writing paper. The pulp alone, it is estimated, will pay the cost of working, and the fibre produced will therefore be nett profit.

Mr. J. B. Sharp, a very intelligent gentleman on all that relates to fibrous products, has also recently patented important improvements in machinery, and is about to enter largely into the cultivation of the plantain in Jamaica, Demerara, and Montserrat, for the manufacture of fibres on the spot.

We know little of the available fibres of the vast valley of the Amazon, now laid open to commerce by steamers running from Brazil to Peru and the various tributary streams. We know nothing of the character of the thistles which form the chief vegetation of large districts of the Pampas of South America. We know nothing of the nature of the prairie grasses and reeds of North America, and we know little of the indigenous products of the fertile countries round the various states of Central Africa, recently discovered by Livingston, Overweg, and other African travellers. And why are we ignorant of the nature and value of all these products, so important to be ascertained? Because we have no City Trade Museum, no central repository for every raw product of nature in her several kingdoms. For this desideratum I have agitated and laboured assiduously; for this I have endeavoured to move public opinion by the press; * for this I have held an extensive correspondence with energetic and scientific men in various parts of the world; for this I have had interviews with Lord Mayors, civic functionaries, brokers, and merchants, most of whom have pooh-poohed the matter, and started frivolous objections, pointing to the British Museum, and the museums at Kew and at the India House as amply sufficient for the purpose. Glad, therefore, am I to find that this Society is slowly but steadily progressing in its exertions to establish a Trade Museum which shall be a credit to the nation, and the benefits of which to science and the arts it is impossible to overrate. I regretted, however, to notice that the valuable collection remaining over from the Great Exhibition of 1851 was being scattered through the country in gifts to provincial museums.

From the kittool or jaggery palm (*Caryota urens*) a very strong black fibre, like horse-hair, is obtained, about a yard long, which is made into ropes by the Singhalese for tying wild elephants and buffaloes. It is more durable in water than coir, and is well adapted for making brushes, baskets, caps, and other purposes for which horse-hair and bristles are used, and to which it is now being applied in this country.

The Nehinda plant of Ceylon (*Zanseviera zeylanica*) is well adapted to textile uses, possessing a long, white, silky, strong, and excellent fibre, equal to flax. Good paper might be manufactured from it.

The Muddar (*Calotropis gigantea*) has a very strong, short, silky fibre; the marsh-mallow, a longer and finer fibre, but deficient in strength—paper has been manufactured from this fibre. The inner bark of the Ceylon sack tree comes off entire, like a woven fabric, and is made into sacks, which are very durable; it might be used for making strong paper. The *Gnidia eriocephala* furnishes a very suitable fibre for paper manufacture. The natives of Ceylon make bagging with the inner bark. The *Ficus papyrifera*, as its specific name implies, is used by the Kandyans for manufacturing paper. One of my correspondents at Ceylon writes me, by the mail just arrived, that he has lately met there with a species of nettle allied to the China grass plant, and he is preparing some fibre therefrom, of which he proposes sending me a specimen.

Gums of different kinds enter largely into our commercial transactions, coming chiefly from Asia and Africa. Morocco, Alexandria, and the Arab coasts of the Red Sea are great gum marts. Our imports exceed 50,0000 cwt. per annum; about 30,000 cwts. are annually shipped from Indian ports—these are classified chiefly

* *Vide* leading articles in the *Journal of Commerce*, May 13, 1854, and in the *Globe*.

into gum-arabic, gum-senegal, gum-tragacanth, and copal and animi, which are resins, the classification or proper distinction being little attended to by shippers or importers. Besides the above, there is about 30,000 to 40,000 cwts. of lac dye and schellac imported from India.

In Morocco, about the middle of December the gum harvest commences, and the Arabs encamp on the borders of the forests to collect the gum from the various species of acacia-tree. It is packed in very large sacks of leather, and brought on the backs of bullocks and camels to certain ports, where it is sold to the French and English merchants. It is highly nutritious. During the whole time of harvest, of the journey, and of the fair, the Moors of the desert live almost entirely upon it; and experience proves that six ounces of gum are sufficient for the support of a man twenty-four hours.

It is stated that in the year 1750 one of the large Abyssinian caravans, having consumed all their provisions in the desert, when still two months' journey from Cairo, were obliged to support themselves solely on this gum, and thus above one thousand souls were preserved from death.

In Australia and the Cape Colony, where numberless species of acacia abound, a considerable quantity of gum might be collected.

A large trade in gums is carried on by Bombay merchants with the Somallies inhabiting the north-east point of Africa, who ship considerable quantities annually to the Red Sea and Indian markets, the average shipment in the season being about 1000 tons. Frankincense and myrrh are also obtained in Arabia Felix, about the shores of the Red Sea, and the Persian Gulf. One of the gum trees of Popayan, in South America, yields a resin so remarkably tenacious that when used to varnish ornamental work it resists the application of boiling water or even acids.

A wood oil, known as gurgun in the Indian bazaars, is obtained from a species of *Dipterocarpus* (*D. laevis*), which is of the consistence of honey. It has an odour like balsam of copaiba, and contains a principle analogous to that balsam, for which it is an efficacious substitute. The well-known gingilie oil is a good substitute for olive oil. A nearly colourless oil, obtained from the Ceylon oak, might be used as a drying oil; it is said to be a good remedy for the itch. An empyreumatic liquid resin, or wood oil, is obtained from the *Sethia indica*, and it is applied, like tar, to boats and canoes, as a preservative of the wood. It is much used in Southern India. The *Litsea sebcifera* furnishes a solid, pungent, and aromatic oil, like cubebs, which is fit for making candles. Kekune and Illepi oils yield inferior lamp oils. The latter, from the *Bassia latifolia*, forms an ingredient in the manufacture of Indian soap. From the Ceylon gamboge a fatty oil is obtained, soluble in turpentine, producing a golden yellow fluid. It is obtained in the proportion of 79 per cent., and is used by the Singhalese for culinary purposes. Cinnamon suet furnishes a solid aromatic oil, which is made into candles, used as lamp oil, and in cookery by the natives of Ceylon, and might probably be used in the manufacture of scented soap.

The *Semecarpus obovatum* furnishes abundantly a superior black varnish, equal to that of China or Japan, mixed with Vateria resin. It is soluble in turpentine, and free from acidity. The East Indian copal, from the *Vateria indica*, is very like the gum animi of our shops, is soluble in turpentine, and a very useful varnish for furniture and pictures. The wild nutmeg tree of the East produces a kind of dragon's blood; the red juice, which dries in transparent brittle flakes, might also be used as a beautiful varnish.

The extension of the electric telegraph wires over various seas and lands renders an available supply of gutta percha of the utmost value just now, and the discovery of new and abundant sources of this very important staple would develop a wide field for commerce.

There are no less than twenty-two plants already registered as productive of this resinous gum in India, mostly of the fig and Euphorbia tribes, and the Indian government have, I understand, engaged the services of a gentleman formerly employed as chemical examiner and analyist to the Gutta Percha Company, to examine into all the indigenous substitutes for this valuable gum. Many hundred maunds of the India rubber gum are obtained in the forests of Chardwan, in Assam, from the *Ficus elastica*, which extends over 10,000 square miles. *Urceola elastica*, a large creeper abounding in the Indian Archipelago, is another source of supply. The tree which yields it in Brazil is the *Siphonia elastica*. The imports of caoutchouc have gradually increased within the last five years, from 4,000 cwt. to 20,000 cwt.

All the milk-yielding plants furnish substances likely to prove of commercial value, especially the very common *Cactus cereus*. The various plants of the fig tribe will all yield a kind of gutta percha. The product varies, but that from the *Ficus Indica*, which is the best, is perfectly firm and hard, of a reddish-brown colour, and very plastic.

The *Euphorbia cattamundos*, and another species—plants which are common in India—supply a gum very analogous to gutta percha. The juice or sap of the muddar tree is also firm and white, and capable of answering any purpose to which gutta percha can be applied. The inspissated juices of the jack fruit, and the wild and cultivated bread fruit trees (*Artocarpus*), and the Lola tree of Ceylon, yield substances which could be used as substitutes for caoutchouc or gutta percha. The great question, however, to be decided is that of cost—namely, the producing price of the article. The true gutta percha ranges here just now from 1s. to 1s. 6d. per pound. The newspapers of Sinde speak of the gutta thoor, which, it is said, with care and attention, might be made to rival gutta percha.

The India rubber tree grows in great abundance in some parts of the province of Chiriqui, Costa Rica, and yet, notwithstanding its convenient locality near the Isthmus, and the great demand for the product both in the United States and Europe, little or nothing has been done to bring it into notice, or to make it available.

In Ceylon resinous gums could be obtained from the *Calophyllum Inophyllum*, the *Hebradendron Cambogoides*, the *Ficus politoria* and *Stalagmitis tinctorius*.

The *Asclepia gigantea*, which is common in Jamaica and many of the West India islands, abounds with a milky juice, which, as it gradually dries, becomes tough and hard, like gutta percha. It also produces an excellent fibre, useful in the place of hemp and flax, and the poorest land suffices for its growth.

Gutta percha has been discovered in the British province of Mergui; it is not precisely identical with the gutta percha of commerce, but it possesses all the valuable properties of that substance, including plasticity in hot water, and the power of insulating electric currents.

The *demand for vegetable oils* is largely on the increase, as our supplies of animal oils and fatty substances are declining. For food, for illuminating purposes, for lubricating machinery, for making soap and candles, and for the woollen manufactures, the consumption is now very considerable, and although supplies are derived from many new sources, yet there is no limit to the quantity to be obtained; and the animal and vegetable kingdoms can yet be laid largely under contribution for the wants of mankind. Leaving out of consideration here the well-known oils of commerce—cocoa-nut oil, palm oil, olive oil, and earth-nut oil—beginning with the castor oil, so useful for burning and as a medicine, and ending with the moringa, which serves to the distiller as a medium for extracting and preserving the perfume of flowers, the list of oil plants is innumerable. The oil or butter of the cacao seed is a production the surpassing qualities of which only require to be made known in Europe to supersede many other productions of the sort.

The stoppage of supplies of tallow from Russia has led to experiments on, and enquiries for, other materials. Mr.

Wilson, of the Belmont Works, Vauxhall, has patented certain improvements in treating a new vegetable tallow from Borneo, and nutmeg butter by powerful acids, and fitting the product for the manufacture of candles. And a patent has been taken out by a Liverpool merchant for making soap by means of tallow extracted from materials hitherto considered nearly worthless, and which can be obtained at one-sixth of the price paid for Russian tallow. The wax obtained from the berries of the candle berry myrtle is now occupying considerable attention at the Cape of Good Hope, where it can be obtained very cheap, and in large quantities. Varieties of the shrub abound in Carolina, New Brunswick, and other parts of North America, and in the Bahamas, and I recently directed attention to its cultivation and the manufacture of its product in the *Pharmaceutical Journal* (vol. xiii. p. 418).

A very large white pea is grown near Shanghae, in China, from which oil is extracted for burning; and the refuse is then made into a large cake, pressure being used to cause all the moisture to exude; this cake is used for manure, and for feeding cattle and swine. So extensively is this article used, and so great is the consumption, that the late Mr. Thom, then one of her Majesty's consuls, stated that from Shanghae alone 10 million dollars' worth is sent or distributed over China. This leguminous plant is called Teuss, and the marc or cake, tan-ping. Dr. Robert T. Thomson calls attention to another extensively used Chinese oil, named tea-oil, said to be produced from the seeds of species of the two genera *Thea* and *Camellia*, which oil is nearly unknown in Europe. It is, when fresh, quite free of smell, of a pale yellow tint, without any sediment when long kept. It resists a cold of 40° Fahr. Its density is 927. It is insoluble in alcohol; sparingly soluble in ether. It burns with a remarkably clear white flame. This oil might prove an important article of commerce in the East, because in its properties it is superior to cocoa-nut oil, and the various other oils prevalently used for burning, or as oleaginous condiments in Asiatic countries.

From the leaves of the Australian Eucalypti an oil can be procured of equal utility to the cajeput oil of the East. The Sandarac exuding from the Callitris or pine tree, the balsamic resin of the grass trees, and moreover the Eucalyptus gum, which could be gathered in boundless quantities in Australia, and which, for its astringent qualities, might at least supersede the use of kino or catechu, will probably, at a future period, form articles of import.

*The products of the forests* of the globe are very numerous, and have conferred inestimable blessings on the people; and yet how many of these products are as yet unknown and unappreciated. True we obtain from them timber for various building purposes, for turners' use and marquetry; fire-wood, charcoal, ashes, tanning and dye-woods, medicinal barks, nuts and seeds, grasses and reeds for mats.

The imports and consumption of foreign and colonial timber last year amounted to 2,276,000 loads, besides 111,003 loads of staves. To the forests we are further indebted for many adhesive and resinous gums, for our dietetic drinks, tea, coffee, and cocoa, for most of our species of oils and drugs, for the naval stores of tar, pitch, and turpentine, for lacs and varnishes, for many fibres and a host of other useful staples. Careful investigation by scientific enquirers, each in his particular locality, will yet bring to light much that is new—much that was heretofore unknown or overlooked in this department of commerce.

The collection of ornamental useful timber is inexhaustible, and hundreds of these might be applied to a thousand different purposes in many important branches of European industry. The list of woods is a voluminous one, with special peculiarities in each locality.

The guiacum, the logwood, the mammy sapota, the green-heart, the manchieneel, and many others would be found of high worth to the cabinet-maker.

I would call attention especially to the Catalpa, a beautiful tree, which has the twofold advantage of furnishing an excellent wood for household furniture and yielding a natural dye from the seeds, in which the tree abounds far more than in leaves.

I have before me a carefully-prepared list of nearly 100 of the timber trees of Ceylon, with their separate uses, and the variety of purposes to which they can be applied, prepared by Mr. Mendis, master-carpenter of the Royal Engineers Department in that island. And this is but a small portion of the forest vegetation of that beautiful island. My friend, Mr. John Capper, catalogued 416 varieties, and then admitted there might have been others which had not come under his notice.

The variegated or flowered satin-wood, most valuable for furniture, and the Jack tree, when well-selected and polished, very frequently equal good mahogany. The heart of the bastard ebony is occasionally met with of extraordinary beauty. Central America, the West India Islands, India, and the Eastern Archipelago, Australia, Van Diemen's Land, and New Zealand, are all rich in woods of various kinds, on which our merchants have yet drawn but slightly.

This is a most neglected department of commerce, and we greatly require special and general information in this extensive field. A spirit of investigation is on foot, which I trust will contribute shortly to this desired end. The Australian Society of Sydney recently offered its large gold medal for the best treatise on the woods of New South Wales and the adjacent colonies and islands, setting forth their localities and botanical description, and accompanied by specimens in their natural, manufactured, or polished state. Mr. Balfour, in charge of the Government Central Museum at Madras, has recently set on foot inquiries to enable him to draw up a report and description of the forests and woods of Southern India.

It is impossible to overrate the importance of the timber trade to a maritime and manufacturing country like Great Britain, and fortunately we are rendered thoroughly independent of foreign supplies by the immense quantities to be obtained in our North American provinces, India, and other British possessions.

Attention has recently been directed to the propagation in some of our colonies of the African argan tree, (*Argania sideroxylon*), which is especially recommended for Australia and some parts of the Cape Colony subject to drought. The kernels of the nut yield by expression a considerable quantity of oil, and the husks are greedily eaten by cattle. The wood, which is close and hard, is also useful for many domestic purposes. The tree bears fruit at from three to five years in Morocco.

The exchange of new and valuable plants is going on from time to time, and is likely to be attended with very beneficial results; the Guinea grass of the West Indies has been transplanted to Bermuda and other quarters, where it is highly valued for fodder; and the Tussac grass of the Falkland islands has been carried to many parts of America and to Scotland.

Thus Dr. Mueller, the Government botanist of Victoria, in his official report made at the close of last year, after a journey of several months into the interior, among other things pointed out that *Anistome glacialis*, a large-rooted umbelliferous plant, from the snowy top of Mount Buller, might be added with advantage to the culinary vegetables of the colder climates, and that the root of *Scorzonera Lawrencii*, a favourite food of the natives, would form, if enlarged by culture, an agreeable substitute for asparagus. The bark of *Tasmania aromatica* he also found to possess the medicinal properties of the Winter bark.

Such apparently unimportant things as rattans, malacca canes, cork, bast-matting, basket-work, straw plait, and palm leaves for hats and bonnets, form large items in our imports, and give extensive employment to industry. The value of the mats and matting we receive principally from Russia is about £40,000 per annum; of basket-

work, chiefly from France, and chip and straw plait, each about the same amount; corks, ready made, some £19,000 to £20,000.

Among the miscellaneous articles of industry in our colonies are mattrasses made from the husks of the Indian corn, from mosses, the down of the silk cotton tree; and there are also a variety of grasses admirably fitted for the purpose. A useful material was also, not long ago, brought into notice, originating in Prussia, being a kind of wool or cotton prepared from the leaves of the coniferous trees, and termed pine wool, which could be spun and twisted into carpets, horse-cloths, coverlets, &c.

A new kind of stuffing for sofas, beds, &c., was recently introduced into Sydney from Java. It is said to be a vegetable fibre produced by some grass, and resembles extremely fine cotton, except that it is more silky in appearance. It is stated to possess the very valuable qualities of never felting or getting into lumps, like common flocks; that it will not harbour any insects; and that it is not retentive of moisture. If, on future experiment, it is found to possess these qualities, it must prove a most valuable article of commerce, especially when the high price of horsehair and feathers is taken into consideration. A great amount of ingenuity has been expended to provide substitutes for these costly materials. Cocoanut fibre, cork shavings, steel springs—a peculiar black moss, that is gathered on the coast of Mexico, have all been tried with various success, but none of these would be able to compete with this new material, if it is procurable in any abundance and at a low price. This is probably the stuff obtained at the Feejee Islands, under the name of Ballambala.

The ordinary sugar packages of Mauritius and Bourbon are made of the leaves of the vacona palm.

The Ceylon moss (*Gracelaria lichenoides*) is very abundant on the lakes and shores of Ceylon, and is much used as a valuable vegetable jelly. It contains a large proportion of true starch.

Agar-agar, (probably the *Fucus tenax*,) is shipped from the settlements of the Straits of Singapore to the Chinese markets, to the extent of several thousand tons, being much used as a size for stiffening silks, and for making jellies. Iceland moss, carrageen or Irish rock moss, and other fuci, might enter more largely into commerce than they already do. Iodine, the orchil dye, seaweed for manure, and other preparations, attest the value of the marine vegetation, on which as yet but a small degree of attention has been bestowed.

The protracted civil war in China bids fair to restrict the cultivation and manufacture of tea, and to lessen the supplies for European commerce. Is it not, therefore, highly desirable to promote the culture of the plant in suitable localities, particularly those where Chinese labour and experience are readily available? Its culture and manufacture have been successfully prosecuted in India, Java, and Brazil; and the tea-plant has been introduced into Madeira, the United States, and California. Natal and Australia seem also to offer suitable localities.

How much remains to be done in the production of wines, brandy, cider, vinegar, shrub, cordials, essences, and liqueurs of all kinds from tropical juices and fruits. Aromatic wines, with lasting bouquets, might be used in abundance. Look at the fruits, with their luscious flavour, which are wasted; the pommerose, the pineapple, the guava, the mango, mammy-apple, limes, and oranges; whilst granadilla flowers, orange flowers, and the vanilla are there for perfume. Peach brandy is largely manufactured in the United States.

In twenty-four hours vinegar may be made from numerous tropical juices in abundance.

The production of alcohol might be greatly extended, if necessary. Rice, jaggery, and the palm juice, or toddy, in India, and the pulp of the beet-root, could be extensively applied to the production of spirit, which is largely in request for various tinctures, preserves, spirit-lamps, ether, in the chemical and pharmaceutical laboratories, for dissolving gums, preserving objects of natural history, and other purposes.

An excellent cider beverage may be obtained from the juice of the pine apple by fermentation. Old Ligon, the early historian of Barbados, writing two centuries ago, speaks in raptures of it: "The last and best sort of drink that this island or the world affords, is (says he) the incomparable wine of pines; and is certainly the nectar which the gods drinke, for on earth there is none like it; and that is made of the pine juyce of the fruite itself, without commixture of water or any other creature, having in itself a natural compound of all tastes excellent that the world can yield. This drink (he adds) is too pure to keep long; in three or four days it will be fine; 'tis made by pressing the fruit and strayning the liquor, and it is kept in bottles."

In Mexico, a most nourishing and refreshing beverage, known as *tepache*, is compounded of pine apple juice, parched corn, and sugar.

How little attention has been paid to the trade in succades. Sweetmeats and jellies, which by their lusciousness, purity, whiteness, and clearness, might surpass anything produced in Europe, could be sent from our colonies in large quantities at a most cheap rate. A new era ought to be opened up in confectionary from the West Indies—an art which seems to have been intended in particular for islands producing in luxurious abundance sugar and all the rich and palatable fruits susceptible of preparation—the pine apple, guava, mango, tamarinds, bananas, &c. Bordeaux, Marseilles, Spain, and Greece, have, be it remembered, established an immense trade for their dried fruits, and with sugar obtained at second hand. The manner in which a large trade in fruit can profitably be carried on, is shown in the commerce in oranges from the Azores and Portugal, in grapes, melons, peaches, and other delicate fruit from the continent, and in pine apples from the Bahamas and Coast of Africa. Dried fruits of various kinds might be experimentally tried from the colonies, and the Society of Arts has repeatedly endeavoured to stimulate colonists to experiments in this line.

How rich are many localities in *medicinal plants*, the useful properties of which are well known to the natives. Central and South America particularly abound in these, and Mr. Berthold Seeman, in his Flora of Panama, has recently given a long list of new ones worth trial by our pharmaceutists, which are recommended as febrifuges, purgatives, tonics, emetics, vulneraries, anti-syphilitics, antidotes, &c. The soil of tropical countries is almost overrun with those plants famous for different virtues. My correspondent in Ceylon writes me last mail: "I have lately been using the snake gourd *Trichosanthes palmata* and *T. cucumerina*, with much success as a febrifuge. I shall be glad to send you some of this herb together with my notes and remarks on it. I have just begun to subject to direct chemical experiment the indigenous plants of this island, with a view to ascertain their therapeutic effects."

By all civilised and commercial nations the *products of the sea* have been accounted fully as important as those of the land; because they not only afford cheap, nutritious, and abundant food to the people, but contribute largely, moreover, to the national resources, and to the maintenance of a maritime ascendancy. What a rich and inexhaustible source of wealth our home and colonial fisheries could be made if more generally engaged in, and conducted and managed on a proper system. Twelve years ago I called attention, in the "Colonial Magazine"* to the value of our colonial fisheries, and subsequently frequently returned to the subject.

A rapid glance at a few products of the fisheries may be possible. The United States have about 2500 vessels and boats, aggregating nearly 150,000 tons, employed in the cod and mackerel fisheries, and the value of their

* "Fisher's Colonial Magazine," vol. ii. pp. 89, 291; "Simmond's Colonial Magazine," vol. vi. p. 51; vol. ix, pp. 105, 471.

catch of fish exceeds one million sterling. The value of our North American fisheries is well known. On the coast of Scotland about 15,000 fishing boats, manned by 62,000 men are employed, and the catch of herrings on our coasts last year was very large, amounting to 908,801 barrels. Sixteen and a half million of herrings were also caught by the Dutch on their coasts last season. The catch of pilchards in the West of England averages about 24,000 hhds. in the season; and the pilchard being one of the fattest of fish, the oil obtained is a very valuable product of the fishery. The French pilchard fishery of the Loire gives employment to 3000 fishermen on the water, and a great many persons on shore in curing the fish. The coarse and impure kinds of fish oil are much used by fullers and curriers in the leather manufactures of Holland and the North of Germany, and are supposed to possess the power of dissolving and removing the gelatinous matter of the hide. Besides clarified lard oil the principal animal oils are whale and porpoise oil, and various fish oils. We all know the enhanced value which has been given to cod liver oil by its extensive prescription in cases of rheumatism, scrofula, and consumption. The oil is not procurable alone from the liver of the cod, but is obtainable in smaller quantities from the ling, the dorse, the torsk, the coal fish, the skate, the ray, and many other species of white fish, some of which, or individuals allied to them in genus and conformation, are to be found on almost every sea coast in the world. About one hogshead of fish oil is obtained from every hundred quintals of cod.

The application of steam to the extraction of oil from seal blubber would both increase the quantity and improve the quality. The present plan is to extract it, partly by compression, and then to boil down the blubber in large pans or cauldrons, by which much is wasted by volatilisation, and the rest deteriorated by becoming carbonised, or browned. The export of fish oils from Newfoundland averages nearly three million gallons.

The dugong or yungun—the sea-pig, as it is popularly called—is spoken of favourably in Australia for its commercial products. It yields a large quantity of remarkably pure, clear oil, about five or six gallons from each animal, and in fineness and hardness of grain, and specific gravity and appearance, its bone approaches nearly to the nature of ivory. It could be used as a substitute for that material for most of its purposes, and might be procured at Moreton Bay, Port Phillip, and other quarters, in considerable quantities for export. The blacks are very expert in harpooning them, and they are passionately fond of the flesh, preferring it to any other kind of food.

Sharks of several kinds are abundant in all tropical harbours, in the mouths of the larger streams, and in the adjacent ocean. Residents on or near the coast procure a good serviceable oil for their lamps from the fat and liver of the shark, but this oil has a most disagreeable smell, which, however, might be got rid of.

The liver of a large shark, twenty-eight feet long, and eighteen feet girth, recently caught on the American coast, filled ten barrels, and furnished a large quantity of valuable oil. The hunting of these ravenous sea-wolves has become quite an exciting and manly sport in many quarters, and is enthusiastically followed up. The fins, which fetch a good price in the China market, can be procured at a very moderate rate in New Zealand and the Indian Presidencies. One of the largest sharks I have seen mentioned was caught in Burmah in March last. It got stranded on a shoal, from which it could not extricate itself, and forty boatmen plunging into the water, attacked it with spears and other offensive weapons, and at length conquered it. The creature measured thirty-five feet, and afforded, by very imperfect cutting, 365 pounds of solid flesh, which the men dried, and took to Rangoon.

Dr. Buist, in a communication to the Zoological Society in 1851, stated that there were thirteen large boats with twelve men in each constantly employed in the shark fishery at Kurrachee. The value of the fins sent to market varied from 1,500*l.* to 1,800*l.*. One boat will sometimes take at a draught as many as 100 sharks of different sizes. The average capture of each boat probably amounts to about 3,000, so as to give the whole sharks killed at that one station, as not less than 40,000 a year. The Mhor, or great basking shark, which is frequently forty to sixty feet in length, has to be harpooned.

The back fins, the only ones used, are cut from the fish and dried on the sands in the sun; the flesh is cut off in long strips and salted for food, the liver is taken out and boiled down for oil, and the head, bones, and intestines, left on the shore to rot, or thrown into the sea, where numberless little sharks are on the watch to eat up the remains of their kindred. About twenty-six cwt. of fish maws, besides sharks' fins, are annually exported from Penang to China.

The dogfish is peculiarly rich in oil and very plentiful, and porpoise oil fetches a higher price than seal oil.

Then again we have in India the Pulla fish; surely something might be made of the rich oil which abounds in it.

In the Pacific a trade has sprung up at the Gallipagos and other islands in dried fish, which finds a ready sale at the ports of the continent. The fish is a species of rock cod, averaging about seven or eight pounds, exceedingly sweet and well flavoured, but different from the species of the same name in the Atlantic, being much shorter, but more fleshy.

Flounders are dried at Siam, and exported to all the eastern ports. There is also procured the best balachong, a composition of dried shrimps, pepper, salt, and seaweed, &c., beaten together to the consistency of a tough paste, then packed in jars for use and importation. It is much sought after by the Malays, but to an European palate is not very pleasing. About 500 tons of dried fish, principally from the independent states of Hindostan and the Maldive Islands, is imported into Ceylon for local consumption, and about 50 tons of trepang or beche de mer, the well-known esculent sea-slug, is supplied from Ceylon, annually, to China.

It strikes me that many fish might be dried and reduced to powder, as the larger conger eels are done which are shipped from Mount's Bay and the Devonshire coasts, and exported largely to Spain and Portugal, where this powder is used for enriching soup. Several savage nations possess the art of preparing fish in a great variety of ways even as a kind of flour, bread, &c. The modes of preserving fish are various; they are salted and dried, smoked and potted, baked or marinaded, preserved in oil, and pounded into a dry mass. Fish maws and sharks' fins are esteemed great delicacies by the Chinese, and form the chief ingredient of their mock-turtle soup. Dried shrimps are an extensive article of commerce in the Philippine Islands and the Eastern Seas. Some dried mullet were shown at the Great Exhibition from New Zealand, cured for the China market, which were sound, but not high-flavoured.

The cow-fish is a species of Manatus, found on the rivers and lakes of the Amazon valley, is killed by the natives for its oil, from 5 to 25 gallons being obtained from each, and the flesh is also eaten.

In many quarters turtle are found in large numbers. On the coasts and rivers of South America and in the Indian Archipelago they are very abundant. Soon after the fall of the waters of the Orinoco, which begins in February, millions of turtles deposit their eggs among the sand, and the Indians obtain a rich harvest of food. From the eggs they obtain a rich oil, termed mantega, which is preserved in pots. A good deal is sent down the Amazon, fully to the value of £2000, and several thousand persons are occupied in its preparation.

The eggs are not very large, about the size of a bantam's egg. The stratum of eggs in the sand is ascertained by a pole thrust in, the mean depth being about 3 feet, and the harvest of eggs is estimated like the produce of a well cultivated acre. An area accurately measured, of

120 feet long and 30 wide, having been known to yield 100 jars of oil. The eggs when collected are thrown into long troughs of water, and being broken and stirred with shovels, they remain exposed to the sun, till the yolk, the oily part, which swims on the surface, has time to inspissate; as fast as this oily part is collected on the surface of the water, it is taken off and boiled over a quick fire. This animal oil or tortoise grease, when prepared, is limpid, inodorous and scarcely yellow. It is used not merely to burn in lamps, but in dressing victuals, to which it imparts no disagreeable taste. It is not easy, however, to produce oil of turtle's eggs quite pure. It has generally a putrid smell, owing to the mixture of addled eggs. The total gathering of the three shores between the junction of the Orinoco with the Apure, where the collection of eggs is annually made, is 5000 jars, and it takes about 5000 eggs to furnish one jar of oil.

In some of the bays of the Bonin Islands, green turtle are so numerous that they quite hide the colour of the shore, and many are from 3 to 4 cwt. each.

The land tortoise is largely used for food, both fresh and salted in the Gallipagos Archipelago, and other islands of the Pacific, and a beautifully clear oil is prepared from the fat. They are eaten in Australia by the aborigines, and in Russia, the shores of the Mediterranean, and some parts of Germany are fattened for the table, and are esteemed a great delicacy.

In view of the use to which these turtle eggs are applied, could no commercial value be given to the large numbers of sea-fowl's eggs which are met with on our own rocky coasts, and distant islands and shores. Is there no way of preserving them for food, or applying them to the purposes of the arts. Spoiled and broken eggs find a ready sale here among bookbinders as a glaze. From an island a few miles from the Cape of Good Hope, about 250,000 eggs of the penguin and gull are collected every fortnight, and sold at Cape Town at a halfpenny each.

Excellent saddles, and beautiful boots and shoes have been made out of alligator skins, as pliant as calf skin, and beautifully mottled, like tortoiseshell. The skin of the porpoise has also been tanned in the cities of the St. Lawrence—and the hide of the walrus has been turned to profitable account by our North American neighbours.

The sponge trade is largely on the increase, and affords profitable employment to the fishermen of the Bahama islands, the shipments being to the amount of 12,000*l.* to 14,000*l.* in value per annum. It is only, however, the coarse descriptions of sponge that are obtained on the Bahama banks, and abundantly all about the coast of Florida. Sponge to the value of 5,000*l.* was gathered last year in the neighbourhood of Key West, Florida. The finest kinds come from the Mediterranean; but sponge could be procured in all the warm latitudes.

One person alone pays £15,000 a year for lobsters from Norway and Sweden; and from Bergen as many as 260,000 pairs have been exported in one year; and while we go thus far afield for this highly-prized shell-fish, they can be obtained in large quantities round the shores of our own island. From Skye and the Western Islands hundreds of tea-chests full are sent by rail to Liverpool, London, and the large manufacturing towns; and a report on the Irish fisheries tells us that 20,000 or 30,000 a week might easily be captured on about twenty miles of the coast of Clifden, Buffon Island, and Bunown. On the coasts of New Brunswick carts are frequently driven down to the beaches at low-water, and filled with lobsters left by the tide in the shallow pools, and they are used to manure the potato fields. Within a few years establishments have been founded to preserve the best parts of the lobsters for export in tin cases, of which 12,000 to 13,000 cases, and one or two tons of preserved salmon, are shipped by one establishment. The finest lobsters, caught in hoop nets, can be procured there at 2s. the hundred. Another firm, in the Bay of Chaleur purchases from the settlers the white part of the lobsters, free from shell, and salts them, and packs them in barrels, in plain pickle, for Quebec—sending off thus from 2,000 to 3,000 pounds at a time.

It is stated that 40,000 fishing vessels arrive annually from different parts of the coast of China, and remain three months, fishing off the island of Chusan. The "yellow mandarin" fishery is analogous to the herring fishery of Great Britain or of Holland. About £60,000 is invested in this trade. Ice boats attend the fishing vessels off Chusan, and as soon as the fish are caught they are packed in ice, and sent to the most distant parts of the empire.

The white fish of the bays and lakes of Canada is said to be the finest fish in the world. The flavour of it is incomparable, especially when split open and fried with eggs and crumbs of bread. They weigh on the average about two pounds each when cleaned, 100 of them filling a good-sized barrel. Those caught in Lake Huron are more highly-prized than any others. A huge maskalonge, so ravenous is its propensities, is often caught from the stern of a steamer in full sail, by throwing out a strong line with a small tin fish attached.

The quantity of fish cured in Upper Canada is about 100,000 barrels, worth about twenty shillings per barrel. Including the home consumption in both provinces the Canadian waters yield nearly £150,000 worth of fish every year, and might be made to yield tenfold that amount.

A marked peculiarity of most of the lake fish is the quantity of *fat*, resembling that of quadrupeds, which they contain, entirely different from the salt-water fish; while their flavour differs from that of the latter, it is much more delicate and whiter than that of river fish.

The siskawit, a fish of Lake Superior, is reported to be the fattest fish that swims either in fresh or salt water. The fishermen say that one of these fish, when hung by the tail in the hot sun of a summer's day, will melt and entirely disappear except the bones. In packing about fifty barrels last season at Isle Royale, one of the fishermen made two and a half barrels of oil from the heads and leaf fat alone, without the least injury to the marketableness of the fish. Besides this leaf fat the fat or oil is disseminated in a layer of fat and a layer of lean throughout the fish. They are too fat to be eaten fresh, and are put up for market like the Lake white fish and Mackinac trout—celebrated American delicacies.

The salmon is found in no other waters in such vast multitudes as are met in the rivers emptying into the Pacific. In California and Oregon the rivers are alive with them, and the fish ascend the rivers at all seasons, in numbers beyond all computation. The great number taken by the fishermen are but a drop from the bucket. Higher up on the coast side tribes of Indians use no other food. In the course of a few years salmon-fishing will extend to all the prominent rivers in that quarter of America. Catching and curing salmon will then have become a systematised business; the fish consumption will then have extended itself more generally over the State of California, and have probably become, in the meantime, an important article of export.

In the Sacramento river, California, about 2,000 to 3,000 salmon are taken daily, averaging 17lbs. weight each, and the fish sold at 1d. a pound. Large numbers are salted down daily, several firms and individuals being extensively engaged in this branch of the trade, and the fish business employs about 1,000 men in the Sacramento river alone.

In the New Brunswick rivers, on the Atlantic side, the old plan of salting the salmon in barrels is now nearly abandoned, and the more profitable one pursued of putting them up fresh in tins. This is a most important and valuable branch of trade, and is becoming more so every year. On the Labrador coast, about Sandwich and Esquimaux bays, the great salmon fisheries of the north commence. It is, observes Captain Cochrane, in a recent report to the Newfoundland Government, much to be regretted that so little is known to the public generally

of the available rivers and bays about those parts. I may mention, as a curious fact, that in 1852 a large establishment was made in an excellent harbour, where not a house had stood for near half a century, that is now catching 1,200 tierces of salmon, with a probable chance of doubling that amount. Such resources, it is desirable, should be found out and developed.

Myriads of sardines abound along the whole southern coast of California. The Bay of Monterey has especially become famous for its abundance of this small but valuable fish. It is a matter of surprise that the taking and preparation of this fish, which enters so largely into the commerce of the world, has never been attended to as a source of revenue and profit there, to supply the home demand, instead of importing, as is now done, some 8,000 or 9,000 cases.

Sea-shells form a considerable item of commerce, and might be much more introduced. Cowries for the purposes of money, are imported to the extent of, frequently, 25,000 cwt. in the year, to be diffused over the coasts of Africa and India, where they pass current. The shells suited for cameo cutting in this country and France are used to the number of several hundred thousand, which are worth £40,000 to £50,000. Mother-of-pearl shells to the extent of millions could be imported from the South Sea Islands and China Seas, and are always exceedingly valuable. I entered at some length into the importance of the trade in shells in a paper in the *Merchant's Magazine*, in February last.

The French and ourselves are large consumers of isinglass, the average imports into each country being about 50 tons; but the supply is not equal to the demand, and hence the price keeps high. Our principal supplies have come recently from Brazil. Isinglass was long regarded as obtainable only from the swimming-bladder of species of the sturgeon in Russia, but the hake, cod, and many other fish of India and America now furnish it, so that isinglass could be obtained at a much more reasonable rate than hitherto, and particularly from the sturgeon in North America, where the swimming bladder is absolutely wasted altogether.

Mr. Borden, of Texas, received a Council Medal at the Great Exhibition in 1851 for his meat biscuit, of which I have since heard little in a commercial point of view, although its value for supplying the troops of the allies in the Crimea would now be inestimable. There were very many species of concentrated and portable nutritious food, such as Du Liscoet's biscuit beef for soup, Warriner's osma zone, and others, which deserved more enduring attention than the evanescent notice which they appear to have received. The preservation of vegetable food is at many times of great importance.

The waste of the fisheries might be made a very profitable source of revenue as manure, and the subject has frequently occupied attention without leading to any definite result. About two-thirds, or one-half, of the cod and other fish caught in the Gulf of St. Lawrence, and on the banks of Newfoundland, is thrown away as waste or offal. The quantity of animal matter wasted from the seal fishery is estimated at nearly 100,000 tons, and from the Newfoundland cod-fishery at about 120,000 tons. A Mr. Pettitt has patented a plan by which this refuse might be converted to a portable manure of considerable value. He subjects the pulpy mass to the action of sulphuric acid, and afterwards dries it by dessication, or absorbs the fluidity by admixture with peat, charcoal, or other drying material. The French scientific agriculturalists have taken great pains to make fish manure available, by subjecting the refuse, or waste fish, to the action of steam, drawing off the oil and water, and after drying the compact mass, pulverizing it in mills.

The dry bones of seals, whales, &c., if burnt, to facilitate transport, would always be valuable as manure.

The carcases of beasts slaughtered for their skins, and then exposed to the action of steam, to extract the fat, have been occasionally exported as manure from South America.

When we see the value of the dead carcases of horses, and the numerous purposes to which offal is applied—that even rats are turned to advantage for their skins—we should not despise the most insignificant and apparently trivial things. The contractor for the dead carcases and offal of the city of New York is making a large fortune by the uses to which he turns all this apparent refuse of about 500 dead horses and cows, and two or three hundred cats and dogs per month. He converts all these into Prussian blue, glue, bone dust, and manure. The local trade in hair and feathers, again, in New York, is estimated at £600,000 per annum.

In the River Plate, cattle furnish a large amount of the staples of commerce, hides, horns, jerked beef, tallow, bones, and animal guano. The meat is cut into long thin strips, dragged through a vat of brine to cleanse it, salted for a day or two, and hung on poles in the sun to dry. When dried it is stacked up in regular hay-stack form, where it remains until exported as jerked beef. It is shipped principally to Cuba and Brazil as food for the slaves.

Mares by thousands are also killed at these butchering establishments, the skins are preserved, and the carcase is steamed to produce grease or fat. The very city of Buenos Ayres is lit with gas made from mare's grease. This whole region has been well described as one horse and hoof fair. Refined oil is now obtained from bones.

A large quantity of glue might be made abroad from the parings and cutting of hides, and all animal skins, the tendons and other offal of slaughter-houses, yielding an inferior quality. About fifteen tons of gelatine are imported annually from France.

Immense herds of buffaloes range the vast American prairies, extending from the Mississipi to the Missouri. Droves of them, reaching as far as the eye could see, and numbering several hundred thousands, were met with recently by the surveyors of the Pacific railroad. About 400,000 are supposed to be slaughtered annually. 150,000 buffalo robes are received at various fur stations, and 100,000 buffaloes are supposed to be killed by the Indians merely to obtain their skins for tent coverings. Of the remaining 150,000 some are diverted to the use of blankets, saddles, skin boots, &c. The flesh is entirely wasted. One steamer brought down to St. Louis recently from the Kansas river 4,000 packs of buffalo robes, valued at 32,000*l*. The average price of buffalo robes in the Western territories is about four dollars wholesale, and seven or eight retail. Very large black robes bring as high as ten dollars. From 800,000 to 1,000,000 buffaloes must die annually in India and the East, from the number of horns and tips brought to England from thence. From South America we import a million horns annually. From 18,000 to 20,000 elephants are killed annually to furnish the ivory used by the Sheffield manufacturers.

Biltong is a name given in the Cape Colony to strips of raw meat cut out of the hams, sirloins, or fleshy parts of cattle, antelopes, &c., sprinkled with salt, and dried in the sun.

At Galatz, on the Danube, the best kind of tallow is called chervice, and for the Turkish market it is worth ten per cent. more than ordinary tallow. It is the clear fat of the carcase and marrow boiled, and is much used at Constantinople for culinary purposes.

If we have glanced at the commercial products of the earth and the seas we should not omit altogether the *tenants of the air*, which, although, less important, are yet not undeserving of a passing notice. The trade and commerce in poultry and eggs is a considerable one, and I have elsewhere in a paper on the subject drawn attention to its growing importance.* From France we import annually about 110 millions of eggs, and 11,000 head of poultry, besides dressed feathers to the value of

* Lawson's Merchant's Magazine, Vol. 2, p. 855.

£6720. About 5000 bags of feathers are annually brought down the Mississipipi to New Orleans. A large trade is carried on in eggs between Canada and the United States, about 12,000 barrels being annually sent to one American town, Oswego. Game of various kinds, ortolans, quails, quills, ostrich feathers, swan down, eider down, feathers, flowers, and birds of Paradise, are other products of the feathered tribe. From Greenland 3,000 lbs. of eider-down are shipped annually, besides quantities from other quarters. In the East about four million swallows' nests, made of a glutinous sea-weed, and used for soups, are collected in Java and imported to China, where the best kinds fetch two dollars the ounce.

The passenger pigeon of America is a very large and well-flavoured variety, which migrates in millions, and seven tons of them have frequently been carried into the New York market by the Erie railroad in one day. In their breeding places herds of hogs are fed on the young pigeons, or squabs as they are termed, which are also melted down as a substitute for butter or lard. The felling of a single tree often produces 200 squabs, nearly as large as the old ones, and almost one mass of fat. When the flocks of full-grown pigeons enter a district, nets and guns are in requisition, and waggon loads of pigeons are poured into the towns, and sold at 6d. to 2s. the dozen. Why could not this large pigeon, whose migratory habits are principally caused by search for food, be introduced into this country, as a tame variety; or, by crossing with our native breeds, enlarge the size; or, in the same way as fresh mutton was sent from Australia, be shipped in casks, potted in their own fat, to supply us with cheap pigeon pies.

And the same with a cross with the large Texan rabbit, or the wild American turkey, the latter being far superior in size and appearance to its degenerate descendant—the tame turkey—being sometimes four feet in length, and five feet from wing to wing.

The canvas-back ducks of America are there boasted of exceedingly as a delicacy; yet, although a great variety of useless waterfowl have been introduced merely as ornaments for the ponds and streams of our gentry, no attempt has been made to bring this kind to our farm-yards and tables; and even if it was found impossible to have the pure breed, a cross with our own might be effected.

The albatross is easily caught in moderate weather by any kind of hook floated with a bait. They not only extend far north into the Pacific, but are found on the southern borders of the Indian Ocean, and occasionally far to the eastward. They have a large quantity of remarkably fine and soft down upon their bodies, nearly an inch in thickness. The prepared skins would, therefore, be very valuable, and, in connection with a sealing voyage, might, perhaps, be well worthy of attention. The sea-fowl generally furnish large quantities of feathers, which are seldom collected.

Great numbers of the guacharo (*Steatornis caripensis*), a curious nocturnal bird, about the size of a common fowl, inhabiting immense caves in some parts of South America, are slaughtered by the Indians for the great quantity of oil which is rendered by the fat of its body. The fat is melted in clay pots over a fire of brushwood. The butter or oil thus obtained is half liquid, transparent, inodorous, and so pure that it will keep a year without turning rancid.

*The products of the insect tribe* are well worthy of more extended attention—silk, especially, has been much neglected, but more attention is now being directed to it in India, in Malta, and in Natal. Cochineal, lac, cantharides, galls, honey, and beeswax are all articles of commercial importance. The beeswax of Ceylon, unlike that of Europe, contains no elements of acidity. Many of our colonies could furnish a large amount of honey and wax. Canada produces a fair supply, and a great deal is shipped from Cuba. It has been estimated that Scotland could maintain as many bees as would on an average produce eighty million quarts of honey and one million pounds of wax. Were this quantity tripled for England and Ireland, the produce of the empire would be two hundred and forty million quarts of honey, and three million pounds of wax annually, yielding a return of about £3,250 sterling.

*The mineralogical resources of our foreign possessions* is a department of science replete with interest and value, and glad am I to find so much investigation taking place in geological surveys, which are calculated to lead to valuable results and discoveries. Already we see that great attention has been paid to this subject in Jamaica and some of the other West India islands, in Natal and the Cape Colony, in India and the East, and in Australia. Valuable lodes of copper and lead, iron stone, lime stone, lithographic stone, slate, coal, &c., have thus been opened up to commerce. The importance of coal discoveries at distant stations, whether for domestic use or manufacturing purposes, cannot be overrated, and is more especially important now, when steam communication is fast taking the place of sailing vessels in coasting traffic, on the shores and rivers of India, Australia, California, and America.

Time will not permit me even to allude to the *chemical and pharmaceutical products*, many of which are entirely of recent origin, and some of which swell our commerce to an immense extent. We find uses for some 60,000 tons of pearl and potashes per annum. Montreal ships 30,000 or 40,000 barrels yearly, and New York nearly as much.

I have thus glanced cursorily over some few matters and products which appeared to me deserving of greater attention. The enumeration is necessarily circumscribed, and the descriptions brief and limited. Happy, however, shall I be if I have been able to point attention to any which may seem hopeful and promising to those who are in search of fresh supplies of a particular commodity. This Society, in its century of operations, has accomplished great good, not only by the discussions and investigations originated by its own members, the useful information it has diffused, the premiums it has annually offered and awarded for new products, or supplies of old staples from new fields; but also by the spirit of investigation and inquiry it has stimulated, and by the example of industrial exhibitions which it has originated, and which are spreading far and wide, not only throughout our colonies, but over foreign countries and distant possessions, where emulation is awakened, a kindly spirit of rivalry promoted, and the principle of the advantages of reciprocal trade, and scientific ideas and improvements, is becoming more thoroughly understood.

The second paper read was

## ON THE INFLUENCE OF CLIMATE ON PRODUCTION.

By A. G. Findlay, F.R.G.S.

I would suggest one view of the subject which has been discussed this evening, based upon natural causes, which, in the consideration of raw products, is not always kept prominent—that their *nature* is dependent on the physical and climatological conditions of their locality.

Viewed in this way we shall see that in certain corresponding portions of the globe there will be a similarity of animal and vegetable products resulting from these physical relations; and supposing that it be desirable or necessary to seek for an increased supply of any particular *class* of products, it may certainly be found in other localities, perhaps untried, corresponding to those from which it may have been previously derived.

It would be trite and unnecessary to go into the question of climatology, the phenomena of the evaporating trade winds causing the climates on the eastern sides of tropical countries to be very much more humid than the western, from their moisture being all deposited in their transit—that under the tropics there are two lines of rainless deserts around the globe—and that within the tropics, between lats. 10° and 20°, is a region of surpassing fertility on each side of the equator, while on the equator there is a constant state of humidity and extreme

heat. These facts will present themselves to most present. I would wish to apply these observations to the subject before us, vegetable and animal life being only those influenced by these causes.

To agriculture any artificial fertiliser is of the utmost importance. The *guano* products have been of enormous advantage. These deposits owe their excellence pre-eminently to the facts above quoted. Guano, by which is meant of good quality, has long been found in three districts which it will be seen lie exactly in the same geographical and physical relation; on the west side of the continent of South America, within the tropic, and near the tropic on the south-west coast of Africa, &c., and Sharks' bay, West Australia. All these deposits free from any deterioration from rain: in the first instance, they are protected therefrom by the Andes to the eastward, which, by intercepting one-half the atmospheric circulation, prevents the rain reaching the west coast. It may be confidently assumed that guano will not be found in any other part of the world. I would draw attention to a district which I believe is as yet almost commercially untried which might bring great benefit to agriculture and chemistry by the importation of native salts existing in enormous quantities. I refer to the Desert of Acatama, near the Pacific coast, between Chile and Bolivia. The existence of soda, either in the form of nitrate, carbonate, or sulphate in addition to the common muriate, on the surface of this vast arid tract is a singular fact, owing to the absence of rain. The enormous wealth of the adjacent silver and other mines developed since 1832, has eclipsed the value of these otherwise useful products. Numerous other mineral productions abound here, which perhaps the completion of the Panama railroad, expected at the present moment may bring more perfectly within the range of British enterprise.

There is a zone on either side of the Equator, or about latitude 20° which is singularly rich in the production of gum-bearing plants. Thus the French colonies of the Senegal have engrossed those regions which were formerly the great mart for the supply of British demand. Increase in the supply of these gums, so essential to the silk and many other manufactures is a great desideratum, and I would direct attention to those regions of Southern Africa, discovered and traversed by Mr. Galton, the Ovampo, and the northern portions of Damara Lands, and the regions just travelled over by Dr. Livingston, the outlet of which, it seems probable will be the noble but hitherto unexplored river Congo. A great portion of the trees and shrubs here produce gum, and this of course in great variety, among which many new species may exist. The region is in exact correspondence to the gum regions of N.W. Africa near the Senegal. The great difficulties in establishing this trade, and any other which beyond doubt will arise here, will be the formation of a currency, cattle being at present the chief means of barter, a mode which excludes small quantities. If a desire for European manufactured goods can be judiciously introduced, it will develope the immense resources of this hitherto unknown region.

Fibre and its production have been so amply discussed of late, that nothing can be added. One remark will suffice. The best cotton is grown on the eastern side of the continents, and at that part where the great tropical currents commence to flow in an opposite direction. The Sea Islands of the United States, the eastern provinces of Brazil, and the N.E. provinces of the Cape Colony are examples of this. The great field for future production is the N.E. coast of Australia, which lies in an analogous geographical and climatological position to these.

Oil-producing plants flourish in the equatorial regions, and no reasonable doubts can be entertained that the commerce is only limited by the stimulus which can be given to native labour by the inducement of European goods. The personal requirements are so few in these regions where food is so abundant, and raiment unnecessary, that there is a corresponding difficulty in acquiring what is produced by native labour—that which can only be employed. One among many easily-cultivated plants may be adduced—the *Arachis hypogea*, the African ground-nut. Large quantities of it are brought down the Gambia and Senegal, chiefly by French vessels, for the production of an excellent soap-making oil. The whole of the coast of Africa, from the parts named to beyond the Bight of Biaffra, would produce incalculable quantities of this useful vegetable. The country between the Bights and Loango may be a peculiarly advantageous field for this and similar commerce; a fact of which the French have recently availed themselves in the new establishment on the Gaboon River.

The capabilities of this portion of the world are almost dormant. The beautiful islands of the Bights of Africa, rich in countless products and fertility, are unknown to European commerce. St. Thomas, one of these, was the chief colonial possession of Portugal prior to the great advance of Brazil as a European colony,—now it does not contain a single white inhabitant. Fernando Po, another island of exuberant fertility, does not afford a single article of export. Yet all these parts not only would afford very many *new*, but almost any quantity of known articles of the raw produce of the tropics.

Many spices have been almost exclusively drawn from the Eastern Archipelago; it will be seen that these African islands lie in a similar physical position, and would add to the catalogue and quantities of many very valuable products of this nature. One great region for this class of products is the countries of the Somali and Hadramaut, at the eastern part of Africa, and South Arabia,—the latitude of the celebrated Philippines. In similar south latitudes there are archipelagoes, of the nature and extent of which, geographically, we are now only becoming acquainted: I allude to the islands of the Western Pacific, which are now beginning to attract attention.

The natural forests of many of the untried parts of the world would afford dye-woods and timber of every variety, in sufficient quantities to supersede those now in use; as for example,—the vast basins of the Amazon and Orinoco, a world in itself entirely unknown to the white man, except for its exuberant fertility, and its unexampled facilities for water conveyance.

This enumeration might be swelled into a long and tedious catalogue of unused resources, which the most moderate acquaintance with physical geography will determine, are at present quite ready for the hand of man to gather, when the changes of taste, or the insufficiency of existing supplies, shall render their acquisition profitable or necessary.

Again reverting to our first proposition—that certain classes of raw products will be found in particular localities, it is by no means intended to assert that this class *alone* will be found as a staple produce; nature seems to demand a rotation of products, and perhaps it is to this cause that the migrations of commerce, singular in their aspect, have arisen. The producing powers of a country have declined from the fact of but *one* article, in lieu of many, being cultivated.

The countries we have alluded to, being inter-tropical, are not adapted for white labour, and therefore commerce becomes an ethnographical question—one in which the requirements, natural or artificial, of their inhabitants, becomes the primary point. To draw from these countries the produce, dependant even upon slight labour, will require the inducement of European goods in barter, as has been before stated, and therefore the question of the foundation of new commerce will begin in this direction.

## DISCUSSION.

Professor Owen said he rose with great pleasure to express the gratification with which he had listened to the papers which had just been read, and also to express his high admiration at the manner in which Mr. Simmonds had compressed into so small a compass the results of so

extensive a field of inquiry and observation. He entirely concurred with him that mankind had at present availed itself of a very small proportion only of the benefits to be derived from the teeming fields of organic nature. It was true that that proportion afforded them almost everything they were in want of, either for the necessities, the comforts, or the luxuries of life; but that was only an evidence of the incalculable richness of the gifts of the Great Creator of organic nature. It was only, indeed, when they found from some circumstance, either obscure and unaccountable, like that which appeared to be annihilating the potato root in many countries, or from some changes in our political relations which threatened to cut off the supplies of some of those products, that they began to exercise a little ingenuity and thought, and became stimulated to look further into the rich field of raw materials. With regard to the potato root, for example, he supposed if any one had been acquainted with that root only in its native state, as seen growing scantily in the valleys of Mexico and South America, no ingenuity would have foreseen that it was a source from whence so immense a quantity of nutritious food could be derived, and it was one of the most marvellous circumstances in the development of that plant for human purposes to the extent it had been, when they considered that a poisonous nature was associated with its nutritious nature, but that human culture had diminished the first and increased the quantity of the latter. Perhaps the singular decline of that plant might be intended as a sort of rebuke to that spirit of contentment with what we have, and a stimulus to direct attention to some other specimens of tuberous plants to which the talented author of the paper had that evening called their attention. He entirely concurred with him, that there were many plants as little promising, whilst there were some far more promising, than was the potato when first discovered, which would amply repay the care, labour, skill, and attention of mankind. With respect to another raw material to which the author of the paper had referred,—isinglass, for example —he was much struck, when fulfilling the duties of Chairman of the Jury on Raw Materials from the Animal Kingdom at the Great Exhibition in 1851, to find that no specimens of isinglass were exhibited in the Canadian department. The finest and best specimens of that commodity were exhibited in the Russian department. Isinglass of an inferior description was seen in the Indian department, and amongst the produce of South America and the West Indies. The property of isinglass which made it most valuable for the refinement of fermented vinous liquors, was dependent upon the peculiar organisation of the fibre of the air-bladder, and was not connected with its chemical nature. The air-bladder of the sturgeon in particular contained that pure gelatinous material in the greatest quantity, and it was that peculiar characteristic and complex fibre which gave the material the power of catching the feculent matters, and performing all the offices required in the management of fermented vinous liquors. There were unquestionably other fishes which afforded that form of gelatine. Many such were to be found in the Ganges and the Indus, and in the fresh waters of the immense rivers of North America, but in none that he was acquainted with was that peculiar form of isinglass so fully developed as in the sturgeon species. Looking at the geographical relations with the organic products, he should have expected to find the sturgeon in the North American rivers, and, on inquiring of the chief of the Canadian department, he found that such was the fact, and that they were brought by the steamers to Quebec for food, but that the air-bladders were all thrown away. There was a source of wealth which he thought they ought to welcome. He believed the Canadian markets were capable of affording very large supplies of isinglass, and he had taken pains to arouse them upon the subject, and he had put the representatives of that department in communication with some of the largest isinglass merchants in London, and he hoped by this time attention had been awakened to the matter; for he was sure that when a cargo of isinglass from the air-bladder of the sturgeon arrived from our colonies in North America, it would meet with a pecuniary reward, which would be the best stimulus they could have. With reference to the introduction of animals as food—for instance, the delicacy of the canvas-back duck, that had called his mind to another fact, which was at present exciting a great deal of attention, and some degree of anxiety, too, in England. He referred to the development, which they all regretted, of a peculiar aquatic plant, which appeared to defy all mechanical modes of extirpation, and was spreading in our rivers and streams with fearful rapidity. Nature, however, had ordained a means of keeping a balance in this respect, that was, in the aquatic birds which fed upon those subaqueous plants. For that purpose he would recommend the more extensive introduction of the ordinary tame swan. He believed that beautiful and noble bird would thrive, breed, and fatten, and multiply to a large extent, helping in a very great measure to keep down these newly-introduced orders of aquatic plants. In fact, he had heard instances of the benefits in that respect arising from the operations of the swan; and, moreover, the delicate luxury of the young swan, which was introduced with all the epicurean honors at the civic feasts at Norwich, would be no longer confined to that body, but would become a readily obtainable delicacy for the table. But seeing that the canvas-back duck owed its delicate flavour to the proportion of aquatic plants on which it fed, the best chance they had of procuring it in the high perfection for which it was celebrated in North America, would be to try the experiment with those birds in their own rivers and streams, and such as were curious in those matters he would advise to put themselves in communication with his friend, Mr. Mitchell, the secretary of the Zoological Society, who he was sure would give them all the benefit which his practical experience could afford. There were other points of a more general nature which this paper suggested. It was the fact that there are vast tracts of land in our colonies which are as yet wholly uncultivated, but which were placed by Nature under circumstances to produce the most valuable vegetable products. He would only refer to the western coast of India, leading to the extremity of the cape of land near to which is the island of Ceylon. Let them consider the mountain range that extended along that coast. How extremely small a proportion of that part of India was as yet under any kind of profitable cultivation, and yet its valleys abounded with Coolie labourers, and it was from thence they were exported to Ceylon to work in the coffee plantations. This brought to his mind the remark of that talented and sagacious statesman, Lord John Russell, which he made when some crude proposals were broached as to the supply of a substitute for slave labour—"Carry," said his lordship, "the plantation to the Coolie, and not the Coolie to the plantation."

Mr. Varley said he could not go to the length which the learned professor had done in totally condemning the aquatic plant referred to, inasmuch, as from experiments he had made, he found it to act as an excellent filter and purifier of water. He felt bound to state that it possessed some redeeming qualities.

Mr. G. F. Wilson should be very glad if he could add anything to the mass of valuable information which Mr. Simmonds had brought forward. The unused valuable products with which he had some acquaintance were of the class of vegetable oils and tallows. He had made many inquiries respecting them in various parts of the world, and had heard of them as being produced in very great numbers and abundance. The Borneon vegetable tallow, which Mr. Simmonds mentioned, came to this country in considerable quantity when its value here was a third less than it was at present; the reduction in the supply was probably owing to the increased collection of

gutta percha, and the want of work people. The oil of the Argan tree of Morocco, of which he spoke, was a valuable one, even if it could not be obtained profitably from its present country; yet, thanks to the watchful care of Sir William Hooker, the tree would probably soon be naturalised in our own colonies. The profitable obtaining of seeds containing new oils and fats depended, of course, on the cost of collection and transit. In some of the forests of Central and South America, where these products are plentiful, the Indians have to be employed to procure them from a distance of often many days' journey from a station, and they must be paid beforehand. The money was too often spent in drink in the neighbourhood, and the collectors returned, saying that they had made the journey, but could not find any seed. He had a letter in his pocket which, he thought, well pictured the difficulties a collector in these countries had to contend with. His correspondent said—"If a trader wishes to get together a cargo of any product of the country, he must start up one of the rivers with a cargo of goods, which he distributes, as he goes along, to all the Indians who are disposed to work, marking the time of his returning to the same spot to receive payment, at three months, or six months, or perhaps twelve months. When he comes again he perhaps spends two or three months in seeking up his cargo—beating up the Indians at their 'Sitios,' dragging his boat up cataracts, and threading wearisome forest tracts. If, after all this, he succeeds in getting together half the quantity owing to him, he considers his success extraordinary. He must, of course, go the following year to the same place, and without a further advance he will not receive a single stick of what was owing to him. Thus it has happened that many persons who have come up the Rio Negro with a cargo of goods, intending to purchase 'generos' of the country, and return laden with them, have found it necessary to leave their goods and return empty-handed, while in the following year they come again to collect a modicum of their debt, and leave as much more on credit. They have thus no alternative but to go on, year by year, to the end of their days, and never possess a farthing they can call their own—their original cargo having been furnished on credit by some merchant in Para or the Barra." We have heard the same story from other sources. Many new oils were now coming in from India and elsewhere, and would come in in greatly increased quantities, but, owing to the difficulties above mentioned very many others could not be expected for some time to come.

Mr. Bennoch said he had hardly intended to trouble the meeting with any observations, because he felt himself incompetent to add anything to the interest of the papers which had been read; but as the reading of a good paper frequently led to some suggestions being made, perhaps it was well that those suggestions should be offered, although they might not strictly pertain to the subject matter of the paper itself. On the present occasion, there seemed to be mixed up with the subject a certain amount of public advantage with a feeling of political and patriotic sentiments; and the great consideration was, how they could best overcome the difficulties occasioned to our manufacturers by the cessation of the supplies of European products which they had been accustomed to receive. He had sometimes thought that, on occasions, nature came in and rebuked them for their indulgence and presumption. If they depended upon a particular root or staple, it was sometimes taken from them, and their indulgence was punished; but at the same time it stirred them up in another direction, and compelled them, by attention to the laws of nature, not only to supply the deficiency created, but to produce something for their benefit superior to that which they had lost. Two or three points in the very talented papers that had been read had struck him as being very peculiar, and one especially had excited in him a certain degree, he would say, of annoyance, and that was, the dispersion of the valuable collection of raw products from the Great Exhibition of 1851. He, for one, had expected that it would have been got together and exhibited in some position where the commercial interests of the country might view the various products of the earth without difficulty; but he discovered that they had been distributed throughout the different museums in the country, and would be looked upon as matters of curiosity, and not of utility, which was much to be lamented. He had hoped that this Society would have possessed sufficient influence with the Government to have induced them to have set up in some part of London an exhibition of matters so important to them as a commercial people. They all knew the difficulty there was, in shipping a cargo to a foreign country, to know what they should have back in return for their venture. Their seamen and captains of vessels were not generally personally acquainted with the raw products of the countries they were bound to; but in the event of such an exhibition having been established, the merchant himself could take those men who were to represent him at the antipodes, and show them the description of commodity which he wished them to bring back, and by that means England would be benefited, and the world at large would be advanced in its commercial institutions. They had discovered a hiatus which could only be supplied by such lectures as these, and their necessities became their great instructors. He felt very great diffidence in expressing his sentiments before that enlightened assembly, but he thought that these were points which it was very important to keep before them, when they discovered that by a chemical application to vegetable matters, they could produce tallow equal to that which they got from Russia at one-sixth the cost. That was an important fact, if there had been no other to engage them that evening.

Mr. Simmonds, on the part of Mr. Rowbotham, called attention to a stout description of fibre obtained from the kittool or jaggery palm of Ceylon, which he said was in every respect applicable for street-sweeping machinery, and other operations for which bristles had hitherto been used. About 20 tons of that material, he said, had either just arrived, or was shortly expected.

Mr. Sharp said, that in responding to the call of the Chairman, he should limit himself to a few observations on the question of fibrous plants,—not the least important of the various subjects introduced into Mr. Simmonds's able and comprehensive dissertation. It was a subject that had long occupied his anxious and earnest attention, and although reference had been made to numerous plants of the eastern world, he should restrict his remarks to the fibrous plants produced in the West Indies, to which he had more particularly directed his attention. It had afforded him much pleasure to place at the disposal of Mr. Simmonds, for illustration of that part of his subject, various plants received from his correspondent in Jamaica, which lay upon the table. The plantain, among them, was one of the most extensive and prolific growth, and he had not the slightest hesitation in saying that the colonies would produce everything necessary for the requirements of this country, whether for textile purposes, cordage, or paper,—for which latter purpose, especially in the present state of the trade, the fibre was of peculiar value, as producing paper of the finest quality. Referring only to the two colonies of Jamaica and British Guiana, he would declare his conviction that these two colonies alone could furnish fibres to the extent, if needful, of 100,000 tons a year. Was this a trifling consideration? It was well, on a subject of this nature, to examine the field that was open for such a new branch of industry. We have imported from foreign countries within the present century 2,250,000 tons of flax, and 1,500,000 tons of hemp, of the value of 140 millions sterling; of which upwards of 3,000,000 tons, of the value of 116 millions sterling, came from Russia. Our payments to that country for these two commodities, last year, was four millions, part of the eleven millions

which we paid her for the produce of her soil, whilst she took of our produce and manufactures only one-tenth of that amount, being less than £1,100,000. "Sir," said Mr. Sharp, "I am an old man; and more than seventy summers having passed over my head, you can readily comprehend that all the events of the French Revolution of the last century, and the wars in which for the succeeding twenty-five years we were engaged, are within my recollection. I well remember, and closely watched the state of affairs in the five years, 1809 to 1813, which succeeded to the promulgation of the celebrated Berlin and Milan decrees, when our continental trade was so much disturbed. I have looked into the value of flax and hemp during that period, and I find that the average price of flax for those five years was £98, and for hemp £82 per ton; the highest prices quoted having been respectively £142 and £118 per ton. I have perfectly in my recollection the extreme earnestness and anxiety with which the Government of that day ransacked the most remote quarters of the globe to find substitutes for the continental produce; and, if I am not much mistaken, the Society of Arts lent their best aid to the accomplishment of that object. It is time that the smuggling of Russian produce into this country through Prussian ports should be put an end to, and that the millions a-year paid to them for flax and hemp should be henceforth paid for the produce of our colonial possessions, which were well able to provide it."

Mr. Trent having made an observation, questioning the applicability of the plantain fibre to all the purposes for which flax and hemp were employed,

Mr. Sharp stated, in explanation, that his remarks were somewhat misconstrued; it was true that he had more particularly referred to the plantain, that tree being of the most extensive and prolific growth, and the specimens being before them on the table, but instead of limiting his remarks to that fibre, he could enumerate twenty or more fibres, of great value, all of them equal, many greatly superior in quality, to either flax or hemp. He repeated that 100,000 tons of them could be provided, and they were proved capable of being converted into various fabrics, as well as being mixed with cotton, silk, and even wool. It had been observed that he had patents for the requisite machinery to prepare these fibres. That was the fact; and arrangements were making for carrying out the question on a large scale; and he was resolved that it should be carried forward with all the energy and earnestness that he could throw into it.

Mr. Stewart said if, through the medium of this Society, or of Mr. Simmonds himself, a greater number of the curative agents he had mentioned could be obtained, he was happy to say, on the part of the Pharmaceutical Society, that the fullest investigation would be made of their medical properties.

The Chairman said it now became his duty to propose that the thanks of that meeting should be given to Mr. Simmonds for his very interesting and valuable paper, and also to Mr. Findlay for the supplemental paper read by Mr. Foster. He could not but express his opinion of the great value of the papers which had been read that evening, and if any subject was a proper one for this Society to take cognizance of, it must be that which had now occupied their attention, at a moment like the present, when every energy of the country was directed towards the finding of substitutes for materials which they had hitherto been accustomed to receive from other countries. If a discussion of this kind was important in the time of peace, how much was its importance enhanced in time of war. We were now more than ever dependent upon our colonies, and it was our duty to encourage the inhabitants of those countries, to supply us with the produce with which nature had so bountifully provided them. He could truly say that he never recollected hearing a paper read into which so much valuable information was compressed, or so many ideas thrown out so appropriately,—so tersely, and so eloquently. He could uot agree in the view expressed by Mr. Sharp as to the stopping altogether our supplies of Russian produce. He believed that the increased price which must necessarily be paid for such products, due to the peculiar manner in which they had to be obtained, would afford ample margin for encouragement to our colonies, and to foster their production there. It was, therefore, with very great pleasure that he called upon the meeting to join with him in cordially thanking Mr. Simmonds for his very able paper, and to Mr. Findlay, for the interesting additions he had made to it.

The motion was carried by acclamation.

The Secretary announced that at the meeting of Wednesday, the 6th instant, the following paper would be read:—"Fourth Paper on British Agriculture, with an account of his own operations at Tiptree-hall Farm," by Mr. J. J. Mechi.

## THE ROYAL SCOTTISH SOCIETY OF ARTS.

The annual general meeting of the Royal Scottish Society of Arts was held in their hall, 51 George-street, Edinburgh, on Monday, 13th November, 1854, Rev. Professor Kelland, A.M., President, in the chair.

The President opened the session with an address, in which he remarked that the duty of Societies is to make known, to encourage, or to educe. On these three points he entered at some length, remarking, in connection with the first, that from the character of the British Government, exercising so little central supervision, individual enterprise and ingenuity must trust to the practical value of their labours, and not to any State interference. Thus, without the assistance of a Society, the publication of the papers he had already mentioned, would, he thought, be a hazardous speculation. The Society are both publishers and public for the members. It is otherwise on the Continent. The deepest and most crabbed speculations are published in Germany, and find a sale, simply because the State compels public institutions to support them. The State wills that you be scientific, and scientific you are. With us, on the contrary, there is neither coaxing nor constraint; and though the result may be that the lighter bodies sometimes swim to the surface and catch the public eye, yet in the end the heavier bodies generally find their way down the stream too, and reach their landing place. Here it is that a Society like this comes in with its invaluable assistance. In connection with the second head he called attention to the fact that in the history of science and literature eminent names appear in clusters. The discoveries of one man excite the undeveloped talents of others. Intellects strike fire by their mutual friction. Thus it happens that posterity finds it difficult sometimes to assign to each man his exact share in every branch of discovery. Hence the value of societies for circulating information, and bringing minds to bear upon each other and on particular subjects. The native inertness of some minds needs to be overcome by the example of others. The quiet of the country, the absence of disturbing excitements, the freedom from cares, which at first sight seem conducive to a life of study, these are not in practice found to be the concomitants of high eminence. The men who do great things are those who vividly echo in every fibre the sentiment that "society expects every man shall do his duty." These facts (he said) indicate the true object and the value of an association for the encouragement of genius and the reward of exertion. They place its members in the proud position of men who are anxious to see their young brethren raised up to and above their own level—of men who strive to do something towards fulfilling the injunction, "care for others"—an injunction which may be said to be the touchstone of our humanity.

The following Report of the Prize Committee awarding

the prizes for Session 1853-54 was then read, and the prizes were delivered by the President to the successful candidates:—1. To Thomas Stevenson, Esq., F.R.S.E., Civil-Engineer, Edinburgh,—for his "Description and Drawings of Dipping and Apparent Lights for Sunk Reefs and Pier-heads of Harbours."—The Society's Gold Medal, value Ten Sovereigns. 2. To James Elliot, Esq., Teacher of Mathematics, Edinburgh,—for his "Mechanical Illustrations of the Planetary Motions," including an Illustration of his Theory of the Stability of Equilibrium of Saturn's Ring.—The Society's Silver Medal, value Ten Sovereigns. 3. To Robert Henry Bow, Esq., C.E., Edinburgh,—for his "Description of New Designs for Iron Roofs of great clear span," &c.; with Drawings.—The Society's Silver Medal, value Ten Sovereigns. 4. To William Swan, Esq., F.R.S.E., Teacher of Mathematics, Edinburgh,—for "Description of his Simple Variation Compass."—The Society's Medal, value Five Sovereigns. 5. To John Scott, Esq., Teacher of Mathematics, Edinburgh,—for his paper "On New properties and applications of Spiral Pumps, &c., with Models and Diagrams."—The Society's Silver Medal, value Five Sovereigns. 6. To Mr. George Mitchell, 101, High-street, Edinburgh,—for his Description of a "Safe Lock, incapable of being opened by any other means than by its own key."—The Society's Medal, value Five Sovereigns. 7. To the Rev. Jame Brodie, Monimail, Fife,—for his "Enquiry into the principles on which the action of Sails and Rudders depends, with Diagrams."—The Society's Silver Medal. 8. To J. T. Thompson, Esq., F.R.G.S., Civil-Engineer and Government Surveyor at Singapore,—for his Description and Drawing of a "Semi-Revolving Light for Lighthouses."—The Society's Silver Medal. 9. To Thomas Rodger, jun., Esq., St. Andrews,—for his Paper "On Collodion Calotype," with Illustrative Specimens.—The Society's Silver Medal. 10. To Alexander Melville Bell, Esq., Teacher of Elocution, Edinburgh,—for his Paper on a "New Principle of Stenography or Shorthand Writing."—The Society's Silver Medal. 11. To Mr. Thomas Steven, Builder, Bonnyrig, Lasswade,—for his Description of a "New Method of Shutting Doors," with a Model.—The Society's Silver Medal. The Committee has also recommended the Model to be purchased for the Museum.

The *Special Thanks* of the Society were given to the following gentlemen, viz.:—1. To Charles Cowan, Esq., M.P.,—for his oral "Sketch of the various changes and improvements which have taken place in the Manufacture of Paper during the last thirty years," with copious Illustrations. 2. To Andrew Fyfe, M.D., F.R.S.E., Professor of Chemistry, King's College, Aberdeen,—for his Communication "On the Chemical Constitution of Coal," and on the question, "Is Torbane Mineral a Coal?" 3. To George Buist, LL.D., Bombay,—for his oral "Account of some of the East India Arts and Manufactures, with Specimens of the Tools and Manufactured Articles." 4. To J. Stonehouse, M.D., London—for the "Description of his Charcoal Respirator, for breathing without danger infectious Atmospheres, with an account of his recent Researches into the Deodorizing and Disinfectant Properties of Charcoal." 5. To George Wilson, M.D., F.R.S.E., Lecturer on Chemistry, Edinburgh,—for his Communication "On the Prevalence of Colour-Blindness, or Chromato-Pseudopsis, and on the Limit which it puts to the Use of Coloured Signals on Railways, at Sea, and elsewhere," and "on the Use of Yellow Eye-Glasses, to assist the Vision of the Colour-Blind by Daylight." Dr. Wilson being engaged in making still further investigations on this subject, a further grant, not exceeding Ten Pounds, to assist in defraying the expense of the prosecution of his important researches, was made to him by the Committee till the investigations be completed. 6. To James Alexander, Esq., Wine Merchant, Edinburgh,—for his "Suggestions for a Simple System of Decimal Notation and Currency after the Portuguese Model." 7. To Mr. John Wilson, 47 Portugal-street, Glasgow,—for his "Description of a Method of preventing Water-cocks from bursting during Frost." The Committee regretted that there had been no communication read during the past Session to which it seemed proper to award the Keith Prize of Thirty Sovereigns.

After the close of the public business, the Society elected its office-bearers for 1854-55, as follows:—President—David Rhind, Esq., F.R.S.E. Vice-Presidents—Edward Sang, Esq.; William A. Smail, Esq., of Overmains, R.N. Secretary, James Todd, Esq., F.R.S.E., W.S., 55, Great King-street. Treasurer, John Scott Moncrief, Esq., Accountant, 20, India-street. Ordinary Councillors,—William Paterson, Esq., C.E.; Thomas Stevenson, Esq., F.R.S.E., C.E.; David Landale, Esq., M.E.; David Stevenson, Esq., F.R.S.E., M.I.C.E.; Robert Ritchie, Esq., C.E. A.I.C.E.; George Wilson, M.D., F.R.S.E.; William A. Roberts, M.D.; Rev. Professor Kelland, M.A.; William Swan, Esq., F.R.S.E.; H. W. Nachot, Ph. D.; James Elliott, Esq.; David Cousin, Esq. Editor of Transactions—George Wilson, M.D., F.R.S.E. Curator of Museum—Mr. Alexander Jamieson. Medalist—Mr. Alexander Kirkwood. Officer and Collector—Mr. Hugh Johnston.

## DEATH OF DR. EDWARD STOLLE.

The Berlin correspondent of the *Morning Chronicle*, under date of the 18th inst., announces the sudden death from cholera, at Munich, of this talented technologist. He had remained at Munich to wind up the affairs of the Prussian exhibitors, of whom he was the representative, when he was thus suddenly carried off in the prime of life. It will be remembered that in the year 1852 he received the Gold Medal of the Society, and in the following year the Thanks of the Society, for his papers on the manufacture of Sugar; one of which "On Recent Improvements in the Manufacture of Sugar from the Sugar Cane and Beet-root," was printed in No. 32 of this Journal, Vol. 1, page 389.

# Home Correspondence.

## OIL OF TAR.

Sir,—In confirmation of what Mr. Bethell advanced at the last meeting in reference *to the preservation of wood from dry rot*, my father and myself have used oil of tar for the last forty years, with the utmost success.

The external application (after scraping off all appearance of dry rot) has never failed in arresting the progress of the disease.

Yours obediently,
DAVID G. LAING,
Member.

2, Villiers-street, Strand.

## MEETINGS FOR THE ENSUING WEEK.

Mon. Entomological, 8.
Chemical, 8.
Tues. Horticultural, 3.
Linnæan, 8.
Civil Engineers, 8.—Mr. P. W. Barlow, "On the Water-bearing Strata in the neighbourhood of London."
Pathological, 8.
Wed. Society of Arts, 8.—Mr. J. J. Mechi, "Fourth Paper on British Agriculture, with the results of his own operations at Tiptree-hall Farm.'
Pharmaceutical, 8½.
Ethnological, 8½.
Thurs. Antiquaries, 8.
Photographic, 8.—Mr. J. Mayall, "On a New Albumenized Process on Glass."
Royal, 8½.
Fri. Astronomical, 8.
Philological, 8.
Sat. Royal Botanic, 3¾.
Medical, 8.

## ERRATA.

Page 29, col. 1, line 4, article on the Ventilation of Apartments and Hospitals, for "50 to 75 cubic centimetres," read "·50 to ·75 cubic metres. Col. 2, line 7, for "consumes," read "produces." Line 8, for "absorbed," read "generated." Page 30, col. 1, line 45, for "2,550," read "2,250." Line 48, for "1,982," read "1,928.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Nov. 24th*, 1854.]

*Dated 18th August*, 1854.

1815. F. C. Calvert, Manchester—Iron manufacture.

*Dated 22nd August*, 1854.

1839. T. Lees, Stockport—Lubricating steam-engines.

*Dated 7th October*, 1854.

2153. C. Blunt, Sydenham, and Dr. J. I. W. Watson, Wandsworth—Artificial fuel.

*Dated 18th October*, 1854.

2227. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury Preventing collisions on railways. (A communication.)

*Dated 21st October*, 1854.

2244. J. Bernard, Club-chambers, Regent street—Stitching machinery.

*Dated 30th October*, 1854.

2303. G. H. Lilie, De Beauvoir-grove, Kingsland—New material for paper.

*Dated 31st October*, 1854.

2313. C. Vorster, Cologne—Ribbons.

*Dated 2nd November*, 1854.

2327. C. Hargrove, Birmingham—Annealing cast iron.

*Dated 3rd November*, 1854.

2329. H. Walmsley and J. Day, Failsworth, near Manchester—Looms.

2331. C. L. V. Maurice, St. Etienne (Loire)—Carbonising coal.

2333. J. A. Moineau and J. G. Lemasson, Paris—Elastic mattresses and seats.

2335. J. Atherton and J. Kinlock, Preston—Dressing yarns.

*Dated 4th November*, 1854.

2337. G. L. Baxter, Sneinton—Reaping machines.

*Dated 6th November*, 1854.

2341. W. Collis, Barnes—Brewing.

2343. J. Betteley, Liverpool—Iron knees for ships' fastenings.

2345. J. Wallace, jun., Glasgow—Zincographic and lithographic printing.

2347. L. A. Farjon, Paris—Jointing pipes, tubes, &c.

*Dated 7th November*, 1854

2349. J. K. Worts, sen., and J. Worts, jun., Colchester, and J. Page, Langham—Motive power.

2351. C. S. H. Hartog, Islington—Fire arms and cartridges. (A communication.)

2353. A. P. How, Mark lane—Machine for cutting metal rods and bars. (A communication.)

2357. T. Metcalf, High-street, Camden-town—Portable carriages, chairs, &c.

2359. W. Beardmore, Deptford—Railway axle bearings.

*Dated 8th November*, 1854.

2361. G. Davis, Southampton—Taps.

2363. W. Stead, W. Spence, and S. Wood, Bradford—Combing machinery.

2365. J. Gray, Edinburgh—Ventilating hats.

2367. A. McDonald and A. McIntosh, Alexandria, N.B.—Machinery for stretching cloth to be printed on.

2369. A Dalgety, Deptford—Steam boilers.

2370. E. A. Chameroy, Paris—Junction of sheet metal pipes.

2371. G. Bartholemew, Linlithgow—Boots and shoes.

*Dated 9th November*, 1854.

2373. P. Pretsch, Sydenham—Producing copper and plates for printing.

2375. D. Ferrier, Edinburgh—Facilitating reference to books.

2376. F. Palling, Lambeth—Preventing horses running away.

2378. S. Show, Plaistow marshes—Template.

2380. G. T. Bousfield, 8 Sussex-place, Brixton—Machinery for turning prismatic forms. (A communication).

2381. D. Tunks, Accrington—Watches, clocks, chronometers, &c.

2382. H. W. Harman, Northfleet—Windlasses, capstans, crabs, cranes, &c.

2383. F. Smith, York-street, Lambeth—Smoke consuming furnace.

2384. G. Ross, Falcon-square—Articles of caoutchouc. (A communication.)

*Dated 10th November*, 1854.

2385. J. N. Gardener, Keir, near Dunblane—New material for paper and textile fabrics.

2386. W. L. Wigginton, Barnet—Cooking, heating, and ventilating apparatus.

2387. E. Loysel, Paris—Obtaining infusions.

2388. W. Jeakes, Great Russell-street—Heating and ventilating by gas.

2391. S. Ellen, Hackney—Machine for washing clothes.

2392. H. Witthoff, Manchester—Construction of ships.

2394. E. Rimmell, 39 Gerrard-street, Soho—Coating fabrics in substitution of india-rubber. (A communication.)

2395. F. Ransome, Ipswich—Oxides and carbonates of lead or zinc, and carbonate or sulphate of barytes.

*Dated 11th November*, 1854.

2396. W. Kolen, Birmingham—Ornamenting and attaching lables, cards, and window bills.

2397. R. Hesketh, Wimpole-street—Apparatus for supplying fuel to fire-places and stoves.

2398. J. Thomson, Dollar, Clockmaunder—Motive power.

2399. P. A. le Comte de Fontaine Moreau, 4 South-street, Finsbury—Fire-engines. (A communication.)

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2443. G. T. Bousfield, 8 Sussex place, Brixton—Wrought iron carriage and other wheels and pullies—17th November, 1854.

2444. W. Coulson, Fetter-lane—Machinery for morticing, tenoning, and boring—17th November, 1854.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed November 24th*, 1854.

1179. Julius Schmoock, Oxford-street—Improvements in the construction of children's and other carriages moved by manual power.

2027. James Robinson, Huddersfield—Improvements in apparatus for generating steam and gas, and consuming smoke.

*Sealed November 28th*, 1854.

1199. Andrieu Ernest Sablons, 4, South-street, Finsbury—Improvements in the construction of trunks, travelling boxes, portmanteaus, and other similar receptacles.

1199. Leopold Wertheimber, Paris—Improvements in apparatus for preventing sea sickness.

1200. Hall Colby, New York—Improvements in instruments for taking altitudes, levels, and angles, which he designates Colby's altimeter or self-adjusting quadrant or sextant.

1209. Julian Bernard, Club-chambers, Regent-street—Improvements in the manufacture or production of boots, shoes, and other protectors for the feet, and in the materials, machinery, or apparatus employed in such manufacture.

1214. John Arrowsmith, Bilston—Improvements in steam boilers.

1216. Walter Westrup, Old Ford—Improvements in the manufacture of wheat into flour.

1225. Edward Orange Wildman Whitehouse—Improvements in effecting telegraphic communications.

1239. John Mason and Louis Christian Keoffler, Rochdale—Improvements in scouring and in washing wool, hairs, and yarns, and in machinery or apparatus for effecting the same.

1247. Napoleon Neron, 119 Rue St. Lazare, Paris—Improvements in muskets, carbines, fowling-pieces, and other fire-arms.

1395. James Pickup, Liverpool—Improvements in steering apparatus.

1327. Louis Ambrose Henry, Metz—Improvements in constructing railroads.

1332. Joseph Valentin Weber, Orchard-street, St. Luke's—Improvements applicable to chronometers and other mechanism requiring a steady spring power.

1363. William Stableford, Bromsgrove—Improvements in railway brakes.

1341. Charles Cowper, 20 Southampton-buildings, Chancery-lane—Improvements in machinery for combing cotton, wool, flax, tow, silk-waste, and other fibrous substances.

1432. John Edwards, Manchester—Improvements in railway chairs.

1463. James Newman, Birmingham—Improvements in the manufacture of metallic rods, rails, and bars.

1686. Joseph Green and William Jackson, Leeds—Improvements in mortising machines.

1825. Nehemiah Brough, Birmingham—Improved dress fastening.

2019. William Henry Dawes, Handsworth—Improvement in the manufacture of iron.

2025. William Gee, Birmingham—Improvements in the manufacture of braces used for boring, driving screws, and other such like purposes.

2053. Samuel Elliott Hoskins, M.D., F.R.S., Guernsey—Improvement in the manufacture of paper.

2126. Thomas Cooper, Isle of Wight—Improvement in the manufacture and in the mode of joining earthenware pipes.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| Date of Registration. | No. in the Register. | Title. | Proprietors' Names. | Address |
|---|---|---|---|---|
| Nov. 27. | 3662 | Chaff-cutting Engine Frame .............. | Smith & Ashby .................. | Stamford, Lincolnshire. |
| | 3663 | The Alma Chess and Draught Board, Case, and Instructions.................. | James Grove .................. | 11, Icknield-st. West, Birmingham. |
| | 3664 | Settings for Centres of Buttons and similar Dress Ornaments ........... | Twigg & Silvester.............. | Powell-street, Birmingham. |

Journal of the Society of Arts.

*FRIDAY, DECEMBER* 8, 1854.

## FOURTH ORDINARY MEETING.

Wednesday, December 6, 1854.

The Fourth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 6th instant, J. B. Lawes, Esq., in the chair.

The following Candidates were balloted for, and duly elected:—

Colfox, William, B.A. | Hunt, Joseph.

The following Institution has been taken into Union since the last announcement:—

381. Rye, Mechanics' Institution.

The paper read was

## FOURTH PAPER ON BRITISH AGRICULTURE, WITH SOME ACCOUNT OF HIS OWN OPERATIONS AT TIPTREE HALL FARM.

By I. J. Mechi.

This is the fourth time I have had the honour to appear before our Society; but I offer no apology, because I believe that there is no question at the present moment so important to the national welfare, as the attempt to increase our supply of food by improved British Agriculture. The stomach brooks no delay; and, unless duly supplied, there is an end at once to art, science, commerce, and manufactures; honour and glory succumb to short commons. When this country was purely agricultural, and we exported corn, our anxiety was about clothing and manufactures; but now that mighty steam and scientific appliances have enabled our mechanical millions to envelope the world in cloth and calico, and now that this vast and increasing population has outstripped the limited acreage of our little island, the question of food enough by home-improvement, or by foreign supplies, has become one of vital import.

There is something of stern admonition in our present food position. With an abundant harvest, for which we have just returned grateful thanks, the price of corn is enormous. An abundant home-harvest is not now enough for the increased population; and, therefore, because some of our foreign supplies are cut off by accidental circumstances, Consols are depressed; confidence is withdrawn; circulation contracted; trade, commerce, and manufactures are paralyzed, with a prospect of much individual suffering and privation.

I venture to assert, from my own experience, that we could grow more than all the food that is required by the British people; but it must be done by investment and improvement.

The mere drainage of all the land that requires it would add millions of quarters of corn, and much additional meat to our present supply.

My own farm may be taken as an instance of greatly and amply increasing our food supply.

I therefore purpose this evening to lay before you my own agricultural balance-sheet, which is again highly satisfactory and remunerative, showing an advantage to me in rent and profit of about £750.

I shall glance at the progress of British agriculture, and enter into some details connected with its internal economy, thinking that such information may be a useful preparative for those who, like myself, hitherto engaged in other pursuits, may be disposed to divert some portion of their capital to agricultural practice and amendment.

I do not know anything more rational and more desirable than that the surplusage of our town and city profits should find useful employment on the land. It is much needed. The agricultural cry is always, "but where is the money to come from for these great improvements?" and therefore every landlord and tenant should rejoice at an increase of "apron-string" farmers and improvers, seeing that the inflowing of capital and intelligence diminishes rates and increases profits and comforts in a thousand various ways.

If I were to ask "Why so little town capital finds its way to agricultural improvement?" I should say, you have hitherto not held out to it the hand of invitation.

Great landed proprietors, with poor, unimproved and entailed estates, either from want of knowing that means for their improvement exist, or from a false delicacy as to borrowing the money, or from a disbelief or doubt of the improvements resulting profitably to themselves and their tenantry, have not generally availed themselves to any extent of the two or three existing companies which have the means and legal powers to effect every necessary amendment, even on strictly entailed estates.

I know a great many small landholders whose property and tenantry would be equally benefited by such investments.

In a national point of view, it would be highly desirable that some hundred millions of our surplus capital should be engaged in producing British food on British soil by British means and labour*—rather than that the cash boxes of our capitalists should be crammed with bonds and responsibilities from every foreign nation and foreign undertaking—to the very casting of Russian cannon to be used against our own troops. I could readily point out how one hundred millions could be at once *profitably* employed in agricultural amendment. But ere this can be done there is an immense amount of prejudice to be removed, and self-satisfaction to be disturbed.

This is not an age of impossibilities—on the contrary, steam, gas, railways, electric telegraphs, Britannia tubes, suspension bridges, and chemical discoveries, which were all once considered visionary, have become realities, working immense changes, and affecting largely the comforts and intelligence of our own country and of the whole world.

I venture then to predict that, in a comparatively short period, we shall see every farmery covered in with sufficient shelter for its stock, lighted with gas, its fixed steam-engine, economizing the costly labour of horses, and warming by its waste steam the various sheds. The food which the farm produces having done its office in the town will run back to restore the fertility which it had exhausted—our land will be drained and irrigated—the residences will be worthy of a more intelligent tenantry, possessing greater capital, and rejoicing in pianos and libraries. The waste and loss occasioned by misplaced buildings, bad roads, and queer-shaped fields, will be corrected by the facile sale or transfer and interchange caused by an easy legal registration.

It is a great point to provoke people to *talk* about such matters, causing first a little wonder, anger, disbelief, inquiry, and ultimate calculations and conviction.

Our British agriculture must progress with the other interests of the country. I often, on a summer's morning, before the business of London commences, take a reflective stroll, and ponder on our rapid increase of wealth and intelligence, as evidenced by our new and magnificent streets and buildings; queer old quaint buildings are swept away, and you see rising in their room business palaces, involving enormously increased rentals, and built of stone and iron, as if never to decay.

This is real economy where there is capital, and I naturally, on these occasions, wish that I had on either

* By companies, or by an improved law of partnership.

side of me the prejudiced defenders of our rotten and inefficient farmeries, exhibiting in their decay the rotten thatch and dripping eaves—the beau ideal of rustic landscape.

If we have capital in this country—and who can deny that we have it in superabundance?—let it avail to give to agriculture a higher and more dignified, more intelligent, and, consequently, a more profitable position. The clumsy appliances and prejudiced neglects of antiquated agricultural customs, are *not* profitable. The men who now suffer most in agriculture are precisely those whose ill-farmed, wooded, small, and undrained fields, and unimproved buildings, are slowly but surely absorbing the tenant's capital, binding him in poverty and discontent. It will be a happy day for the tenantry of this country when their rents are doubled, provided that increase represents a proper interest for necessary improvements. This takes place in our towns and cities—why not in our agriculture?

I do attach much importance to the application of our town sewage to agricultural fructification. It is going on rapidly in various quarters; and I have been delighted to find that my intelligent and calculating friend, Mr. Samuel Brooks, of Manchester, has placed at the disposal of the Managing Council of that city, the munificent sum of one thousand pounds, to be expended in prizes, or means to obtain the best mode of applying the sewage of that city to the fructification of the surrounding country.

My own experience in this matter, with two miles of pipe on my farm, convinces me that the engineering difficulties are perfectly insignificant, and that a nation which has passed its iron railways through every man's house and property, *nolens volens*, for a useful general purpose, will not be deterred from acting similarly in the great question of feeding the British people. We have local commissioners for superintending the drainage of our fens, and why not for irrigating with our town sewage?

I will not insult this meeting with details on so simple a question, for pumping and conveying manure is no other than diffusing water, every fractional detail of which is perfectly well understood, and can be at once readily calculated.

One thing is quite certain, that you must convince landlords and tenants that manure liquified is *better* and more available than *solid* manure; this it will take some time to do, and you must also convince engineers that they do not at all know at present the greediness of soil for manure, for if they did, a recent writer in your Journal would never have made the mistake of over-estimating some *thirty times*, the area that would appropriate the sewage of the metropolis.

Our excrement is literally our food, disagreeable and disgusting in form and smell, but unaltered in elementary value. Injurious to man, it is vitality to plants; and much of the luxuriant vegetables that grace our table, are a merere-embodiment of our own excreta. The time is gone by for false delicacy in these matters—we must entertain this great privy question. The Chinese would be starved, did they follow our example; but that wise people economise with rigid care that which they alone depend upon for the reproduction of their food. I am informed they do not, as we do, fatten cattle at a loss, with purchased food, to produce manure for the growth of corn.

In order to form some idea of the extent to which our food might be increased by the application of town sewage, let us consider that 300 sheep on a farm of 100 acres would keep it in a high state of fertility, and that, therefore, reckoning 450 men, women, and children, as equivalent to 300 sheep, our population would fertilize 500,000 additional acres.

I say nothing of dogs, cats, parrots, canary birds, and horses—they consume largely, each horse consuming the food of eight men; then you have enormous supplies of waste blood and offal, and a thousand other things that should add millions of quarters to your food.

The mere disintegration of your alkaline granites by the abrasion and trituration of traffic—the carbon, or smuts from your roofs, which is but too perceptible after a shower, are all sources of fertility.

Amongst the coming improvements in agriculture, is—

CULIVATION BY STEAM.

On public grounds, I expended some money in the construction of Mr. Romaine's machine. Our trials with it were only partially successful; we had too much velocity, and too little steam. The act of raising the soil must evidently be by a slow steady motion. Enough, however, was shown, to prove that cultivation by steam will soon be the order of the day: several parties are engaged upon it, and I have a strong impression that Mr. Usher's, of Edinburgh, will not be one of the least successful. I find there is one at work in Germany, of which a drawing lies on the table, for your inspection. I think Mr. Romaine's has an advantage, by the attachment of horse-power in the case of undulating surfaces; but I need hardly tell you, that it requires an immensity of time, and no small investment of capital, to bring new inventions to perfection.

The Royal Agricultural Society of England have very properly offered a premium of £200, which will no doubt develop many attempts.

When we consider that the farm horses consume the produce of nearly one-fourth of the arable land of the country, and when we calculate for how few hours daily they can be kept at work, the whole question is one of great importance to agriculture and to the nation.

I hope now that *Agricultural Statistics* are becoming acceptable, that we shall have comprehensive details of the number of acres undrained, and otherwise imperfectly farmed, amouut of steam power employed, number of acres under lease or annual tenure, customs of valuation to incoming tenants, extent of irrigation, number and position of cottage residences, and other details, necessary to form sound conclusions as to the present condition of British Agriculture.

As there are, no doubt, several in this meeting, who may hereafter desire to enter upon British Agriculture, I think it will be useful to lay bare its internal economy in a popular and simple form, unincumbered with tedious details. Farming, although a most agreeable occupation, is notoriously a slow business, attended with small profits.

Fortunately it is so, otherwise our towns and cities would be comparatively deserted.

Yet, how desirable it is, that the surplus profits of trade, commerce, and manufactures, should flow into the lap of poorer Ceres, to develope her powers and increase her riches.

One thing is quite certain, that if high farming is slow, unimproved farming is ruinous.

ARITHMETICAL ANALYSIS OF THE ECONOMY OF FARMING.

There is nothing more difficult than to obtain from farmers a statistical detail of the cost and return of the various branches of their occupation.

Comparatively few keep books—nor do they appear to have considered it necessary to investigate details. (By-the-by, I know a great many tradesmen who have much to revise in this respect.)

FARMING CAPITAL.

I may, perhaps, be permitted to say, generally, that to farm 400 acres of land you should have at least £5000, or £12 per acre: but if you are to carry out subterranean irrigation, and all the modern improvements, you will want £6000 to £7000, irrespective of landlords' improvements, for building, drainage, &c.

You will then be in a condition to avail yourself of opportunities to buy, when you see anything cheap, and to sell when things are dear. I assume that you have judgment and a thorough knowledge of your business in all its details; for, unless by yourself or others acting for

you, the most is made of everything, you must expect to lose your capital.

There always are, in every market, men of extraordinary powers, ready to absorb the injudicious or uninformed.

Look at my own live stock account—if five per cent. mistake were made in buying and selling it would derange my balance sheet to the extent of £250.

FARM PROFITS.

As a general rule, ten per cent. on the capital invested is considered a very good profit in farming. There are thousands who do not realise half of it; here and there a man of extraordinary powers and great personal economy accumulates a large fortune—but it is the exception, not the rule.

A return of four rents per acre is generally considered satisfactory—the average of the kingdom is, I think, less. In cases of improved farms it is sometimes five rents, or more.

The necessity for diminishing the fixed expence, by an increased produce, is illustrated by the statement of a first-rate North-country farmer, who says, that if he spends £1 per acre, or £600 a year for artificial manures he makes a profit; if he omits it he makes a loss.

If stock is too dear, or you are short of capital, plough in green and root crops—particularly on heavy land.

DISPOSAL OF CAPITAL.

As a general rule, your capital will be absorbed as follows:—

| | | | | |
|---|---|---|---|---|
| Valuation | £2 | 10 | 0 | |
| Live stock | 2 | 0 | 0 | to £6 |
| Implements | 1 | 0 | 0 | |
| Labour | 1 | 15 | 0 | to £2 5s |
| Seed | 0 | 10 | 0 | |
| Tradesmen's bills | 0 | 5 | 0 | |
| Rent | 1 | 10 | 0 | |
| Poor rates, tithes, &c. | 0 | 10 | 0 | |
| Artificial manure | 1 | 0 | 0 | |
| Farm horses | 1 | 0 | 0 | |
| Personal expenditure | | | | |
| | £12 | 0 | 0 | |

Farmers have generally the advantage of house rent free, although too many of our farmeries are entirely unfit for a tenant of capital and intelligence, who will seldom enter upon such occupations.

Supposing we take a farm of four hundred acres, on the four-course or mixed husbandry system, we shall find that one-half the farm produces nothing in the way of profit, but, on the contrary, leaves a considerable charge against, or upon the remaining half which is in corn. For instance, the horses consume one quarter of the farm, the sheep and cattle consume the other quarter; and you will find, if you give your live stock much oil-cake or corn, that the whole of the expences of one-half the farm have to be paid by the other half, which is in corn—and whether that corn is at 40s. or 80s. per quarter make a very serious difference to the occupier:—

EXAMPLE.

400 acres (minus fences, buildings, roads, and waste, for which the tenant always pays rent) really 380 acres.

50 acres in clover
30 acres in beans
20 acres in pasture
40 acres in tares, rye grass, &c.
50 acres in roots
100 acres in wheat
90 acres in barley and oats

380

It follows then that your 190 acres of corn have to pay two rents; two tythes; two rates; two manual labours; two seedings; two tradesmen's bills; and merely make a polite bow to the other half of the farm for the manure left by the consumption of its crops.

Now, it seems very ungracious, that when you have grown a splendid crop of turnips, at an expense of £7 to £10 the acre, the sheep are to consume it, leaving you nothing but the price of the hay and cake you gave them with it; but it is a system that cannot be avoided until you find some cheaper sources of manure.

The man who does not feed off his green crops, but attempts to steal extra crops of corn, soon impoverishes the land and himself too. All our most successful farmers are large purchasers of cake and artificial manure.

But if manure is so costly to produce, how important is it that not one drop or atom of it should be wasted! or allowed to run down the ditches and road-sides with every shower.

Amongst the evidences of enlightenment and improvement of the present day, is the introduction of covered homestalls or farm-yards, where the animals and manure are both sheltered from adverse weather.

This is one of the paying moves in agriculture.

But to return to live stock; a reference to my balance sheet will confirm what I have stated.

After paying for purchased food, shelter and attendance, the sheep and bullocks left a mere nothing for the cost of producing some seventy acres of fine roots and green crops. Owing to my system of managing live stock, I never have disease, but when I find Insurance Companies charging 20 per cent. for insuring animals, it is an evidence of ruinous mismanagement, and would form a charge on my farm of £200 per annum.

In pastoral and dairy and cheese districts, where a suitable soil and climate combine to produce a natural fertility, live stock may be reared, or sustained with advantage on the natural produce; and I believe in parts of Scotland the turnip is produced more cheaply and nutritiously than elsewhere, owing to the climate; but my remarks will apply to a great portion of this kingdom, especially where the rainfall is under twenty-six inches, and the climate dry and suitable for cereals—as on the Eastern and South Eastern coasts. In such districts, the retention of poor worthless pastures is a great mistake, and they should give way to a mixed husbandry.

On the subject of live stock, I once asked a Lincolnshire farmer, who consumed £500 worth of cake annually, how he charged it.—"Oh!" said he, "I charge half to the bullocks and half to the manure."

As a general rule, when we are buying sheep for fattening, we pay one penny per pound more for them than we could realise for the same weight when fat.

This is the penalty we have to pay to the breeder, who has to provide the bone and offal in the animal.

Breeding is not all profit, for it robs the corn side of the farm, unless much purchased food and manure is used to restore the balance; but to return to my 400 acre farm.

Now I have no doubt this statement will startle many a practical farmer, and will raise a storm of indignation amongst stock feeders and stock breeders, but the naked truth is best told, which is "that live stock are necessary evils, mere manufacturers of manure, and unattended with any direct profit."

That if you give them cake and hay while feeding off your turnips and green crops, the return for these green and root crops will be "nil," and their cost must be charged to the corn crops against the manure.

I am firm in this opinion, not only from my own extensive stock feeding, but from an extended observation, as well as by the undeniable proofs recorded by Mr. Lawes in the *Royal Agricultural Society's Journal.*

It is a want of this knowledge or belief that leads to so much vexation and disappointment.

I remember receiving an inquiry from a novice on farming how much the bullocks should leave for his roots and hay. I told him if he gave them much cake he would get nothing for his roots, and about two-thirds the marked value of his hay. He evidently was not prepared for

this, and suspected foul play. He has since retired from farming in disgust.

Another correspondent wrote to state he was about to prepare for the accommodation and feeding of a large number of pigs, as a matter of profit. I told him the only profit he would get would be the manure, which would cost him a loss of ten to twenty per cent., including attendance, casualties, &c.

Of course, he thanked me, and gave up all idea of making a fortune by pig feeding. The same remark applies with increased force to poultry, which should only be in sufficient number to consume the waste corn.

Now there is nothing loses so little as a pig, because he makes a quick return, and you get paid meat price for his skin, which is not the case with other animals; his offal is also valuable.

I find, with a very extensive practice, that with fine heavy barley at 30s. per quarter, and pork at 6d. per lb. net, pigs will "clear their teeth," or pay for their food, leaving attendance, housing, and casualties, as a charge against the manure. This agrees with the Suffolk saying that a bushel of barley, 56lbs., will make a stone of pork (8lbs.).

For fattening pigs nothing beats one-third pea-meal, two-thirds barley-meal, and some milk, if you have a dairy.

I am particular in enlarging and insisting on this important question in agriculture, because there is much mistaken opinion about it; and even the editor of the best Scotch agricultural periodical (*The North British Agriculturist*) will continue to assert that live stock will pay, irrespective of manure.

AGRICULTURAL VICISSITUDES.

Three years ago, when I had the honour of addressing you, wheat was at 38s. per quarter, and agriculture gloomy and desponding. Now wheat is at 78s. per quarter, with an abundant harvest, and agriculturists happy. Those who will refer to my predictions at that period will admit that I was a true prophet.

I will not detain this meeting with details, but will refer you to "Norfolk Agriculture," by Bacon, a most valuable book, where you will see many honest farming balance-sheets, exhibiting all the phases of agricultural prosperity and adversity. You will there see (page 99 and 100) a difference of £1000 between a "good year" and a "bad one."

It is precisely these strange agricultural vicissitudes that should teach us wisdom. They always have occurred, and they always will occur.

A wise agriculturist will therefore, when things are palmy, put by a little to meet future difficulties, and not invest his happy balance in enlarged holdings, which may hereafter be a dead weight and loss in times of difficulty.

On a farm of 400 acres of highly farmed arable land, the discrepancy in price between the two periods would be enormous. Take the 200 acres in grain, the difference would be something like £1500.

If I were to advise you, I would say never take a farm that is not thoroughly drained, more particularly if of heavy clay, the alternative is one of profit or ruin. I know so many estates where I see the tenant's capital wasting away under the evil influence of undrained clay, that it is quite a painful consideration. I am preprared to prove that if a tenant will pay his landlord 5s. per acre extra, or 5 per cent. on £5 per acre drainage, the gain will, in various ways, far exceed the charge.

I will illustrate this:—a tenant of mine, at the expiration of his lease, appealed for a reduction of rent. I declined acceding to it—I said if I reduce your rent 5s. per acre, that will be the whole amount of your gain; but if I drain your strong clay four feet deep, at an expense of £5 per acre, it will, particularly in wet untoward seasons, increase your crop from eight to twelve bushels per acre, or in money from 20s. to £4 per acre. I saw by a certain expression of countenance, that he doubted the benefits of deep drainage in strong soils, but he said, "suppose we try one field." Well, we did try one field, the drains poured forth their volumes of water after rain, the surface was dry and easy to work, and the crop succeeded where it had always before failed; this led to the drainage of other fields, and then came a covered yard or shed, on the same terms. The result appears already—a property more valuable to the landlord, and more marketable—more remunerative to the tenant—and certainly more useful to the country at large. The neighbouring farmers watched the operation, which I believe was not without its influence on their proceedings and sentiments.

The farm was a small one of thirty-two acres; I had previously removed a five acre wood, and sixty great oak pollards.

The covered yard with feeding places and conveniences, cost £105, with slated roof.

Formerly it was farmed at a loss—now it will be profitable. There is something very distressing in seeing men full of hope taking unimproved farms, and plunging into destruction; they are "booked" by the knowing ones on their first entrance, with a "ah, poor fellow, a very few years on that nasty soil will settle him."

I may be asked—why I attach so much importance to drainage? Why you might as well ask me, why I attach importance to circulation, vital or monetary? Stagnated water, or stagnated air, are as ruinous to the plants as they would be to our own vitality. Fix a cork in the drainage hole of your flower-pot, and you will soon have a practical illustration of my meaning.

The sallow and bilious plant (like many turnip crops I know of on undrained land) will shew by their expression what is denied to them in speech.

This is not the occasion to enter into a subterranean examination of gravity, capillary attraction, aeration, or filtration, much less of all those affectionate or repulsive inter- changes, that turn air, water, and earth, into food for man or beast; but be assured, circulation is vitality—stagnation death and ruin.

It has often been asked of me, by townsmen, "why so few farmers become bankrupt?" and they are apt to infer from this that it is a very profitable occupation. The law does not prevent it, because the mere purchase and sale of a sheep in a market constitutes him a trader.

Let me explain it: there are certain things of value *in* every farm which you cannot seize, and which will defy the powers of the most alert sheriff's officer. He cannot carry off the hoeings, ploughings, and drillings, vegetating seeds, juvenile plants, incorporated manures, and a score of other invisible things that constitute "a valuation," and which seldom amounts to less than two years' rent, or two pounds per acre—very often much more.

Farming is in England too much of a ready-money business. You walk into a market, and settle with the ready cash. But supposing you have a complaisant banker, there is no concealing the declining state of your exchequer; you cannot hide stacks in drawers, or make "dummy" bullocks and sheep; there is hardly a bumpkin in the village who cannot take your exact financial measure.

It is in vain that you plead, that the early disappearance of your stacks is because you want the straw.

No! the poor declining farmer has no chance of "making a pocket," or obtaining a bankrupt's allowance during the winding up of his affairs. The whole thing is simple and winds itself up—the unfortunate comes out pennyless, glad to take a bailiff's place at fifteen shillings to twenty shillings per week. I have been painfully reminded of the unprofitableness of farming, by the innumerable applications I have received for employment, from men who had farmed largely and deserved a better fate. I recently asked a valuer, how many farmers failed, and lost their capital—whether more than fifty out of one hundred did not do so? and he admitted that it was so.

I may be asked why is farming so unprofitable. I reply because it is unimproved, or because there is no valuation for improvements.

AGRICULTURAL POWER.

I lay down as a great axiom in agriculture, in the mere question of physical labour or power, independent of skill, that steam is cheaper than horse, and horse cheaper than man. A steam horse costs 1s. 6d. per day, and will do as much work as two real horses. A real horse costs 2s. per day (including harness, shoeing, etc.), and a farm labourer nearly the same. But as a good horse weighs 1600 lbs. and a man only 160 lbs. the power being as from eight or ten to one in favour of the horse, it follows that horse power is considerably the cheaper, probably (including the necessity for manual superintendence) as four to one.

This brings me to the fearful question—What portion of the acreage of this kingdom do farm horses consume? I answer, nearly one-fourth of all the arable land in the kingdom. In ordinary arable culture, where there is little permanent grass, it requires four farm horses to 100 acres. Each of these horses will consume on the average from five to six acres (landlord's measure, which includes hedges, roads, waste, farm buildings, &c.)

42 weeks . . . . 84 bushels oats
157 trusses hay, or $78\frac{1}{2}$ cwt.

10 summer weeks (no corn) will clear $2\frac{1}{2}$ acres clover.

This will be found to amount to 10s. per week, or £26 per annum, and will be the produce of about six acres at £4 10s., or four rents per acre. I speak, of course, of average land, rented at 20s. to 22s. 6d. per acre, ordinary farming. Many farmers give oats all the year round.

On very poor farming, like some I know of, ten acres would hardly keep a horse, whilst on very high farming (especially on the irrigation system), one or two acres would suffice. This brings us to consider the imperious necessity and advantage of forcing from the land its utmost possible development. If one acre will keep a horse there is only one rent, one tythe, one rate, one seeding, and so on; but all these are multiplied from five to ten times, by middling and bad farming.

Those who have watched the discrepant productions of three tons or fifty tons of green food per acre, can at once apply my observations.

But a great economy may be effected in horse-keep, by crushing the oats, cutting the green food, and mixing with it a proper proportion of straw, &c., instead of turning the horses out to trample down and defile their food.

On the whole, I think we may congratulate ourselves on a considerable advance; facility of intercourse and ventilation of the question by public meetings, remove, both on the part of landlord and tenant, many erroneous and antiquated prejudices.

In conclusion, permit me to state as a result of a very minute investigation of the facts, that there is ample scope for a noble future in our British agriculture; that the same principles apply to that as to all our other branches of national industry, that self-satisfaction and immovability are ruin, but that a rapid availment of science, capital, and amendment, is wealth and profit; even leaving out of consideration our higher duty as providers of the food and employment of the British people.

BALANCE SHEET.

| *Dr.* | £ s. d. | £ s. d. |
|---|---|---|
| To Valuation, 31st October, 1853— | | |
| Horses | 74 0 0 | |
| Pigs | 255 6 0 | |
| Sheep | 448 0 0 | |
| Cattle and Cows | 239 10 0 | |
| Implements | 390 12 0 | |
| Tillages, Hay, &c. | 471 18 9 | |
| | | £1879 6 9 |
| Rent of Chapel Land | | 45 0 0 |
| Tythes, Rates | | 75 0 0 |
| Labour, including Engineer, Bailiff, &c. | | 450 0 0 |
| Guano, Bones, & Superphosphate of Lime | | 100 0 0 |
| Seed-Corn and Seeds | | 50 0 0 |
| Live Stock bought | | 1619 0 6 |
| Corn and Cake for feeding purposes, Horses' keep, &c | | 1021 10 9 |
| Coals for Engine, Tradesmen's Bills, &c. | | 160 0 0 |
| Interest on Irrigation Pipes, $7\frac{1}{2}$ per cent. | | 55 0 0 |
| | | £5454 18 0 |
| My Improved Rent, 36s. per Acre | £240 0 0 | |
| Profit | 517 15 0 | |
| | | 757 15 0 |
| | | £6212 13 0 |

| *Cr.* | £ s. d. | £ s. d. |
|---|---|---|
| By Valuation, 31st October, 1854— | | |
| Horses | 140 0 0 | |
| Pigs, &c. | 131 14 0 | |
| Sheep | 555 2 0 | |
| Cattle and Cows | 189 10 0 | |
| Implements | 390 12 0 | |
| Tillages, Hay, &c. | 542 6 7 | |
| | | £1949 4 7 |
| Wheat, 4 Qrs. 6 Bu. ℔ Acre, 70s.—50a. | | 831 5 0 |
| Barley, 7 ,, ,, 35s.—16a. | | 196 0 0 |
| Beans, 5 ,, ,, —13a. | | 100 16 0 |
| Oats, 13 ,, ,, 28s.—12a. | | 218 8 0 |
| Produce of Cows and Poultry | | 50 0 0 |
| Hay Sold | | — — |
| Horse Work, Labour, Hay, Manure, &c. for Private Establishment | | 90 0 0 |
| Live Stock and Wool Sold | | 2576 19 5 |
| 200 tons of Mangel Wurzel, to be sold to London Cowkeepers, 20s. | | 200 0 0 |
| | | £6212 13 0 |

LIVE STOCK ACCOUNT.

| *Cr.* | £ s. d. |
|---|---|
| To Valuation, 1853 | 1016 16 0 |
| Corn, Cake, and Feeding Stuffs bought | 1021 10 9 |
| Live Stock bought (including 2 horses) | 1619 0 6 |
| | £3657 7 3 |

| *Dr.* | £ s. d. |
|---|---|
| By Valuation, 1854 | 1016 6 0 |
| Live Stock and Wool sold | 2576 19 5 |
| Loss independent of the Root and Green Crops consumed | 64 11 10 |
| | £3657 7 3 |

The quantity of green and root food consumed by the Stock is estimated as follows (this includes the keep of 6 farm horses):—

12 Acres of Mangel Wurzel.

6 Acres of Italian Rye Grass, well irrigated and five times cut or fed (a very heavy crop).

A good second growth of Clover, irrigated, about nine acres. A first growth on eight acres.

20 Acres of Tares and winter Oats.

16 Acres of good white Turnips and Swedes.

The Straw of the Farm.

5 Acres of Pasture.

Grinding Meal, Attendance, Interest for Shelter, &c., may be considered as a set-off against the Horse-keep.

## DISCUSSION.

Mr. Samuel Sidney said, that the Smithfield Club Dinner would detain, until a very late hour of the evening, Mr. J. Hudson, of Norfolk, Mr. Jonas Webb, of Cambridgeshire, Mr. Fisher Hobbs, of Essex, and other agricultural improvers of the first-class, who had been invited to attend and take part in the very important discussion which had been introduced in so amusing a manner by Mr. Mechi. Under these circumstances, as he (Mr. Sidney) had made it his pleasure and his business for some years past to visit and gather the opinions of the best farmers in almost every county from Yorkshire to Devonshire, he should venture, in the most friendly spirit, to criticise Mr. Mechi's statements and opinions. But before doing this, he must put himself right with the meeting, by informing them that he was not, and never had been, a political opponent of Mr. Mechi—that he agreed with the broad, general principles that he laid down, although, fortified by the experience and the experiments of some of the first farmers of the day, he dissented widely from his agricultural recommendations. In the first place, Mr. Mechi had not done justice to the improving spirit of the farmers of England, by implication rather than by direct assertion. By his silence, in a paper on "British Agriculture," as to all doings except his own, he had led that *un*agricultural assembly to believe that an active improving agriculture was only to be found in his little farm in Essex. This was not the case. There was no doubt that well-drained land—appropriate farm-buildings—the best implements the agricultural mechanic could produce—a steam engine, fixed or locomotive—stock of good quality—the use of artificial manures and artificial food, were essential to developing to the utmost the food-producing capabilities of the kingdom. This every modern farmer acknowledged. Why, as to drainage it was no new thing; it had been practised in Essex and Norfolk years ago, as could be confirmed by a Norfolk farmer now at his side, of forty years' experience. For many years the "Journal of the Royal Agricultural Society," and the discussions at Farmers' Clubs, had been directed to the subject; and wherever he went, whether for farming or for hunting, he found the ground drained, or in process of being drained, by landowners and tenants, without reference to proceedings at Tiptree. Four or five draining companies were fully occupied; the Government Draining Loan was eagerly taken up from North to South; there was no show of supineness. The same remark applied to farm buildings. In Lincolnshire, in Norfolk, in Bedfordshire, and in Essex, excellent farm buildings had long existed. They were being erected in every county of England. In Devonshire, the Duke of Bedford was doing great things; in Herefordshire and Worcestershire improved buildings had been erected by Mr. Oakley, who was in the room; and by Mr. Beadel, in Essex; while the buildings in Bedfordshire left nothing to be desired. But none of these buildings were on the model, or planned on the principles, of Mr. Mechi's. As to steam-engines, they were not new; in Scotland they were as common as barns; and long before Mr. Mechi erected his, their construction was an established branch of trade with half-a-dozen agricultural implement makers. The enormous, the constantly increasing, demand for the most improved implements by real farmers, showed that our agriculturists were awake and up to the spirit of the times. As to stock, he preferred Mr. Mechi's advice to his example. He had seen his stock, and compared it with that he saw tied up feeding on Lincolnshire and Bedfordshire farms, and he must say the comparison was not to the advantage of Mr. Mechi's system. They had heard something of the amount of meat sold off Mr. Mechi's farm; why he could tell those who now looked into farming details for the first time, of Mr. Hudson's farm of 2000 acres, where, besides enormous corn crops, he sent off to the London market 10 fat bullocks and from 200 to 250 fat sheep every week, from January to July, where the bill for oil cake was 600*l*. or more, and this on the same which in 1822 would only carry in the year two hundred farm beasts and two hundred and fifty sheep. The owner of that farm had been farming more than thirty years, and had been improving every year of that time. He could tell them, too, of a farm in Bedfordshire where on no remarkable soil a thousand sheep and lambs and a hundred and fifty bullocks were sent off to market out of nine hundred acres; and these were specimens of modern and successful farming principles, which for many years had been making constantly-increasing progress without any reference or benefit from the little farm in Essex. He made these observations in justice to a most deserving, industrious, intelligent body of men, who were doing their duty in their calling. It was unfair to compare farmers to shopkeepers and manufacturers. The profits of a farmer were limited to one return in the year,—his occupation required his personal attention. In an hour the inhabitants of a town could receive all the advantages of such meetings as those of the Society of Arts. The farmer, from his local position, was deprived of the same benefit of discussion, comparison, and competition to be obtained by a town population. The value of land must always be limited by the extent of its markets. But he maintained confidently that the progress of agriculture had kept pace with the improved means of communication. On Mr. Mechi's balance-sheet he did not mean to make any remarks, although on a fitting occasion it might give rise to many inquiries. He hoped that Mr. Mechi would every year report to that Society the results of his many experiments, and give it the benefit of his shrewd and wily observations. But a balance-sheet, whether of a farm or a railway, was not the sort of thing to be discussed with any advantage by a public meeting. Mr. Mechi had been very unfairly worried into producing it, but he might now with a good grace discontinue it; especially as a favourable or unfavourable balance proved nothing on an experimental farm. At present prices every kind of industrious cultivation paid, or ought to pay. In conclusion, he would say a few words on the only subjects in Mr. Mechi's paper which raised any disputed points—steam digging and liquid *versus* solid manure. Steam digging might be dismissed in a sentence—it had nothing to do with British agriculture—it was a mere theory, very proper for the investigation of mechanics, but no working digger had yet been produced. So far the plough was the best instrument, and the efforts of agricultural reformers would be most usefully directed to inducing our farmers in dark districts to adopt the improved iron ploughs of Howard and of Ransome, instead of their clumsy wooden affairs, without waiting for the invention of a steam digger. As to the liquid manure, there were, no doubt, circumstances under which it might be used with great advantage, but the balance of evidence was against its exclusive employment for every kind of crop. The use of it was twofold, mechanical and chemical. Solid long straw manure was invaluable as a disintegrator of heavy clays. It had another advantage: when once laid in the soil, the labour was done; thenceforth it gradually and surely gave forth its fertility to every crop. But the crops of a farm were, at any rate, of three kinds: root crops, corn crops, and grass crops. The whole balance of experiments tried in every part of England showed that liquid manure was not more advantageous or economical, and sometimes positively injurious to root crops. To corn crops it was positively injurious, stimulating the straw at the expense of the ear, and washing away the soil from the roots. On grass crops the results, when applied in sufficient quantities, and at proper times, were very satisfactory, especially on the perennial Italian Rye-grass. It would depend on circumstances whether green crops should be the chief object of cultivation. But, at any rate, young farmers must pause before they altered the whole economy of their farm, went to enormous expense in iron pipes, hose, labourers, and coal for pumping, and incurred the difficulty of building great tanks for a manure available for only one kind of crop

At present the whole current of opinion was towards covered homesteads and feeding in boxes, for the purpose of producing solid concentrated manure. That plan was rapidly superseding open yards, and that was the very reverse of tanks, pipes, pumps, and squirts. The most effectual application of liquid manure he had ever seen was in the Water Meadows of Ersmoor, where a stream, carried through the farm-yard of Mr. Robert Smith, was impregnated with a dung heap, and on rainy days eighty acres were flooded in an hour. By this means land not worth 2s. was made worth 40s. a year, but that depended on local peculiarities, as to form of land and flow of water. He (Mr. Sidney) deprecated the hasty adoption of the enormous expenses attendant on applying liquid manure to farms where dairy produce was not the principal object. As to town sewage, that was quite a different question ; it would, he hoped, be shortly discussed separately at the Society of Arts. He would not enter into any elaborate details as to the sewage question, which had been exhausted in a recent paper by Mr. Way, the consulting chemist of the Royal Agricultural Society. Sewage manure was not night soil—it was a very weak solution, the solid matter floating in 1,400 times its weight in water. Night-soil was largely used by our market gardeners, who brought it back from towns in their carts when they sold their vegetables. London manure could be sent down the Medway to Kent for 1s. 6d. a ton. But the Chinese plan of collecting soil from house to house would not pay here. There wages were a penny, here they were 3s. a-day. For his part he said, let those who could use town sewage and nightsoil, but do not let the towns wait for a profit from nuisances, when farmers can more cheaply send thousands of miles for guano. In conclusion, he begged to thank Mr. Mechi for having opened so important a subject as British Agriculture, and to recommend those who were inclined to commence the study not to be satisfied with books and lectures, but to visit our best counties. From long acquaintance with farmers he would promise them a hospitable reception from a body of men not inferior, having regard to their opportunities, in intelligence and enterprise to any class of men in the kingdom.

Mr. Moore spoke in favour of the application of the sewage of towns to the purposes of agriculture, and gave his opinion that it was perfectly practicable to be carried out.

Mr. Oakley said, he was not aware that he should be called upon to express his own views upon this subject, but having been invited to do so, he would say, in the first place, he thought the farmers of this country had a great deal to thank Mr. Mechi for—not only for the good he had accomplished, and the money he had spent in effecting improvements, but also for having pointed out to the agriculturist the shoals and breakers which he should steer clear of. From what had fallen in the course of this discussion, it appeared to him that the principal question was that of economy in the application of manure, and he thought there was no matter more worthy the attention of the farmer than that. As far as his own experience went, he would say the best economy of manure, and the cheapest way to make it available and profitable was to make it under cover, and to keep the rain of heaven from it, in order that the real manure might go into the land in that state; and if that was done, the manure so used had been proved to have a stronger fertilising power than manure made in the open air. Believing that to be the case, he had adopted the system of box feeding, which he first saw in practice on the farm of Mr. Beadel, in Essex. He saw the system in operation there, and took an opportunity to introduce what he considered some improvements, and those persons who had adopted the plan had thanked him over and over again for having called their attention to it, and had acknowledged the great advantages resulting from it. He was happy to tell them that it had been proved beyond doubt that the same area of land, covered with buildings—be they stables, barns, cattle-sheds, or piggeries—could be closed under one roof at less expense than upon the old plan, leaving as much stable and yard room as under the old system. If that were so the landlord was benefited by the buildings costing him less; and he was, moreover, benefited, because the tenant would thrive better upon the manure which he made. He could not sit down without again expressing how much they were indebted to Mr. Mechi for the public way in which he had come forward; and he (Mr. Oakley) would assert, without fear of contradiction, that the agricultural world would unite in acknowledging that it was greatly indebted to Mr. Mechi for the ingenuous manner in which all his communications had been made. One word with regard to the balance-sheet. He agreed with Mr. Sidney that the production of figures before an assembly was of very little avail; it was of little use to show a credit of so much to Michaelmas 1853, inasmuch as figures might be made to look well on paper. At the same time he (Mr. Oakley) was quite satisfied that it was not the intention of Mr. Sidney to cast any imputation on the accuracy of the balance-sheet any more than they would discredit any of the other statements which Mr. Mechi had so ably laid before them.

Mr. Davis said he concurred in the adage that "Blessed is the man that makes two blades of grass to grow where only one grew before;" and he thought Mr. Mechi had very materially contributed towards making not only two blades, but four blades of grass to grow where only one grew before. With reference to the cultivation of Italian rye grass, Mr. Sidney had referred to the opinion of Mr. Skirving, that the most preferable form of manure for that crop was guano mixed with water; but Mr. Sidney had not told them the proportions of each, though any one who knew anything of the subject would admit that the quantity of water must be very large. Mr. Sidney appeared to laugh at the introduction of steam-engines for the purposes of agriculture. (Mr. Sidney—No, no.) He spoke of the expense of steam-power. (No, no.) He (Mr. Davis) maintained that by no system could irrigation be so effectually carried out as by means of pipes, and the steam-engine, as introduced by Mr. Kennedy, of Ayr, except where they had water-power adequate for the purpose. The cost of steam-power was, in his opinion, infinitesimal as compared with its value in farming operations. He had the statistics of an experiment upon a small scale in Scotland. There were 15 acres of Italian rye grass sown in 1853, and 25 acres sown in 1854, also 15 acres of ordinary grass. The latter was very badly treated, inasmuch as there was not a sufficiency of liquid manure either for that or the Italian rye grass, owing to the tanks not being completed, so as to save the sewage of the winter of 1853. The Italian rye grass of 1854 was sown between the 17th April and 1st of May, and yielded four good cuttings. There were also four cuttings from the ordinary grass, and four from the Italian rye grass, sown in 1853. Upon these 55 acres of grass there were put on, 8th of May 1854, twenty-five cattle, all sold by the end of September; on the 18th of May, twenty cattle, and on the 22nd of June, eleven cattle, all sold by the end of October; and sixty-eight cattle, rising two-years old, which had been put out between the 26th of June and the 19th of July, were on hand at the end of October. He would mention that the cattle were fed in covered yards, and out of 124 cattle, 260 sheep, and 15 pigs, put on between the 24th of April and the 11th of October, not one case of death occurred, and practical farmers who heard that would say it was very good. These fifty-five acres fed at the rate of two head of cattle and five sheep per acre, and that was in a poor county, where, in general, they would be glad to fatten one beast upon two or three acres of land. As to the profit, without laying a balance sheet before them, he would give them the figures. The net profit, after deducting all expenses for labour, horsework, interest on outlay for buildings and machinery, wear and

tear, interest of money on stock, cost of cake and corn, and all other charges, was 4*l.* 6*s.* 10¾*d.* per acre, or, on fifty-five acres, 238*l.* 19*s.* 4*d.*, that was the result of the application of capital and skill upon very bad land. He had been induced to make this statement in consequence of what had been said as to there being no profit got out of feeding cattle upon rye grass. They need not go to foreign countries for guano, when they had enough at home of excellent quality if they would only put it upon their land, but as to watering-carts and hand-barrows they were child's play. It was like asking the cotton manufacturers to take up the distaff again. (Hear, hear.) He looked upon the steam engine and the pipes as the spinning-jenny and the self-acting mule of agriculture. As Mr. Mechi has justly remarked, it was circulation they wanted. As long as they stayed at home hugging their own notions, they thought themselves very clever, but when they went abroad they very soon found there were others more clever than themselves. Why, a manufacturer in Manchester would not hesitate to go to Switzerland, if he found out that some one there could dye cloth a better red than he could produce it, but it was difficult to get the farmer to go into the next town. No; he would stop at home—his father was a farmer before him, and therefore, he ought to know a good deal about it. (Laughter.) He felt convinced that if farmers would think and consider, they would learn a great deal more abroad than they did by staying at home. With respect to Mr. Mechi, he (Mr. Davis) begged to add his testimony, that there was no one to whom the farmers of this country were more indebted than to that gentleman. He had endeavoured to make farming a trade, and he was happy to say it had become a trade instead of a mere vehicle for the exercise of political influence. He would say in conclusion—give the farmer a good tenure of his land—let the landlord effect the permanent improvements which the tenant ought not to be subjected to, and then they would have meat cheaper and corn cheaper; the people would be happier and the nation at large more contented.

Mr. James Caird had no intention of obtruding himself upon the meeting, and would have been happy to have given way to such gentlemen as Mr. Hudson and Mr. Fisher Hobbs, had they been present. He had very little to say upon the subject further than that he agreed with, he believed, every one present, in acknowledging that all Mr. Mechi's exertions had been productive of great advantages; and on every occasion he had told them the result of his experience, whether favourable or otherwise, with the greatest candour. He agreed with Mr. Oakley that Mr. Mechi's experience had been of that description which had guided others from the shoals which he himself had encountered; and they were therefore not the less indebted to him for his friendly warning. He thought there was some little misapprehension, but no real difference, between Mr. Mechi and Mr. Sidney. The latter gentleman had given a correct history of the improved methods of agriculture which were now in operation throughout the country; but Mr. Mechi had come forward to speak of his own experience, and not the experience of others. It was no slur upon that gentleman that he did not tell them what other eminent men had done. He would ask any practical man present whether the instance which Mr. Sidney had given of sending from a farm in Norfolk 10 fat bullocks and 250 fat sheep per week into the market was not an exception? Would any one say it was the rule? But the observations both of Mr. Sidney and Mr. Mechi tended to the same direction of progress, and they were equally indebted to both gentlemen for this expression of their opinion. There was, in reality, no difference of opinion; but merely in the way in which they had stated it. With regard to liquid manure, he agreed with Mr. Sidney, it was a question of profit to each individual farmer. Some would doubtless find Mr. Mechi's plan most advantageous, whilst others, differently situated in matters which must come into the calculation, might find the application of solid manure the most advisable. It was a question which must be decided by the peculiarities of each case.

Mr. Morton wished to say a word or two on one or two of the points to which Mr. Mechi had referred; and also on the value of his example generally to the progress of British Agriculture. There were no two more important points in the whole range of agricultural subjects than the economy of labour, on the one hand, which Mr. Mechi touched upon when saying that one quarter of the arable produce of this country was consumed by farm horses, and on the other, the profitableness of feeding stock, which he denied. Now he (Mr. Morton) was quite sure that the agricultural experience of the northern half of the island was against Mr. Mechi on both these points. Horses did not consume one-fourth of the arable produce of North Britain; nor were sheep and cattle necessary evils on the arable land of Scotland. They were necessary there as they were here, but they were profitable there, whether they were here or not. On the question of home labour, he might say that there were, last year, on the 250,000 arable acres of Roxburghshire and Haddington, 9,400 horses—a pair to every 54 acres; while over the 1,630,000 arable acres of Norfolk and Hunts there were 73,000 horses, or a pair to every 44 acres. Now it did not need 5½ acres in the South of England to feed a horse, and he was quite sure it did not need 6¾ acres in the Lothians to feed a horse. The question of horse labour was a most important one, whether in a strictly agricultural or a national point of view; but he believed Mr. Mechi's statement exceeded what was in itself, without exaggeration, a sufficiently startling truth. How far the horse population of this country might be diminished by a skilful arrangement and economising of labour—for *that* was the great merit of Scottish agriculture—would be obvious to every one who studied the agriculture of the two countries; and notwithstanding that it was rather in the diminished employment of *manual* labour that the agriculture of Scotland differed from that of England, yet to say that the farm horse consumes a quarter of the food his labour produces was an exaggeration in both North and South, which he would be inclined to put at nearly once and-a-half the truth in England, and as nearly twice the truth in Scotland. Then, as to the practice of feeding stock for the sake of the manure, he believed that his experience would pretty nearly bear out what Mr. Mechi said was his own; but, notwithstanding that, he should not venture to found upon it a general assertion, in the expectation that it would apply with truth to the whole of the country. He found that during four years, with £1,500 worth of stock a-year, he sold more fat beef, mutton, and bacon, than he bought of cattle, sheep, and pigs, and food and attendance, by £160 a-year—this then was the sum he received for the green food, at least 1,000 tons, which during each year they consumed—this was the sum out of which he had to pay the rent and cultivation of the 60 acres on which those 1,000 tons were grown. Well, that was not a very paying concern, but still it was a little better than the loss of £64 on £3,600 worth of stock and food, which was Mr. Mechi's position during this past year. In the former case, about 3s. 6d. worth of meat was made by the consumption of a ton of green food, and of course green food could not be grown for 3s. 6d. per ton—not even on an ordinary grass field, and still less in the turnip field. But he believed, that when good judgment guided the purchaser or the breeder, and skilful management conducted the feeding process, that you might calculate on 1 lb. of meat for every 175 to 200 lbs. of English-grown turnips; and he believed you might expect one-third to one-half more from the consumption of Scotch-grown turnips—there was all that difference in the feeding quality of the food. This amounted to 5s. or 6s. a ton for green food in England, and 7s. to 9s. a ton for green food in Scotland, at which prices, taking roots and grass together, it could be grown. There was all this difference as the result of differences of climate in the

two countries: and under such variable agricultural conditions, he submitted that general sweeping assertions, however, calculated to stir up attention, were not *possibly* applicable to the agriculture of the whole of so variable a country as Great Britain. He should like to add a word or two about the value of Mr. Mechi's example amongst farmers. He believed it to be very considerable, but in an indirect rather than a direct way. As he himself had told us, it was a great point "to provoke people to talk about such matters, causing a little wonder, disbelief, anger, and ultimate calculation and conviction." And all this Mr. Mechi had effected so as no other man could, for no other man, he believed, possessed such exuberance of good nature, or could stand the badgering which had been his lot, and was the lot of all enthusiastic teachers, especially if they carried on the learning and the teaching together, which had been Mr. Mechi's plan, or, at least, had been his plan, in the earlier years of his agricultural history. The so-called failures which he experienced at first were not forgotten yet, as was found at the meeting of the Farmers' Club last night. But his honesty in relating his experience, whatever it might be, was one of the most useful points in his character as a teacher. It seemed that people had yet to learn that in a fully recorded experiment the word "failure" was altogether a misnomer. Let all the circumstances, from the beginning to the end, from the first outlay to the "balance sheet"—from the first operation to the full weight and measure of the result—be recorded; and, let that result be what it might, it could not be a failure. An experiment was just a question put to Nature, and the answer *no* was often as useful and as valuable as the answer *yes*. He hoped, therefore, that whether his experience were a warning or a guide, whether its information were negative or affirmative, Mr. Mechi would continue, as he had done, to give it to the public; and then, whether he were considered the best of farmers or not, he would certainly continue to be one of the most useful men in the agricultural world.

Colonel Challoner said he had listened with attention and with very great pleasure both to the paper and to the discussion which had followed upon its reading; and he believed every one who had listened to what had passed would go out of that room a wiser man than when he came in. He thought they were very much indebted to Mr. Mechi for the way in which he had brought forward the results of his farming operations. He had watched his address throughout, and he could not detect one single point in which he wished any person against their will to try the same as he had done. He had given them the plain facts of what he had done. He was very glad to hear two gentlemen like Mr. Oakley and Mr. Davis take part in the discussion, because the latter especially confirmed a great deal of what Mr. Mechi had brought forward; and therefore he (Col. Challoner) would say hat the time had arrived when they were not to laugh at things because they came from a gentleman who had for so many years courteously, and, he might say, upon such public grounds, and at his own expense, endeavoured to throw some light upon the science of agriculture, and in which he had succeeded in an eminent degree. Mr. Mechi did not ask a single individual to adopt his plan, and there was no one in the present assemblage more qualified to give an opinion upon that plan than was the gentleman who presided over them that evening, and especially upon the relative values of liquid and solid manures; and he hoped the hon. gentleman would favour the meeting with his opinion on that subject. They had heard a great deal from Mr. Sidney—part of which he agreed with, whilst from other parts he must take the liberty of dissenting. One gentleman had said he should like to have a farm-yard entirely covered in. As far as his own little experience went, he should certainly like to have every animal under cover; but he should be sorry to run the risk of any inattention on the part of his farm-bailiff to have the yard entirely covered over, except so far as the cattle was fed in Warne's boxes, where the urine ran in such proportion as to keep the manure in a proper state. He could mention an instance of a yard being covered over, and he had seen the manure turned out in the month of March absolutely with a dry blue heat upon it. No one could say that was in a proper state to be used upon the land. As a general rule, he did not think farm-yards entirely covered in were very desirable. He would now perform the pleasing task which had been assigned him, of proposing that the thanks of this meeting be given to Mr. Mechi, not only for his lucid and interesting paper, but in the name of the farmers of this country, for the expense, pains, and trouble he had been at to throw some light upon the science of farming.

Mr. Wren Hoskyns, on rising to second Col. Challoner's proposal to the meeting, said it was difficult not to feel the application of the old motto,—"Quot hominum tot sententiæ," to the wide field of opinion as well as experiment that the topics of agriculture had presented that evening. So infinitely various were the conditions of climate, soil, and season; so different, and often conflicting, the circumstances under which agricultural experiment was made; so many and various the sciences, and even the faculties of mind called into play, that the difficulty of arriving at absolute conclusions was preceded by the more embarrassing one to a speaker, of selecting one topic out of so many. "British Agriculture" was a wide field. Having, however, been requested to say a few words, he would address them on what appeared the more prominent topic of the evening's discussion, and indeed of very general discussion in all parts of the country—the application of sewage manure. Should it be applied in a liquid or in a dry condition? This seemed to him a most important and preliminary question. Were we employed upon the right problem in attempting its carriage and distribution, diluted with so enormous and costly a bulk of water, in a climate already so moist, and occasioning us so much labour and pains to part with our surplus fluid by drainage; or, was the truer and more economical problem, how to obtain the fertilising matter in its most condensed and solid form? He confessed the latter was the view to which he had been led, both by the results of his own experience and by that of others, whose opinions and experiments had been very convincing to his mind. He could not help indulging the belief, that if it were possible for all the fertilizing matter produced or brought upon a farm, to be equally spread over it in its dry and "fixed" condition, we might trust to the abundant precipitation of moisture in this climate to dissolve and dilute it amply for the wants of the soil. Such, too, was the conclusion arrived at upon Mr. Huxtable's farms, which he had revisited only last week, and which had presented to him a strong instance of the abandonment of the "liquid" system. There the tanks had become receptacles for burnt soil, saw-dust, and pulverulent matter of every kind, to imbibe and solidify the liquid outpour of the farm-yard and buildings; and such he (Mr. Hoskyns) believed to be the most profitable and convenient mode of its application; in the form, in short, of drill manure. He must, he supposed, add a word upon the subject of the steam-engine as applied to agricultural purposes; on which, while he cordially agreed with part of what had fallen from a previous speaker (Mr. Sidney), he could not accept his assertion, that the subject of its future application and cultivation was beyond the pale of practical discussion. Had such a rule been acted on in the other arts of life, where would have been all the advancement which had carried civilisation itself over the globe, by all the various operations to which the steam-engine had been, from time to time, and from invention to invention, newly applied? The practical difficulty which at present beset all the experiments towards this end with the steam-engine, was its own bulk and weight, increasing in equal ratio with its power, and thus appearing to refuse the twofold office of simultaneous cultivation and progression over the yielding

surface of the field. But this, like other difficulties, might yet be overcome. Before sitting down, he must beg leave to second the proposition of Col. Challoner, and in so doing to express his gratification at the interesting paper read to them that evening by Mr. Mechi, whose undaunted pioneering had led to so much interesting and valuable discussion, and whose ready and eloquent call had awakened many a slumbering agricultural question, and whose good-natured advocacy, where it failed to make a convert, had never made an enemy. He begged to second the vote of thanks to Mr. Mechi, proposed by Col. Challoner.

The Chairman was sure he was only expressing the sentiments of all present, in saying that they were greatly obliged to Mr. Mechi for the very interesting and instructive paper he had read to them. From the little he knew of the duties of a chairman, he supposed they were rather to call the attention of the meeting to what appeared to be the chief point of interest in the discussion, than to express prominently his own individual opinions. He had, however, been so pointedly called upon by Colonel Challouer to give his views on one main subject of the evening, that he should trouble them with one or two remarks. Indeed, although a great variety of topics had been touched upon by Mr. Mechi and the gentlemen who had followed him, it was evident that the great question of interest had been, as to the comparative merit of applying manure in the dry or liquid form. When it was considered how large a sum was paid by the British farmer for foreign and for artificial manures, it certainly became his duty, as well as his interest, at least fully to inquire how far such a course was necessary. That was to say, whether any process could be adopted by which the manure of the farm could be more effectively and economically distributed on the land. Although the utility of the sewage of towns, and the methods of applying the manures of the farm, had been mixed up in the discussion, he thought it did not follow that the most economical mode of employing the one, must necessarily be so for the other also. The sewage of towns already existed almost entirely in a liquid form, whilst the manure of the farm was principally solid. If therefore the liquid form be the most practicable for the application of the sewage of towns, it did not follow that it would be the most profitable to convert the manures of the farm into the same condition. He was of opinion that where a large bulk of green produce was to be obtained within a limited area of land, the liquid form of manure would be the most effective. And if the sewage of London and other large towns were to be rendered available for agricultural purposes, he considered the most likely plan to effect it would be that of irrigation upon grass; irrigated manures acting, in his opinion, much more successfully upon Italian rye grass, or common pasture, than upon any other crop. However, he agreed with the opinion expressed by Mr. Sidney, that this question between solid and irrigated manures, was entirely one of cost. He did not think that at the present moment sufficient experimental evidence was before them to prove the economy of converting the manures of the farm into the liquid form, and in that state distributing them over the land. He had much pleasure in putting the vote of thanks to Mr. Mechi to the meeting.

The vote of thanks having been accorded by general acclamation,

Mr. Mechi rose and said, he felt much gratified at the manner in which his exertions had been acknowledged. He was happy on public grounds to aid to the utmost of his power in promoting improvements in agriculture, and he hoped the meeting would not separate without believing that his own practice had proved that the application of manure in a liquid form to every kind of crop, cereal, bulbous, and leguminous, had been most profitable and advantageous, and using it in a liquid form had resulted in his being able to feed double the number of sheep, and to gain twice the number of quarters of wheat per acre to what he could do when he applied the manure in a solid form.

The Secretary announced that at the meeting of Wednesday, the 13th instant, the following paper would be read—"On the Growth and Expansion of our Foreign and Colonial Trade in Iron, and the Fiscal Obstacles to its Extension," by Mr. Harry Scrivenor.

## CONSUMPTION OF SMOKE IN PARIS.

The following order has just been issued by the Prefect of Police of the Seine :—

"Whereas the smoke of factories where steam-engines are used gives rise to continual urgent complaints. And whereas this smoke obscures the atmosphere, enters into dwellings, blackens the outside of houses and public buildings, and produces great inconvenience and unhealthiness in the neighbourhood. And whereas it is important that such a state of things should be put a stop to, at a time especially when the City and the Government are making considerable sacrifices for the embellishment of Paris and its environs, and when so much attention is being given to the importance of the sanitary condition of dwellings, and the laying down better rules for the preservation of the public health. And whereas there are many known practical means of consuming the smoke produced by the combustion of coal in the furnaces of steam-engines, and experience has shown that these means can easily, and at a small expense, be applied to existing factories; and, besides, the employment of anthracite and coke is often economical, and produces but little smoke. And whereas steam-engines have only been allowed on condition of their not producing smoke to the injury of the neighbourhood, and besides the owners of such factories are bound by the terms of their licenses to comply with every condition which the Executive deems proper to prescribe, with a view to public health;

"It is ordered—

"That after six months from the date of this present order (*ordonnance*) the owners of factories employing steam-engines shall be bound to effectually consume the smoke produced in their furnaces, or to feed them with smokeless fuel, such as coke or wood."

## LAW OF PARTNERSHIP.

Well-founded complaints prevail in the city regarding the present course of the Board of Trade with respect to applications for charters to carry out important public enterprises. The Government seem perplexed between two systems, and refuse to act, so that the business of the country, as far as it is connected with this question, is brought to a stand. The opponents of the prohibition against limited partnerships, by which the commercial classes of England are deprived of an advantage possessed by every other people, have constantly pointed to the granting of charters as a proof of the evil of that prohibition, since it centred in a Government Board the power of bestowing privileges which, under proper arrangements, should be equally open to all. The necessity of it, however, until an alteration of the law should be effected, was always admitted, inasmuch as it afforded the principal means of mitigating a restriction which would otherwise have nearly altogether prevented the development of the joint-stock system. It was therefore never expected that any manifestation of the growth of public opinion in favour of a broader principle would lead to a diminished use of this palliative provision; but that, on the contrary, every effort would be made, by giving it the widest application, to render the introduction of the im-

pending change as easy as possible. This anticipation has been disappointed, and since the vote of the House of Commons towards the end of last session, condemning by a large majority the existing laws as too narrow, the Government have made them narrower by refusing, on the ground of the unsettled state of the question, to employ the means by which they were previously rendered endurable. It was a bad state of things when, in order to obtain a charter for any great undertaking, its practical promoters were compelled to forego their own businesslike opinions to conciliate the peculiar views that might happen to prevail for the time at a West-end board, but this was far preferable to being obliged to abandon their objects altogether. At the present moment the fatal results of the passive obstruction practised are incalculable, since the anxieties of the war have already created, among their worst consequences, an indisposition to attend to the introduction of new plans or inventions, although it is under such circumstances that they are most needed, not only for national service, but also to give buoyancy to the revenue.—From the Money Article in the *Times*, Dec. 2, 1854.

It is alleged that a method of supplying the serious want of a cheap material for paper has lately been brought to great perfection, the staple employed being the fibre of common flax. To be productive of good results, however, either to the manufacturers, the nation, or the Excise, it must be conducted on a large scale, by a public company, and, although persons of capital and ability are represented to be ready to engage in it immediately, they refuse, with the prudence of buisness men, to commit themselves to this or any analogous enterprise without a charter of limited liability. From the passive obstructiveness of the Board of Trade, such a charter, it appears, cannot be procured, and another is thus apparently added to the numerous cases of complaint that, whatever may now be the merits or urgency of an object, it must be abandoned, or at all events deferred until speculative times, when it may, perhaps, be turned to account in the usual fashion by some set of adventurers unfit to manage anything, and alike indifferent to all questions of liability limlted or unlimited.—From the Money Article in the *Times*, Dec. 6th, 1854.

## BRITISH METEOROLOGICAL SOCIETY.

At the last meeting of this society, Dr. Lee in the chair, the Rev. H. Gardiner, Rev. J. Woolley, Dr. Buist, Dr. G. F. Burder, Dr. Merryweather, Dr. Paine, T. Collis, F. W. Doggett, E. Hughes, W. Ingram, and R. C. Kemp, Esqs., were balloted for, and elected members.

The following paper was read—" On the Weather in connection with the Aphis Blight and Growth of Hops."

The author commenced by observing that he had been furnished with the monthly rain fall by Mr. Glaisher, from the Royal Society from the year 1787 to 1815, and from Greenwich from the year 1815 to the present time, together with Mr. Glaisher's table of temperatures for 79 years. On discussing these he deduced the following facts —When the fall of rain in or about the quarter ending September, previous to the growth of the crop, has been above the average—the quarters ending December and March following being comparatively dry—a short crop, arising from aphis blight, has been the result. Average or large crops have succeeded when the quarter of the year ending September has been dry, also when both the quarters ending September and December have been very wet.

The temperature of the summer quarter of the year in which the crop is grown will influence the quantity produced (with few exceptions). The small crops were grown in years which experienced cold summers, and, on the other hand, the large crops were produced in hot summers. Observations have been extended over the last 67 years, and on comparing the temperature of the summer of the years in which the twenty-two short crops were grown with that of the twenty-two largest crops, it will be seen that in the former instance the average growth was equal to £55,728, the temperature of the summer quarters averaged 0·9 below that of 79 years; and also the twenty-two years which produced the largest crops, averaged £211,909, the temperature of the summer quarter was 1·5 above the same average.

## WROUGHT-IRON ORDNANCE.

In the *Times* of the 28th ult., there were two letters on this subject, one of them from Mr. Nasmyth, of Patricroft, the other from Mr. F. Henry F. Barisford, Victoria-square, both gentlemen advocating the introduction of wrought-iron ordnance. Mr. Nasymth says: " We continue to employ for our great ordnance a material (cast iron) which, on account of its inherent unfitness to withstand violent shocks and strains, has in every other case been discarded from use." He then adverts to his steam-hammer, as enabling ordnance of immense dimensions to be perfectly well fabricated; says: " that the strength of forged iron is to that of cast iron, as six to one;" that " it is simply the strength or tenacity of the material of a gun which limits the capability of it as to the distance and weight of the missile it is capable of discharging;" and adds: " It is well known to practical men that, besides the vast inferiority in strength of cast iron, its tenacity decreases in a rapid ratio with the increase of the massiveness of the object it is employed to form." Mr. Nasmyth also says that he has " spent the greater part of his life in most intimate connexion with the working of wrought iron on the greatest scale, and where that admirable material has to resist shocks and strains of the utmost violence, and having besides had the happiness to give to the world the most energetic agent mankind has ever possessed for the forging of great masses of wrought iron, I trust I may be permitted to speak on this subject with some degree of confidence." Mr. Nasmyth further asserts, that wrought-iron ordnance might easily be constructed of a size to throw shot or shells of two or three hundred weight.

Mr. Berkeley refers to a previous statement in the *Times* which condemned the use of wrought-iron ordnance on account of its insecurity; in the enlargement of its bore; of its liability to rapid heating; and its expense. Mr. Berkeley then relates facts which came under his own observation, and which render " Mr. Rockwell's opinion doubtful." Mr. Berkeley then states, that about five years ago a trial was made at Woolwich of a " hammered iron gun, constructed by Mr. William Morgan." " A nine-pounder, weighing less than 6 cwt., was forwarded to Woolwich to have its qualities tested, more particularly its durability and powers of resistance." Mr. Morgan had constructed the gun as light as it could well be, that it might be tried on the most disadvantageous terms for the gun. A brass nine-pounder weighs 13 cwt., so that the weight of Mr. Morgan's was less than half that of a brass field piece." The first trial sought was, that the gun should be burst on successive charges. * * Upon the first day's trial, the charge, powder, wads and shot, being progressively increased, the gun did not burst. On the second day's trial they did burst the gun—that is, it was ripped open about ten inches half-way up. The following were the results. * * Great durability of the gun; the absence of heat on its repeated discharge; the absence of enlargement of either muzzle or touch-hole. At the conclusion of the trial, the gun was found to be as smooth as it was at the commencement."

On the 30th ult., the *Times* also published a letter from Mr. James Eastwood, of the Railway Iron Works, Derby. This gentleman relates that he had constructed at Liverpool a wrought-iron gun, whith was said to have been for the United States frigate *Princeton*. This gun was proved

at Liverpool in the year 1845, the piece being of the following dimensions:—

| | |
|---|---|
| Length of bore . . | 12 feet. |
| Diameter of bore . . | 1 foot. |
| Weight of shot . . | 214 pounds. |

The gun was first proved with 45 pounds of powder, then for two rounds with 44 pounds, and it was double shotted; then for 30 rounds it was proved with 30 pounds of powder, and a single shot.

What has been published in the *Times* newspaper has of course been perused by the multitude of its readers, but as the correspondence in question is detached, it has seemed to call for a connected statement of its purport, and therefore the above abstract has been attempted.

It appears thereby that wrought-iron ordnance has already been manufactured, and has proved, on trial, to be free from the objections that have been made to it, excepting only in point of cost; what that might be remains a question. That a given weight of forged iron costs more than the same weight of cast iron is certain; but if, as Mr. Nasmyth says, wrought iron be of six times the strength of cast-iron, it is probable that a wrought-iron gun might be provided at even a less price than if of cast-iron.

Considerable percussion must necessarily have taken place in the forging of wrought iron, and it has been ascertained "that the best Swedish iron may, by hammering, be increased by about a seventh in strength."* The increase of strength by hammering is of importance for ordnance of other materials than iron, for "one of the mixtures of metal used in the Metal Mills (at Portsmouth) bore a weight of 5 tons 7 cwt. before it broke, though the best Swedish iron, so hardened by hammering, broke with seven tons and a half.†"

Excepting in permanent fortifications, the dead weight of artillery is an important consideration, both in the land service and on shipboard. It seems evident that the amount of armament of a navigable vessel rests on the *weight* of metal she can support; hence arose the introduction of carronades, which, on account of their shortness, were less pondrous than long guns of equal diameter. Carronades have, however, been of late rejected in our navy, perhaps without sufficient reason, seeing that the charge of powder allowed for them was much below that for a long gun of equal bore, although the strength of the carronade admitted of a full charge. Increase of weight militates against the use of the increased length of ordnance, so ably advocated by Mr. Bridges Adams, for it can hardly be conceived that the increase of distance to which a long gun will carry its missile, can compensate on shipboard for number or weight of shot. The same reasoning seems applicable to the land service; for, if I mistake not, army brass field-pieces, twelve-pounders, are the largest guns used in the field, and they require half-a-dozen stout horses to draw them. Usually, however, nine-pounders only are brought into the field. A fifty-six-pounder cast iron gun weighs 97 cwt., to which being added its carriage and a few charges of ammunition, would bring the total weight to about 116 cwt., requiring at least eighteen stout horses to draw the whole on tolerably good roads, at a rate of little more than two miles an hour. The great importance of diminishing the weight of ordnance is consequently evident both for land and sea service; so that, if by the use of wrought iron as a material for artillery we should be enabled to throw shot of half a hundred weight instead of a ball of twelve pounds, the advantage thus obtained over an enemy would be proportionably increased, though Mr. Nasmyth's ball of two or three hundred weight were not adopted.

What has hitherto appeared in regard to wrought iron ordnance does not specify a particular that cannot but considerably influence its strength, namely, the degree of rapidity and force with which the strokes of the hammer are given. Probably Mr. Nasmyth's experience and extraordinary habit of observation may have enabled him to decide this question without further experiment.

Mr. Nasmyth says that wrought iron may be rifled. The Lancaster ordnance is on the rifle principle, but is said often to miss aim. Why this should be seems inexplicable, since a chief merit of a rifle small arm gun is its accuracy of aim. Surely this defect in the Lancaster gun might easily be remedied.

Military operations, since the war commenced, have fully evinced the superior efficacy of large to small missiles, and that our power of annoying the enemy has been seriously checked by the dead weight of our ordnance. In the affair at Bomarsund our success was mainly attributable to the use on shore of thirty-two-pounder ship guns, but the weight of them called for extraordinary exertions to place them in position. On that occasion, the crews of vessels of war lent their powerful aid to drag up the artillery of their ships, and so they seem to have done in the Crimea; but if those guns had been of wrought-iron, and but a sixth part of the weight of cast-iron guns—it seems needless to say—six times the number of guns might have been brought up with the same expenditure of manual labour.

Many are the impediments to a speedy introduction of improvements, some of them political; for example, when in the last century the Inspector-General of Naval Works urged General Ross to furnish *shells* for the *Arrow* and *Dart*, the General observed, that this destructive missile was, in naval warfare, as yet unused by the enemy, and that it would be impolitic to show him the efficiency of shells. But there can be no political motive for retarding the introduction of wrought-iron ordnance; on the contrary, it would seem good policy to hasten trials of this improvement, lest the enemy should forestall us. Russia possesses Nasmyth's steam-hammer, iron of a quality equal to the best Swedish, and a manufactory at Toula accustomed to its manipulation. Nor does the Russian Government seem so backward in adopting improvements, as is generally supposed; for it appears in the Blue-book containing evidence to the late Committee of the House of Commons on small arms, that Russia uses machinery from this country for the manufacture of small arms, whilst we continue their fabrication entirely by the uncertain accuracy of common workmen. Whether Russia should adopt wrought-iron ordnance or not, it would seem expedient for us to make preliminary experiments on such artillery without delay, so that should its superiority to cast-iron guns prove incontestible, an adequate provision of wrought-iron ordnance might be fabricated and sent to the seats of war before the commencement of the ensuing campaign. It evidently rests with the Government to decide on the kind of arm to be employed; but discussions on the subject by the Society of Arts could not fail to facilitate greatly a Ministerial decision upon it.

On the score of weight, it is possible that *steel* might be found a better material for ordnance than even wrought-iron. Sir Samuel Bentham suggested trials of it for this purpose, since he had ascertained that in point of strength a given amount of it might be obtained from steel for the same sum as equivalent strength of wrought and hammered iron would cost.

M. S. BENTHAM.

4th December, 1854.

[Since this article was in type Mr. Nasmyth has addressed a further note to the Editor of the *Times*, in which he states, "that Government have entered most cordially into my views, and in the most liberal spirit have empowered me to proceed forthwith in carrying out my designs."—Ed.]

* Sir J. Bentham's "Naval Papers," No. 8, Page 171.
† Ibid.

## Home Correspondence.

### ADULTERATION OF FOOD.—BREAD.

Sir,—It is a most extraordinary fact that in this country, where the march of science and the mechanical arts has made the greatest strides, we should still be so much behind a great portion of the civilised world in the simple process of making bread. Bread, literally the staff of life of the working classes, and so necessary to all, should be pure, wholesome, and palatable, qualities unattainable in England, even if you make and bake your bread at home. I do not allude to those qualities which influence its appearance only, because it is easy enough to procure it light or well raised; and, in regard to colour, it may be equally nutritious and wholesome whether white or brown, or even approaching to black. The causes which have led to this lamentable state of things are many; the long-established habits and customs of the three classes concerned in the manufacture of bread—the farmer, the miller, and the baker.

It is, however, to the last-named, the baker, that the unwholesomeness of our English bread may be chiefly attributed, for if he would receive no flour from the miller but what was made from sound, well-kept wheat, the miller would purchase no deteriorated corn from the farmer, who would, in consequence, be compelled to preserve his wheat in a sound and wholesome state. But it is in vain to hope that the baker will ever act in so reasonable manner, because it is against his interest to do so, his object being to make the greatest number of four-pound loaves out of a given quantity of flour, say 90 loaves out of each sack, or 280 pounds of flour, while of home-made bread the sack will hardly yield 80 loaves. This clearly shows that the baker, by some means or other, makes a fraudulent gain upon the public of at least 10 loaves, or 40 pounds of bread, out of each sack consumed, and this fraud is accomplished by various means, most of which are notorious.

The baker will receive no flour from the miller that does not require an established quantity of water to make the dough of a proper consistency, a quality only to be obtained to the extent required by mixing a large proportion of very old corn, much heated in the rick, with a small quantity of good fresh wheat, in order to give the flour the necessary liveliness. Therefore it is that the miller will give the farmer a better price for old wheat, that has been much heated in the rick, than he will for new; and therefore it is that home breadmakers find it impossible to procure flour that has been made from good, wholesome, well-preserved grain.

The baker, however, is far from being satisfied with this first step; he must throw in a large quantity of alum and other chemicals, in order still further to increase the water-holding quality of his flour. The alum fraud has perhaps arisen from the fact that a few grains dissolved in muddy water will very soon cause it to become apparently limpid and pure, and fit to make white bread. But it was unfortunately discovered that the dough would bear, or stand up with, a much greater quantity of alum water than when made with the pure element, so that alum is now very largely introduced for that purpose alone. It is still more unfortunate that the addition of alum to bad flour greatly improves the appearance of the bread.

Various chemicals, together with common salt, are also introduced, in order to give a still greater water-holding quality to the flour, as well as to disguise the badness of the wheat from which it has been made. There are men in London called bakers' chemists, who supply them with what is called bakers' stuff, under the fictitious appellation of ferment, the composition of which is quite unknown to the baker; and this is the process by means of which they get up the beautifully white and light London bread.

The adulteration by the addition of farinaceous matters other than the flour of wheat, such as bean flour, rice, potatoes, &c., merely amounts to the fraud of selling one article for another, all such being more or less nutritious and wholesome. Some time since a new mode of making bread was introduced at the Marylebone workhouse by two French gentlemen, the object of which was to make 136 four-pound loaves out of one sack of flour (280 lbs.), an enormous increase on the fraudulent practice of our English bakers, who already make at least 10 loaves or 40 pounds of bread more than a sack of pure flour will produce. For the exposure of this fallacy, I beg to refer your readers to my letter on this subject inserted in your Journal, No. 75, page 406, and to Mr. Pepper's very admirable experiments on bread-making at the Royal Polytechnic Institution.

In regard to the millers, a few words will suffice, as I have already shown that their trade is in a great measure regulated by the bakers, of whom they are at once both the slaves and the masters. Their slaves, because they are compelled to produce flour of the greatest water-holding power. Their masters, because a large proportion of the bakers are deeply indebted to them. There is little doubt, however, that some portion of the alum which contaminates our bread, is introduced now and then by the miller. Alum is kept in the mill for the purpose of filling up any inconvenient porosity in the face of the millstones, and besides giving the water-holding power, it very much improves the appearance of flour made from half-spoilt or inferior wheat. It has been said that millers adulterate their flour with ground bones and plaster of Paris; but such assertions deserve no credit, because the cheapest article for that purpose, is undoubtedly low-priced half-perished wheat; and the miller's art consists in being able, when purchasing a really good honest sample, to calculate to a nicety how much inferior corn it will bear, so that, when doctored up, it shall produce to the eye fine white flour.

After all, it would appear that the millers of England, like the bakers, are rather behind those of other countries, especially the Italians, in real practical knowledge. Our English millers have a clever but a very absurd mode of building up their millstones of brickbats and plaster of Paris, with small bits of French burrs to make up the face, thereby losing the valuable crushing power of the greater specific gravity of an entire solid stone.

English mills also are much inferior in strength and power to those of Italy; for I have had corn well ground with broad, flaky, clean bran, at the rate of 12 bushels—I have seen it ground at the rate of 18, and at one mill at the rate of 24 bushels per hour, by one pair of four-feet stones, but the runner or upper millstone was 20 inches thick, and the bedstone upwards of two feet, set upon a vault of masonry in cement 18 inches thick. The greatest rate known in England is, I believe, five bushels per hour for each pair of stones.

In order to test the strength and power of an English mill, you have only to request the miller to grind a few quarters of full-sized Indian corn. He could not reduce it to fine flour, and in a very short time both the mill and machinery would be guttered to pieces. The same effect would follow the attempt to grind the dried chesnuts of the Apennine forests, which produce fine flour, as soft as velvet, and nearly as sweet as sugar. The ordinary bread of the Italian farm labourers is composed of the following materials, in the proportion of about a bushel of each, namely,—soft wheat, hard ditto, pease or vetch, barley, horse beans, and broad Windsor beans from the coast of Barbary, a mixture that would try the courage of any English miller who should be required to grind such stuff into fine flour, with but little bran. The millstones used for this purpose are made from various hard crystallized rocks, as granite, and both the upper and lower stones are of the same quality; but when soft wheat is to be ground with broad bran, the upper millstone only is hard, generally of diallage rock, the lower

or bedstone being universally of porcellaneous limestone.

I need not say much about the farmers, as they must of course follow in the train of the other two, more especially as I may refer your readers to my communication on the "Preservation of Grain," inserted in your Number for October 21st, 1853. I may state, however, that the English agriculturist, generally speaking, is far worse provided with shelter for his crops when gathered, in this very variable climate, than the farmers of the south of Europe, where the climate is quite the reverse.

Some of your readers may think my description of the bread-making business rather overcharged, but I can assure them that it is by no means so. I only hope there may be exceptions, though I fear I may say with Virgil, "Apparent rari nantes in gurgite vasto."

HENRY W. REVELEY.

Parkstone, Dorset, Nov. 28, 1854.

## THE TRADE COLLECTION OF THE GREAT EXHIBITION OF 1851.

Sir,—I observe by the last number of the *Journal of the Society of Arts*, that, in the discussion which recently took place at the Society on the subject of Mr. Simmonds's interesting paper, Mr. Bennoch expressed his regret at the dispersion, amongst the Provincial Museums of the country, of the valuable nucleus of a great Trade Museum possessed by Her Majesty's Commissioners for the Exhibition of 1851. A similar statement was contained in Mr. Simmonds's paper.

I beg to acquaint you that Mr. Bennoch and Mr. Simmonds are entirely mistaken in supposing that the collection in question has been so dispersed. The samples presented by the Commissioners to local museums consist in every case of duplicate specimens, which they were enabled to distribute without in the least injuring their own collection, which is still deposited at Kensington Palace, awaiting the time when matters will be sufficiently ripe for the full execution of the Commissioners' plans, as Mr. Simmonds, Mr. Bennoch, or any other Member of the Society of Arts may ascertain by personal inspection, on presenting his card to the officers of the Commission, at Kensington Palace.—I have the honour to be, sir, your obedient servant,

EDGAR A. BOWRING.

Whitehall, Dec. 4, 1854.

## TRADE MUSEUM.

Sir,—The collection of animal produce and manufactures, which I am forming for the Society, is now rapidly assuming a definite form, as contributions arrive from day to day; the value of the future collection will, however, not so much depend upon the mere number of samples which it contains, as upon their instructive, suggestive, and illustrative importance; and the mode in which, by arrangement, exhibition, and description, their use is brought out and rendered evident.

I am therefore most anxious, at the present time, to ask the aid and co-operation of the individual Members of the Society, in the illustration of particular branches of industry, for I feel that I have a fair ground in asking their help, as the duty with which I am charged is the formation of a museum for the Society itself, and therefore I may reasonably conclude that the Members are not only those most interested in its progress, but also those from whom contributions may most fairly be expected.

My chief object in addressing this letter to you is, that of earnestly requesting the assistance of the Members of the Society, more especially those directly or indirectly engaged in business; and I would beg them to give such aid in the formation of the collection as may be in their power, and, remembering the objects of the museum, to mention it to their friends whenever opportunities occur. There are obviously many ways in which the Members can aid the collection, and I will now only mention a few. Thus I shall be very glad to receive:—

1. Samples of any description of animal produce, raw, prepared, or manufactured either British, colonial, or foreign.

2. Specimens illustrating the past or present mode of manufacture of woollen, silken, or leathern fabrics, or other articles, made from animal substances.

3. Specimens of animal manufacture of various ages, showing the quality of the article made a certain number of years ago, showing how it was kept, and illustrating its durability, or the mode in which it is gradually destroyed by age or use.

4. Information as to the modes of manufacture, processes, and all other matters connected with the arts in which animal substances are used.—I am, sir, yours faithfully,

EDWARD SOLLY.

Society of Arts, Adelphi, Dec. 4, 1854.

## PERFORATING POSTAGE, RECEIPT, AND OTHER STAMPS.

7 Duke street, Adelphi, Nov. 25th, 1854.

Sir,—As the world is made up of little things, may I trespass on your space to suggest the following improvement on the present style of perforating our postage, receipt, and other stamps, which would save time and prevent the stamps from being torn across. If the holes were made diamond-shape instead of circular as at present, I can say, from experiments tried, that they would more effectually answer the purpose intended; the reason is simply that the force of tearing is guided by the angle of the diamond-shape into the direction it is wanted; whereas, in the circular hole, it is spread over nearly half the circumference of the hole. This is only putting into mechanical form the principle employed in tearing paper by means of a *crease*, the circular plan of perforation being analogous to tearing a piece of paper which has merely been *folded*. To be divided properly, the stamps as at present made require to be creased, but on the proposed plan they would not. In respect to the dynamics of the question, this plan would be just such an improvement in perforating postage stamps, as the conical balls used in Minié rifles are on the spherical balls used in the old rifles and guns.

Yours, &c.,

W. H. WALENN.

⁂ The suggestion of Mr. Walenn is said not to be new. It might probably accomplish the object required more easily than the present plan, but, apart from the mechanical question whether or not the machinery could be made exactly true, that is the "perforators," exactly to pass through the two metal plates between which the sheets are placed, doubts have been expressed that the sheets would be so limp, that they could not be handled without coming asunder, thus causing inconvenience to the sellers of stamps and the stamp office. Already the sheets are so weak that it frequently happens, when sheets are packed together, that they adhere to each other, and one or two stamps are torn out of the centre of a sheet, when the upper one is removed.—Ed.

## COVERED HOMESTALLS.

Sir,—Considering I was precluded, by the rules of order, from making any public reply to a remark introduced into the proposition of a vote of thanks last evening to Mr. Mechi, for his interesting Paper on British Agriculture, and desirous that an observation so calculated to mislead should not pass unnoticed, may I beg of you to state that I feel satisfied the instance mentioned by Colonel Challoner, in which the manure taken from a Covered Homestall was found mouldy, can have been but an exceptional case, arising either from over-foddering or a deficiency of stock. I have, for several years, had considerable experience in the use of Covered Homestalls, and have never known a failure where they have been used

in accordance with the design of their erection. A little consideration will, I am sure, satisfy the Colonel that no greater difficulty can attend the proper making of the manure in a Covered Homestall than under the system of box-feeding, if there be only a sufficient number of beasts for the area, and a careful supervision of the foddering, the Covered Homestall being in effect a series of boxes thrown together.

My own experience proves that 100 superficial feet for each horse or bullock, and 10 feet for each sheep or pig, will give ample space and yet secure the perfect conversion of the straw into manure of superior quality and in a fit state for immediate use.

Your obedient servant,
JAMES BEADEL.

25, Gresham-street, Dec. 7th, 1854.

## DECIMAL COINAGE.

SIR,—At page 718, Vol. II, of your Journal, Sir C. Pasley, referring to his work published in 1834, says—"I was also the first in this country to recommend a decimal system of money, of accounts, and a decimal coinage based on the pound sterling as a unit," which he appears to have first suggested in 1831.

If the General will consult the "Pamphleteer" for July, 1814 (iv., 171), he will find, "A Sketch for a New Division and Subdivision of Money, Weights, and Coins," by Mercator, where the money of account is to be 1,000 mils =1*l*. Coins—gold, 1000 mils=1*l*.; 500 mils=½ pound. Silver, 250 mils = crown, 125 mils = half-crown, 50 mils = 1 shilling, 25 mils = sixpence. Copper, 5 mils= penny, 1 mil= farthing. This is exactly the plan recommended by General Pasley, but with the names now used adopted by the committee. In justice to General Pasley I may observe that the plan seemed entirely to have escaped notice until re-proposed by him. I have no idea of accusing the General of having copied "Mercator," for, curiously enough, this plan and the tenpenny plan (which was first proposed, I believe, in 1816) have been independently re-discovered many times at different periods.

Your's truly,
JOHN EDW. GRAY.

British Museum, Dec. 4, 1854.

# Proceedings of Institutions.

MACCLESFIELD.—The nineteenth anniversary of the Society for Acquiring Useful Knowledge was celebrated on Monday fortnight, by the usual meeting in the Town-hall, the President (John Brocklehurst, Esq., M.P.) in the chair. The assemblage was more than usually numerous. The President, in opening the business, said he had for many years continually impressed upon the Managing Committee of the Society the necessity of never forgetting the fundamental rule upon which it was established, namely to provide means for acquiring useful knowledge for its members, and especially for the children of our industrious artizans. That rule had hitherto been abided by, even far beyond his most anxious wishes. The allowances to teachers had been increased, and various sums had been allotted to them as a remuneration for their devotion to the improvement of the pupils. The year had been marked by several extraordinary steps in advance.—Mr. Curwen, the honorary secretary, then read the report, from which it appeared that the new subscription news and reading-room, in connection with the Society, had now nearly 200 subscribers. Fifteen daily and nineteen weekly newspapers, in addition to the *Commer. Daily List*, and the leading quarterly, monthly and weekly serials, were provided, and telegraphic intelligence was furnished three times a day, and an hour on 'Change had lately been commenced for its mercantile members. The institution had thus become the centre of news and business, as well as the leading channel of learning and useful knowledge in the town. The library had been increased during the year by the purchase of 200 volumes, all of which had been carefully selected, and there was now an easy reference catalogue, which might be purchased for a small sum. The committee rejoiced that the classes were in a very thriving condition, as will be seen by the following tabular statement of their numbers and average attendance, viz:—

| Classes. | No. of Pupils. | Average Attendance |
|---|---|---|
| Mathematical and Arithmetic—First Division, including Mathematics ... ... | 59 | 40 |
| Second Division ... ... ... ... ... | 20 | 14 |
| First Reading, Writing, and Dictation Class ... ... ... ... ... ... ... | 26 | 23 |
| Stenographical Class ... ... ... ... ... | 10 | 7 |
| Second Reading and Writing ... ... ... | 60 | 40 |
| Historical and Geographical ... ... ... | 20 | 12 |
| Grammar ... ... ... ... ... ... ... ... | 50 | 30 |
| Juvenile Class ... ... ... ... ... ... ... | 80 | 66 |
| Female Class, in which is taught Reading, Writing, Arithmetic, Grammar, Geography, English History, Dictation, and Sewing ... ... ... ... | 40 | 30 |
| | 365 | 262 |

The reports of the teachers showed that good conduct, regularity of attendance, and assiduity, form the characteristics of each class. The committee have not thought it prudent to risk the Society's funds in engaging professional lecturers, but have made arrangements for the delivery, during the coming session, of gratuitous lectures and readings by several clergymen and gentlemen connected with the town and neighbourhood. Several concerts or musical lectures were given during the last session. The Society's annual excursion, of which upwards of two hundred of the members and their friends availed themselves, was this year to Liverpool, North Wales, and the Isle of Man. The receipts of the year had been £618 6s. 11d., the expenditure, £644 6s. 0d., leaving a balance due to the treasurer of £25 19s. 1d. The report having been adopted, on the motion of the Rev. C. A. J. Smith, seconded by Mr. John Wright, the honorary secretary proceeded to read the reports of the teachers and the adjudication of the prizes, after which their presentation by the president took place. Thanks were voted to the officers, to the chairman of the meeting, and to the mayor for the use of the hall.

## MEETINGS FOR THE ENSUING WEEK.

MON. British Architects, 8.—Adjourned Discussion, "On the Architectural Splendour of the City of Beejapore."
Geographical, 8½.—1. Reports from Dr. Barth, dated Timbuctu. 2. Despatch reporting that the African Mission had not yet returned to Kuka from the South.

TUES. Syro-Egyptian, 7½.—1. "Oseudu—Epigraphic Letter of Baruch," translated from the Syriac, by Dr. Jolowiez. 2. Dr. Carl Abel, "On the Coptic language."
Civil Engineers, 8.—Discussion upon Mr. P. W. Barlow's Paper, "On some peculiar features of the Water-bearing Strata of the London Basin."
Medical and Chirurgical, 8½.
Zoological, 9.

WED. Literary Fund, 3.
Royal Soc. Literature, 4½.
Society of Arts, 8.—Mr. Harry Scrivenor, "On the Growth and Expansion of our Foreign and Colonial Trade in Iron, and the Fiscal Obstacles to its Extension."
Geological, 8.—1. Messrs. J. Prestwich, jun., and J. Brown, "On a Fossiliferous Deposit in the Drift near Salisbury." 2. Mr. W. J. Hamilton, "On the Tertiaries of Cassel." 3. Mr. J. W. Dawson, "On a Submerged Forest at Fort Lawrence."
Graphic, 8.
Archeological Assoc., 8½.

THURS. Antiquaries, 8.
Royal, 8½.

SAT. Asiatic, 2.
Medical, 8.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Dec. 1st*, 1854.]

*Dated 23rd August*, 1854.

1852. J. H. Young, 66, Great College-street, Camden-town—Railways.

*Dated 14th September*, 1854.

1997. C. F. Stansbury, 17, Cornhill—Machinery for making lock springs. (A communication.)

*Dated 10th October*, 1854.

2166. S. Hancock, Nottingham—Looped fabrics.

*Dated 3rd November*, 1854.

2330. P. M. Parsons, 6, Duke-street, Adelphi—Railway axle bearings.

*Dated 7th November*, 1854.

2350. L. N. Langlois, Paris—Steam-boats.

*Dated 13th November*, 1854.

2400. Hon. W. E. Fitzmaurice, Kensington-gore—Bullets, shells, and other projectiles.
2401. A. E. B. Gobert, Montmirail, France—Stamping press.
2402. J. Armstrong, Normanton—Railway chairs and crossings.
2403. J. J. Abadie, Paris—Mode of working screw propellers.
2404. D. Caddick, Ebbw-vale iron works—Puddling furnaces.

*Dated 14th November*, 1854.

2405. J. H. Luson, Old Kent-road—Railway brakes.
2406. A. Pécoul, Marseilles—Sounding log.
2407. J. Howarth, Poplar—Boots and shoes.
2408. L. Kirkup, Newcastle-on-Tyne—Anvils.
2409. A. Turnbull, M.D., Manchester-square—Saw.
2410. H. Law, 15, Essex-street, Strand—Guns and projectiles.
2411. P. M. Parsons, 6, Duke-street, Adelphi—Projectiles.
2412. S. Pearson, Woolwich—Gun-barrels, pipes, and tubes.
2413. P. J. Meens, Paris—Wind instrument. (A communication.)

*Dated 15th November*, 1854.

2415. J. M. Chevron, and C. V. F. de Roulet, Paris—Machinery for textile fabrics.
2416. D. Davies, Wigmore street—Roller blinds.
2417. A. Warner, 11, New Broad street—Combining metals
2418. R. A. Brooman, 166, Fleet street—Gutta percha thread. (A communication.)
2419. W. H. Meriwether, Comal county, Texas—Wrought-iron posts for fences.
2420. F. J. Bramwell, 29, New Bridge street, Blackfriars—Steam-engines and steam-hammers.
2421. A. V. Newton, 66, Chancery-lane—Soluble silicates. (A communication.)
2422. J. H. Johnson, 47 Lincoln's-inn-fields—Air pistols. (A communication).
2423. J. Buchanan, Glasgow—Healds for weaving.

*Dated 16th November*, 1854.

2424. G. H. Ingall, Throgmorton-street—Communication between passengers and guards, &c.
2425. P. Knowles and E. Kirby, Bolton-le-Moors—Machinery for cleaning, &c., fibrous substances.
2426. R. Wilson, Birmingham—Ornamental fabrics.
2427. A. E. L. Bellford, 16, Castle-street, Holborn—Silk-winding machinery. (A communication.)
2428. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Obtaining alcohol, &c. (A communication.)
2429. S. Henton, Lambeth—Saddle.
2430. W. C. Day, Strand—Portable camp bed.
2431. J. Platt, Oldham—Brick-making machinery.
2432. W. Hann, Hetton Fence-houses—Propelling vessels.
2433. W. Low, Lloft Wen, near Wrexham—Ventilating mines.

*Dated 17th November*, 1854.

2435. J. Wilson, Hopton—Printed warp fabrics.
2436. J. Bellamy, Upper street, Islington—Graining.
2437. J. Higgins and T. S. Whitworth, Salford—Shot, shells, &c.
2438. L. Castelain, 14, St. James's-place, Hampstead road—Pulp for paper and millboard.
2439. T. Kennedy, Kilmarnock—Projectiles.
2440. J. Macadam, M.D., Glasgow—Sizeing paper.
2441. C. Asprey, New Bond-street—Handles for dressing cases, &c.
2442. G. T. Bousfield, Loughborough-road, Brixton—Preventing incrustation in steam-boilers. (A communication.)

*Dated 15th November*, 1854.

2445. R. Gaunt, Birmingham—Dress fastening.
2446. H. R. Ramsbotham, Bradford—Combing fibrous substances.
2447. H. J. Luff, 7, Thanet-place, Temple-bar—Attacking hostile bodies, &c.
2448. T. F. Calard, Paris—Bedsteads.
2449. E. Belmer, 8, Macclesfield-street, City-road—Warming apparatus.

*Dated 20th November*, 1854.

2453. P. A. Dulaurens, and M. A. Laubry, Paris—Glove fastenings.

*Dated 21st November*, 1854.

2457. R. Knight, 9, Charterhouse-square—Testing iron as to its capacity for receiving magnetism,
2459. W. Beasley, Smethwick—Gun-barrels.
2461. E. Hunt, Glasgow—Screw-propellers.

*Dated 22nd November*, 1854.

2463. J. B. Bagary, Paris—Sawing apparatus.
2465. J. H. Johnson, 47, Lincoln's-inn-fields—Piled goods. (A communication.)
2467. R. Gibson, Hunslet—Carding machinery. (A communication.)

## WEEKLY LIST OF PATENTS SEALED.

*Sealed December 1st*, 1854.

1321. Joseph Fourdrinier, 12, Sherborne-street, Islington—Improvements in machinery for washing, boiling, cleaning, and bleaching, rags, fabrics, and textile substances.
1373. Ephraim Smith, Carlisle-street—Improved watch key.

*Sealed December 5th*, 1854.

1250. Lemuel Brokelbank, Willesden—Improvements in manufacturing lubricating matters.
1258. John Mansfield, Stoke, Stafford—Improvement or improvements in steam-boilers.
1263. Joseph Kaye, Beeston, near Leeds—Improvements in machinery or apparatus for slubbing, roving, spinning, and doubling wool and other fibrous materials.
1266. James Leadbetter, William Wight, and Thomas Davis, Halifax—Improvements in machinery or apparatus for raising water and other fluids.
1271. Jean Baptiste Numa Erard, Paris—Improvements in the preparation of paint.
1275. John Nelson, and David Boyd, Selby—Improvements in preparing and scutching flax, hemp, and other substances.
1279. Julian Bernard, Club-chambers, Regent-street — Improvements in stitching and sewing machines, and in machines for securing and ornamenting parts of garments and other materials.
1281. John Braithwaite, Gower-street—Improved method of roofing or covering buildings, reservoirs, and other spaces requiring roofs or coverings.
1322. Alfred Vincent Newton, 66, Chancery-lane—Improvements in machinery for block printing.
1344. Joseph Day, Birmingham—Improvements in certain kinds of candlesticks.
1379. Isaac Farrell, Dublin—Improvements in fireproof flooring and roofing, which improvements are also applicable to the construction of walls and bridges, and other like structures.
1426. John Gregory Jones, Roscommon-street, Liverpool—Improvements in apparatus for teaching addition.
1498. James Lee Norton, Holland-street, Blackfriars — Improvements in turnstile counting apparatus.
1954. Robert Adams, King William-street, City—Improvements in breech-loading fire-arms.
2000. Robert Adams, King William-street, City—Improvements in machinery for boring and rifling the barrels of firearms.
2084. Alfred Vincent Newton, 66, Chancery-lane—Improvement in the rigging of sailing vessels.
2102. Arthur Boyle, Birmingham—Improvements in making umbrella and parasol stretchers.
2122. William Edward Newton, 66, Chancery-lane—Improvements in the construction of locks. (A communication.)
2164. Henry Thomas White, Queen's-terrace, Hammersmith, and George Roberts, Great Peter-street— Improved mode of rendering hats, caps, and other coverings for the head self-ventilating.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| Date of Registration. | No. in the Register. | Title. | Proprietors' Names. | Address |
|---|---|---|---|---|
| Nov. 29. | 3665 | Self-acting invalid iron chair bedstead ... | John Wren ...................... | 232 Totenham-court-road |
| ,, 30. | 3666 | Portable bedstead ............................ | Edm. Brown Bishop Wren | 232 Totenham-court-road |
| Dec. 1. | 3667 | Improved fastening for porte-monnaies, cigar cases, and other similar articles | Christian Wemtraud, jun. | Offenbach, and 4, King-street, Cheapside |

Journal of the Society of Arts.

*FRIDAY, DECEMBER* 15, 1854.

## FIFTH ORDINARY MEETING.

Wednesday, December 13, 1854.

The Fifth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 13th instant, James Wilson, Esq., M.P., in the chair.

The following Candidates were balloted for, and duly elected :—

*As Ordinary Members.*

Browning, William. | Jackson, James Barwick.
Williams, J. F.

*As Corresponding Members.*

Crawcour, Dr. | Le Play, F.

The paper read was

## ON THE GROWTH AND EXPANSION OF OUR FOREIGN AND COLONIAL TRADE IN IRON, AND THE FISCAL OBSTRUCTIONS TO ITS EXTENSION.

By Harry Scrivenor, of Liverpool.

In compliance with the request of the Council of this Society, to prepare a paper "*On the Growth and Expansion of our Foreign and Colonial Trade in Iron, and the Fiscal Obstructions to its Extension,*" I have arranged the materials I had at hand, and, to the best of my ability, I have sought to carry out what I consider to be the wish of the Council.

In treating upon a subject which must be allowed to be of great importance, I have had the difficulty which all for the first time have experienced, of appearing in an entirely new position, my ideas and intentions never having led me to even the thought of appearing before any assembly to occupy their time with reading a paper of my own compilation; and much more must I feel the delicacy and difficulty of that position when the composition of this assembly is taken into consideration. I, however, am aware that true genius is accompanied by genuine kindness of feeling, and my deficiencies will be excused when it enters the minds of those about me, that it was more consistent that I should attempt to comply with the wish of the Council, rather than have declined on the ground that I had never done anything of the kind before. I gave the *doubt* in favour of the trial.

There is an uncertainty respecting the knowledge the Ancient Britons had of iron. From Cæsar's observation, that they use either brass or iron rings and plates of a certain weight for money, we might be led to the conclusion that it was a very scarce metal, which is hardly consistent with the knowledge which the Gauls, their near neighbours, had of mining, who are stated by Strabo and Cæsar to have "great iron works, and every kind of mine;" and Strabo mentions iron as one of the British exports. Their early connection also with the Phenicians, who were well acquainted with iron, would lead the Britons to estimate the value of this metal.

After the Romans obtained quiet possession of the country, it was the object of Agricola to promote the arts, and Adrian, in the year 121, established at Bath the great military forge, or college of armourers. His successors continued to work the iron mines till the final abandonment of Britain by the Romans, about the year 409.

The conquest of Britain by the Saxons was at first nearly destructive of all energy in the arts, especially as relates to mines. But Camden states, that in and before the reign of William the Conqueror the chief trade in the city of Gloucester was forging of iron, which Giraldus Cambrensis says was supplied from the forest of Dean. During the period from the Conquest to the death of John, iron and steel were imported from Germany and other countries.

By an act passed in the reign of Edward the Third, no iron manufactured in England, and also no iron imported and sold, could be carried out of the country, under the penalty of forfeiting double the quantity to the king; and the magistrates were empowered to regulate the selling price, and to punish those who sold at too dear a rate, according to the extent of the transaction. This act remained in force till the reign of William and Mary.

During the fourteenth and fifteenth centuries, several improvements had taken place in the manufactures of iron and steel, and upon a petition from the manufacturers of London and other towns, an act was passed in 1483 against the importation of various articles of home production.

We have no particular information of the progress in the manufacture till the reign of Elizabeth—but there is no doubt of the works having materially increased, as both Leland and Camden speak of iron works in many parts of the country.

In the reign of Elizabeth, acts were passed for the protection of timber,—that it should not be felled in certain districts for making iron,—that no new iron-works should be erected within 22 miles of London, nor within 14 miles of the River Thames; and a subsequent act prohibited the erection of any new iron-works in Surrey, Kent, and Sussex, and that no timber of the size of one-foot square at the stub, should be used as fuel at any iron work.

The consequent scarcity of fuel compelled those interested in the manufacture, to turn their attention to pit-coal, and there is a most interesting account by Dudley Dudley of his various experiments in its use for the smelting of iron,— his success, however, was not equal to his exertions, and it was not till the early part of the next century that it came into use.

In 1720, celebrated in the annals of our history for the great South Sea speculation, Mr. William Wood, the patentee of the Irish Halfpence, who is satirised by Swift in his Prometheus, endeavoured to establish an Iron Company; he wrote a pamphlet to prove that while we used about 30,000 tons of iron a year, of which we bought 20,000 tons at 10*l.* per ton, England possessed within herself all the essentials for the manufacture. The distress which ensued on the bursting of the South Sea bubble put a stop to this and all the other schemes of the day.

Attention was called to the encouragement of the make of *pig-iron* in our American colonies, and in the year 1750, an act was passed, that pig-iron made in the British colonies in America, may be imported duty free, and bar-iron into the port of London; no bar-iron so imported to be carried coastwise, or to be landed at any port, except for the use of his Majesty's dockyards; and not to be carried beyond ten miles from London. The act contained the following clause:—

"That from and after the 24th June, 1750, no mill or other engine for slitting or rolling of iron, or any plating forge, to work with a tilt-hammer, or any furnace for making steel, shall be erected, or after such erection continued in any of his Majesty's colonies of America."

This act was amended in 1756, extending the importation of bar-iron to *all* the ports of Great Britain, and the opposers of this amendment obtained the repeal of an act of Henry the 8th, which prohibited the conversion of coppice or underwood into pasture or tillage. But the importation till the time of the war never averaged above 4000 tons a year.

We had now to look to foreign countries, the principal of which were Sweden and Russia, for the necessary supply of iron. From these countries we received from *forty*

to *fifty thousand tons per annum*, which continued till the insane conduct of the Emperor Paul of Russia, in 1801, who, in consequence of our resisting his claim to Malta, confiscated our ships, and sent the crews to Siberia, drove us back on our own resources, and with the aid of the blast-engine and improved machinery, we were soon able to do altogether without the assistance of Russia, except as regarded the better descriptions of iron for the manufacture of steel.

The introduction of the blast-engine, the use of coal in the furnaces, and various improvements which took place in the manufacture, I have considered at length in my work on the iron trade, they would be out of place in the present paper. These improvements increased the make so considerably, that in the year 1797, Mr. Pitt, then Chancellor of the Exchequer, proposed laying a duty of 20s. per ton on pig-iron, but after full consideration he abandoned the idea. Lord Henry Petty, however, revived the subject in 1806, the make then being 250,000 tons. He proposed to levy a duty of 40s. per ton on pig-iron, as a war tax, and submit the various processes to the constant inspection of the Excise officers. There was a strong opposition to this measure; amongst other reasons it was stated that the manufacture of iron had this peculiar recommendation, that it had arisen and flourished most in those parts of the country which nature seemed to have doomed to everlasting sterility; and, as Mr. Wilberforce observed, he had never felt a more sensible pleasure in his life than when, after the lapse of a few years, he had returned to a spot once rugged and barren, but then covered by the fruits of human industry, and gladdened by the face of man, in consequence of the introduction of this manufacture.

Notwithstanding a most powerful opposition, the ministers persisted in carrying the bill into committee, but in a few days after the house had resolved itself into a committee, the ministers were induced to abandon the measure.

The great increase in the make, and the demand which arose for new applications of this metal, which required the assistance of foreign iron, gave such confidence in the success of the trade, that in the year 1825, Mr. Herries, Chancellor of the Exchequer, on bringing forward the budget, proposed a considerable reduction in the duties. The duty on foreign bar-iron had gradually risen since 1782 from 2*l*. 16s. 2d. per ton, to 6*l*. 10s. per ton. He said the price of iron has lately risen to an enormous height, (it was 15*l*. 10s. per ton in London), not from any new speculations in that article, not from any belief that the country was to be covered with iron railroads, and that all the iron which could be dug out of the earth would be required to supply the demand, but from a general increase of trade, produced by the increased and increasing comforts and prosperity of the people in this and other nations. The fact was, the supply of iron in this country was not at all in proportion to the demand.

Mr. Huskisson, President of the Board of Trade, proposed the alterations in the duties—and the duty on bar-iron was reduced to 30s. per ton. The resolutions were agreed to, and came into operation on the 5th of January, 1826.

By the desire of Government a comparative statement was prepared of the quantity of pig-iron made in Great Britain in the years 1823 and 1830. It appeared that the make in 1823 was 450,000 tons, and in 1830 it was 670,000 tons. Mr. Poulett Thompson, in his speech on the Navigation Laws and Commercial Policy, in May, 1832, referred to this great increase in the manufacture of iron.

In 1829, Mr. Neilson, of Glasgow, took out his patent for the application of *hot blast* in the manufacture of cast-iron—and this, aiding the *blackband ironstone*, had such an effect, that in about twenty years the make in Scotland rose from 35,000 tons to 800,000 tons, and the general make of the country, in about fourteen years from the reduction of the duty on foreign iron, increased to 1,300,000 tons; in 1847 it was 2,000,000 tons, and in the years 1851 and 1852 it averaged about 2,700,000 tons.

In noticing the opposition we have had to encounter in foreign countries, the *nature* of the iron manufacture must be taken into consideration. This nation has, for many years, been favoured by circumstances as a manufacturing country. We possess, as regards iron, the best and most suitable coals—we have excellent descriptions of ironstone and limestone, and these, in most instances, found together. We have had that security which alone could warrant the large investment of capital required for the efficient carrying out of this manufacture—feeling, that were we sow there shall we reap. No other country has had equal advantages;—either they are without coal, or have had war at their gates. The former will apply to Russia and Sweden; the latter to France, Germany, Prussia, Austria, and other European states. America will be noticed by itself.

It must be understood that, where charcoal is solely used, the quantity of iron made will necessarily be limited. The engine which, by its power, now forces its blast into an immense and dense mass of materials, would be entirely unsuited to a charcoal furnace. The complaint formerly was far more general—that, insufficient as the blast would appear to us, it was too powerful, rather than that it was not powerful enough. The make, therefore, of Russia and Sweden has not been, and cannot be, materially increased.

Mr. Wærn, a member of the Swedish Diet, considers that the reason why the make in Sweden does not increase, is owing to certain duties and restrictions on the part of the Government, and early in this year he brought forward a motion in the Diet, "on the repeal of the taxes on pig and bar iron, as well as of the privileges still in favour of the mining districts and ironworks of Sweden." He wrote a treatise on the subject, a copy of which he was kind enough to send to me. He has made curious, and, he says, "*accurate calculations*" to support his theory. Amongst others, he observes, if we compare the countries which chiefly produce iron for the twenty years ending in 1850, we find that—

| | |
|---|---|
| Great Britain increased . . . . . | 244 per cent. |
| United States of America . . . . | 171 ,, |
| France . . . . . . . . . . . | 141 ,, |
| German Customs Union . . . . . | 60 ,, |
| Austria . . . . . . . . . . . | 130 ,, |
| Belgium . . . . . . . . . . . | 217 ,, |
| Russia . . . . . . . . . . . | 20 ,, |
| Sweden . . . . . . . . . . . | 51 ,, |

and thus the production has increased more rapidly in every country than in Sweden, with the single exception of Russia. Now, if we compare the total production of these countries twenty years ago and that of Sweden at the same time, with what it is now, we find that the production of this country has suffered a decrease of from 1-16th to 1-32nd. I think Mr. Wærn is wrong in his expectation that any modification of the Government restrictions will materially assist in increasing the make. The difficulty Sweden has to contend against is the want of *coal;* andi instead of an attempt to increase the manufacture, a more certain benefit might be derived by permitting the exportation of iron ore, which could be shipped with advantage to Newcastle, and smelted in our furnaces.

Some considerable reductions of late years have been made in Russia in the duties on the *manufactures* of Iron—and some not quite so favourable in Sweden—but they have too great a confidence in their own resources to allow of the importation of pig and bar-iron; besides which, they are likely to have a greater quantity of their own iron for home consumption, as their exports will probably decrease rather than increase, in consequence of several most important discoveries and improvements in the manufacture of steel. Whenever our manufactures are advantageous to Russia, they find their way there;

Russia has been for some years our principal customer for machinery and mill work, and has taken many thousand tons of our rails.

With regard to other countries of Europe, but more particularly France, which may be taken as a type of the whole, the war, and consequent interruption to commerce, caused several manufactures to grow up in France, or considerably to extend those already in existence, for the successful prosecution of which she was not, under ordinary circumstances, anywise fitted; of these iron may be specified as one. The extraordinary demand for warlike instruments gave a powerful stimulus to this manufacture, and when peace was restored, those engaged in it became involved in considerable difficulties. These, however severe they might be in the first instance, were not of a nature that could have continued for any lengthened period; the manufacturers would gradually have changed their business, and instead of producing cannon and muskets, they would have learnt to produce those improved agricultural or manufacturing implements that were either unknown in France, or obtained only from the foreigner; but matters were not allowed thus to adjust themselves. The ironmasters represented to government that they were in a state of extreme distress, and that this distress was occasioned by the importation of foreign iron, and not by the transition from *war to peace*. The government lent a favourable ear to these representations, and in consequence, the duty on foreign iron, which had continued at 2 fr. 20 c. the 100 kilogrammes from the year 1790, was raised in 1814 to 15 fr., being an increase of nearly seven times its previous amount. This, however, was not found sufficient to secure to the ironmasters that monopoly which they were anxious to obtain, and in 1821 they again represented that the increase of duty was insufficient for their protection, and on the 3rd of November in the same year an ordinance was published relative to the importation of foreign iron manufactured by rolling, in fact, *English iron*. It was ordered that, from fifteen days after the publication of the ordinance, all such iron when imported shall be placed in *bond*, and shall afterwards pay the duty which may be fixed by law when taken out of the warehouse for consumption.

The duty was raised from 15 fr. to 25 fr., the 100 kilogrammes.

Notwithstanding the tariff of 1822, the trade was not so profitable as it was before that period. An extensive ironmaster said, we made some profit when we sold at 450fr. the 1040 kilogrammes, or the ton, and we are losers in selling at 500fr., the cause of which is, that in 1819 the *banne* of charcoal cost 18fr. 3c., while it now costs 37fr. 50c. The proprietors of wood, the landowners, received the profit; and as Messrs. Villiers and Bowring, a commission appointed in 1831, in their report on the commercial relations between France and Great Britain, observe:—"In France, a large proportion of those who are interested in the continuance of the existing commercial system are elevated public functionaries, or are placed in immediate contact with them."

The report further observes:—The annual sacrifice made by the agriculturists to the protected ironmasters, has been frequently allowed to be not less than from 1,500,000*l*. to 2,000,000*l*. per annum. The average difference of price between England and France, for the last twenty years, has been more than 10*l*. per ton; and taking the consumption at one hundred and sixty thousand tons a year, the smallest annual loss is 1,600,000*l*. The law of 1822 has been more than ten years—that of 1814 was eight years, in operation. They have cost the French people above 30,000,000*l*. While on the one hand, the revenue is diminished by the operation of the restrictive system, on the other the expenses of the state are increased whenever purchases are made for the public service. The annual purchase of iron, for instance, for the naval and military services, amounts to ten million francs, of which considerably more than one-half would be saved if foreign iron were admitted at a moderate duty.

The French government proposed that in 1835 the duty should be reduced one-tenth, and in 1838 another ne-tenth; there were also certain concessions, as regarded he importation weight of pig-iron; and on the 22nd November, 1853, the tariff was fixed as follows:—

Bar-iron, former duty 6*l*. 12*s*. per ton, reduced to 5*l*. 5*s*. 10*d*. till the 1st January, 1855, and then to 4*l*. 8*s*. per ton. Pig-iron, former duty 2*l*. 16*s*. 8*d*. per ton, reduced to 2*l*. 4*s*. till the 1st January, 1855, and then to 1*l*. 15*s*. 4*d*. per ton. This most probably is all the amelioration we are to expect; it may not be so much as was anticipated, but the iron manufacture of France is not only increasing, but will in all probability still further and largely increase, in common with the German States, particularly Prussia, which has great mineral resources. A French writer (M. de Villefosse) remarked, that what is called in France the price of iron, is in fact the question of the price of *fuel* and the *means of communication*. The materials necessary for the manufacture of iron on the Continent are abundant, but they are seldom, if ever, found together as they are in this country, and therefore the strength of the remark is evident; but a great change is taking place. On looking at our exports, we find a considerable increase of shipments to all the States of Europe. This increase is not for general uses, but is the supply of material for those means of communication of which they have hitherto been debarred, and which will hereafter render them still more independent of our assistance.

I will now refer to America, a more important part of the subject, as regards our exports.

On the 8th of February, 1830, Mr. Cambreleng, the Chairman of the Committee on Commerce and Navigation, submitted to the House of Representatives of the United States his celebrated report, *deprecating the system of commercial restrictions*. He says:—In 1807 the outrages of the two great powers, England and France, made it necessary to commence a series of irregular restrictions on trade, which led to the war of 1812, and terminated finally with that contest in 1815. Previous to these political restrictions, from 1789 to 1807, our country presented a spectacle of prosperity which had never been surpassed by any nation in any age. We had been suddenly emancipated from a colonial condition; we had not then learned to intermeddle with private employments; we had no heavy taxes to encourage smuggling, to diminish consumption, and repress industry; we had no stimulants but profit and enterprise; no guides but intelligence and judgment; we had, it is true, discriminations, minute and manifold, but happily for the country, our imposts were moderate, our speculations harmless, and our trade was free. The succeeding eight years of restrictions and war checked the natural and rapid march of our industry, and drove us into employments new and unsuited to our age and condition.

The peace of 1815 naturally restored us to our old occupations, and the sudden reaction of the tide of commerce swept away a large portion of capital which had been prematurely invested.

It was to protect an employment new and unsuited to the "age and condition" of the United States, that heavy duties were placed upon the importation of iron.

From the 30th June 1816, the duty on bar-iron was fixed at 6*l*. 5*s*. per ton, at which it remained till 1828, when it was raised to 7*l*. 14*s*. 2*d*. per ton. On pig-iron, the duty was fixed at 20 per cent., *ad valorem*, till 1818, when it was altered to 2*l*. 1*s*. 8*d*. per ton, and in 1828 it was raised to 2*l*. 12*s*. 1*d*. per ton.

Mr. Cambreleng observes on these duties:—"Our present tariff is certainly *national* in one respect, *it is injurious to every interest and to every section of the country*."

No alteration was made till the following session, when an act was passed on the 14th July, 1832, which reduced the duty on bar-iron to 6*l*. 5*s*. per ton, and on pig-iron to 2*l*. 1*s*. 8*d*. per ton. This alteration in the tariff was far from being satisfactory to the state of *South Carolina*, which persisted in opposing these laws, on the ground that

it was unconstitutional to impose taxes with the view of protecting particular interests.

They called a convention of the state for the purpose of declaring the tariffs of 1828 and 1832 null and void within its limits; and this was not only done, but the legislature was directed to pass laws prohibiting the collection of duties, and punishing any person who shall dare to do so after the 1st of February, 1833.

This led to what has been called the *Compromise Act*, which was approved by the president on the 2nd of March, 1833. By this act, in all cases where duties on foreign imports shall exceed 20 per cent. on the value thereof, a gradual reduction shall be made till the 30th of June, 1842, when any residue of excess, above 20 per cent., shall be deducted.

The law was allowed to take effect for a few years, but as the reductions came into operation, the manufacturers set up fresh claims for protection, and in 1842 an act was passed which came into operation on the 29th of August of that year, raising the duty on bar-iron to 5*l.* 4*s.* 2*d.* per ton, and on pig-iron to 1*l.* 17*s.* 6*d.*

Happily this state of things did not last many years. The great commercial reforms effected in this country, and more especially the change in the *Corn-laws*, had a powerful influence in the United States, and *the Government* having profited by these and other circumstances, succeeded in carrying a comparatively liberal tariff, which took effect from the 1st of December, 1846—fixing an *ad valorem* duty of 30 per cent. on all descriptions of iron, and 15 per cent. on steel.

In the statement of American duties, I have given those fixed on *rolled or English iron;* hitherto, there has always been a considerable distinction in favour of *hammered iron*, as not so directly coming into competition with the manufacture of the United States. The great boon to England in the present tariff is, that this distinction is altogether done away with, and we enter on equal terms with the make of Russia and Sweden. I have endeavoured to give a connected sketch of the progress of the manufacture, and the various *fiscal obstructions* which have been thrown in the way of our foreign trade. I will in conclusion refer to "*the growth and expansion of our foreign and colonial trade in iron.*"

In the table which accompanies this paper, I have commenced the exports from 1796, having parliamentary returns from that date, but to give a more correct idea of the advancement of our colonial and foreign trade, I have taken certain years, when all matters connected with the war, had settled down, and in which years authentic returns having been made of the production of iron, I have been enabled to show the per-centage of export upon make.

Pliny says, "By means of iron and steel we build houses, hew quarries, and cut in stone; yea, and in one word, *we apply it to all the necessary uses of this life.*"

What Pliny asserts, the experience of eighteen centuries has confirmed. From the delicate and beautiful spring chain of a watch to the great experimental steam ship Leviathan, all is iron. To almost every new invention the adaptation of iron is so obvious, that it is at once resorted to to supply the required want; we have become dependent upon it, as a matter of course, and it is so familiar to our sight, that we pass it unnoticed. But if it were lost to our use, should we not, as Locke observes, "In a few ages, be unavoidably reduced to the wants and ignorance of the ancient savage Americans, whose natural endowments and provisions came no way short of those of the most flourishing and polite nations. Truly may he, who first made known the use of this mineral, be styled *the Father of Arts and Author of Plenty.*"

It would not *altogether* be correct to judge of the progress of civilisation by the consumption of iron; a calculation by Mr. Wærn shows that in Russia it is less than in other civilised nations, and that Sweden and Austria follow closely in her wake. He has reduced all kinds of iron into pig-iron, and makes the following statement of the year 1850:—

| | | |
|---|---|---|
| In the United States of America the consumption was . . . | per head | 88lbs. |
| Great Britain . . . | ,, | 81 |
| France. . . . . | ,, | 36 |
| Hanover and Oldenburg . | ,, | 29 |
| German Customs Union . | ,, | 24 |
| Switzerland . . . | ,, | 18 |
| Sweden . . . . | ,, | 11½ |
| Austria . . . . . | ,, | 11 |
| Russia . . . . . | ,, | 8 |

Mr. Wærn is rather anxious as regards Sweden, and says, at present there is reason to believe that the consumption is 14lbs. per head.

The requirement of iron is *progressive;* it is a progress which we do not easily estimate, because, ourselves and all about us being habituated to the use of it from our infancy, it is what we neither experience nor observe.

The great step in advance is the railroad. This description of iron is only to be met with to any extent in England. It does not come into competition with any home manufacture; it is a national requirement, and must be admitted by *a total abandonment, or by a great reduction of duty.* A railroad requires many appendages of iron; these have either to be supplied in the country itself, or its dependence on England be acknowledged, and many years must necessarily elapse before any nation can compete with us in this description of iron. No *fiscal* obstructions interpose; and while *an iron network* is covering foreign lands, so must our manufacture be the chief source of supply.

With respect to the usual descriptions of iron, all countries which are dependent on others will come to us; we can make it cheaper, and it is readily supplied of any size. As regards iron making countries, with the exception of Russia and Sweden, it must be a matter of cost. By a report of the Secretary of the Treasury of the United States, in compliance with a resolution of the Senate, of March 28, 1853, it appears that on the average of ten years, from 1843 to 1852, we have been able to compete with America in her own markets. The average price of pig-iron at Glasgow being 2*l.* 15s.; at New York, 5*l.* 11s. 6d.; and at Pittsburg, 5*l.* 10s. 8d.

The average price of bar-iron at Liverpool, 6*l.* 12s. 5d.; at New York, 11*l.* 15s. 6d.; and at Pittsburg, 11*l.* 11s. I have appended to this paper *a schedule of the foreign tarriffs*, for the years 1846 and 1853, showing the changes which have been made during that period, and the per centage of increase and decrease in the duties. The decrease in many instances is considerable, and it does not appear to me that it is either likely that any further reduction will at present be made, or that it is of much importance to our trade.

Many European States will no doubt push the manufacture as facilities are increased for the working of the mines, but not to a sufficient extent to drive us out of their or other markets, provided we can manage to make our iron at a moderate cost; we ought to do so, no fiscal obstruction stands in the way. As *customers* for the purchase of our wares, we have, besides our competition in the markets of ironmaking countries, the countries *dependent* on a supply; and our own colonies, with all the *predelictions* of Englishmen for the use of iron. But the extent of our foreign and colonial trade depends principally on the cost, not on the duty.

In the following statement I have reduced all our exports, with the exception of hardwares and cutlery, into pig-iron, and it shows the percentage of export on make, to have been in 1823, 24 per cent.; 1830, 25*l.* per cent.; 1839, 26*l.* per cent.; 1847, 37*l.* per cent.; and the average of 1851 and 1852, 50 per cent. The declared value of all exports of British iron and unwrought steel, including hardwares and cutlery, machinery, and mill-work, was in

1823, 2,111,448*l.*; 1830, 2,698,226*l.*; 1839, 5,231,631*l.*; 1847, 8,870,775*l.*; and in 1851, 8,594,961*l.*

The proportion from different ports, at which the shipments for 1851 were made, is as follows:—

| | |
|---|---|
| London | £1,582,498 |
| Liverpool | 4,813,773 |
| Bristol | 223,217 |
| Hull | 1,073,732 |
| Other English Ports | 320,981 |
| Total, English Ports | £8,014,201 |
| ,, Scotch Ports | 561,819 |
| ,, Irish Ports | 18,941 |
| Together | £8,594,961 |

The great difficulty England has to contend with is *labour;* in that *word,* iron is really described. The iron manufacture *of all trades,* is that in which, if it were possible, a fair and reasonable understanding should be come to between the masters and men. In the great iron district of South Wales, this might, and probably has to some extent been carried out, because, around many of the larger works, a native population has sprung up, who are aware of their dependence on the works; it is true they have had occasional outbreaks; but nevertheless, from my own experience, they are generally open to reason.

But in South Staffordshire, from the intermixture of iron works and sale collieries, anything like an arrangement seems impossible. I am, however, satisfied that a reasonable rate of wages is more advantageous to the men and their families, than the high rates for which they occasionally contend; and a moderate cost of iron is likely to be of more permanent benefit to the ironmasters.

I will close my paper by reading an extract from a letter, bearing upon this point, from a friend at Marseilles, a practical, and very sensible person; it is dated June, 1854:—

"A material change has taken place in the relative positions of the iron trade in France and England during the last five or six years. The increased number of works, and the improved modes of working, *with the moderate wages paid in France,* have tended to render French iron cheaper; and now that wages and the price of coal and ironstone in England are so high, and with a brisk demand for iron, we find ourselves able to manufacture iron in France nearly as cheap as we could get it in England, even if the duty were taken off. At our forge we roll from ten to twelve tons of boiler plates *per diem,* of superior quality, as they are principally made from scrap—and these plates do not cost us more than 15*l.* to 16*l.* per ton. At present English prices, we certainly could not import them for less, independent of duty.

"It has been my opinion for some time past that *strikes* would deprive England of much of her foreign trade in iron, *for in all parts of the world the materials for makin / it are to be found, and we are more economical in the use of our fuel, a thing but little attended to in England.*"

I have applied high pressure to my condensing engine to confine this vast subject within moderate limits. I have laboured to be short; I trust that I have not been obscure.

## EXPORTS OF BRITISH IRON, INCLUDING UNWROUGHT STEEL.

| Where to. Years | AVERAGE. 1796 to 1805. | 1806 to 1812. | 1815. | 1823. | 1830. | 1839. | 1847. | 1851. | 1852. |
|---|---|---|---|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. |
| Colonies | 13,780 | 18,842 | 23,611 | 29,272 | 39,847 | 58,630 | 71,127 | 159,709 | 141,460 |
| United States | 6,169 | 5,605 | 12,720 | 9,921 | 15,154 | 74,772 | 137,983 | 464,559 | 501,158 |
| Other Countries | 4,168 | 6,517 | 12,120 | 34,757 | 62,047 | 114,510 | 340,599 | 295,211 | 393,266 |
| Total Tons | *a* 24,117 | *a*30,964 | 48,451 | 73,950 | 117,048 | 247,912 | 549,709 | 919,479 | 1,035,884 |
| Declared value | | | 1,090,936 | 878,918 | 1,078,523 | 2,719,825 | 5,265,779 | 4,599,339 | no return |
| Make of Iron . Tons | *b* 125,000 | *c* 258,000 | no return | 450,000 | 670,000 | 1,300,000 | 2,000,000 | 2,700,000 | |

HARDWARE AND CUTLERY, declared value.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | £ | £ | £ | £ | £ | £ | £ | £ | £ |
| Colonies | | | 423,492 | 267,328 | 317,356 | 444,560 | 547,252 | 527,879 | 704,655 |
| United States | | | 1,196,485 | 422,130 | 662,126 | 849,640 | 931,203 | 1,080,487 | 968,493 |
| Other Countries | | | 541,584 | 385,226 | 431,454 | 534,321 | 863,526 | 1,218,645 | 1,018,549 |
| Total . £ | | | 2,161,561 | 1,074,684 | 1,410,936 | 1,828,521 | 2,341,981 | 2,827,011 | 2,691,697 |
| Quantity . Tons | | | 14,363 | 9,095 | 13,369 | 21,177 | 20,615 | 27,625 | 25,290 |
| MACHINERY AND MILLWORK. Declared value . £ | | | | 157,846 | 208,767 | 683,285 | 1,263,015 | 1,168,611 | no return |
| Total value of Exports £ | 2,413,273 | no return | 3,252,497 *d* | 2,111,448 | 2,698,226 | 5,231,631 | 8,870,775 | 8,594,961 | incomplt. |

*a* Including Hardware and Cutlery. *b* The make of 1796. *c* The make of 1806.

*d* This large amount is attributable to the heavy shipments at the close of the war.

AVERAGE PRICES OF BAR AND PIG IRON.

| Bar Iron at Liverpool. Years. | | Per Ton. | Pig Iron at Glasgow. Per Ton. |
|---|---|---|---|
| 1806 to 1812 | . . . | £14 17 6 | |
| 1815 | . . . | 12 2 6 | |
| 1823 | . . . | 8 0 0 | |
| 1830 | . . . | 6 0 0 | |
| 1839 | . . . | 9 17 6 | |
| 1847 | . . . | 9 6 0 | £3 12 6 |
| 1851 | . . . | 5 0 0 | 2 0 9 |
| 1852 | . . . | 5 14 6 | 2 3 6 |

The average price of Pig Iron at Glasgow for 10 years, from the 1st January, 1842, to the 1st January, 1852, was £2 16s. 8d. per ton.

TARIFFS OF FOREIGN COUNTRIES RELATING TO IRON, with rates of Duty in the years 1846 and 1853, shewing the changes that were made within that period, with the per centage increase or decrease.

| COUNTRIES. | per | Rates of Duty. No change. 1846 | Changes made. 1846 | Changes made. 1853 | Increase per Cent. | Decrease per Cent. |
|---|---|---|---|---|---|---|
| | | £ s. d. | £ s. d. | £ s. d. | | |
| RUSSIA. | | | | | | |
| Steel, all kinds, raw ... | cwt. | ... | 0 12 6 | 0 7 9½ | ... | 38 |
| Iron and steel wire and springs ... | ,, | ... | 3 0 0 | 0 18 8 | ... | 68½ |
| Sheet iron, manufactured articles of all kinds ... | ,, | ... | 1 16 0 | 0 15 6¼ | ... | 57 |
| Sewing needles... | lb. | ... | 0 13 6 | 0 5 6¾ | ... | 59¼ |
| Packing needles, &c. ... | ,, | ... | 0 3 6¾ | 0 1 5¾ | ... | 59½ |
| Swords ... | ,, | Prohibt. | Prohibt. | 0 7 5 | Proh | Rmd |
| Knives, &c. ... | ,, | ... | 0 4 6 | 0 2 7¼ | ... | 42½ |
| Fine cutlery ... | ,, | ... | 1 1 9 | 0 7 5 | ... | 65¼ |
| Saws, files, &c. ... | cwt. | ... | 0 15 4 | 0 10 4½ | ... | 32½ |
| Smiths' work, forged, without filing or polishing, as anchors, nails, &c... | ,, | ... | 1 16 2½ | 0 10 4½ | ... | 70¾ |
| Locks, hinges, screws, etc. unpolished... | lb. | ... | 0 4 6 | 0 0 6¾ | ... | 87 |
| Do. polished, and steel pens... | ,, | ... | 0 4 6 | 0 1 10½ | ... | 57½ |
| Firearms, and parts thereof ... | ,, | ... | 1 1 9 | 0 4 5½ | ... | 77¾ |
| *Prohibited*—Pig and bar iron by sea. | | | | | | |
| SWEDEN. | | | | | | |
| Anchors ... | 300 lb. | ... | 0 10 0 | 0 8 4 | ... | 16¾ |
| Bar iron ... | ,, | ... | 0 5 0 | Prohibt. | | |
| Hoops ... | ,, | ... | 0 8 4 | Prohibt. | | |
| Scissors ... | lb. | ... | 0 5 10 | 0 2 8 | ... | 54¼ |
| Steel, cast ... | 75 lb. | ... | 0 3 4 | 0 2 2½ | ... | 33¾ |
| All other kinds except shear ... | ,, | Prohibt. | Prohibt. | 0 5 0 | Proh | Rmd |
| Nails, 2in. and upwards | 320 lb. | 0 17 8½ | | | | |
| Other nails, and all wrought iron manufactures made by hand or machinery ... | ,, | 0 1 4 | | | | |
| Needles, sewing, etc. ... | lb. | 0 0 8¾ | | | | |
| Sword blades... | ,, | 0 0 4 | | | | |
| Cannon, bored ... | 300 lb. | 0 13 4 | | | | |
| Do. unbored ... | ,, | 0 6 8 | | | | |
| Hearths, above 1½ inch thickness ... | ,, | 0 7 6 | | | | |
| Old castings, spoiled cannon and bombs ... | ,, | 0 3 4 | | | | |
| Pots, kettles, etc... | ,, | 0 10 0 | | | | |
| Castings for machinery | ,, | 0 10 0 | | | | |
| Cast iron work, not otherwise specified ... | 25 p. c. | ad val. | | | | |
| Chain cables ... | 300 lb. | 1 0 10 | | | | |
| *Prohibited*—Pig & Ballast iron and old iron, and the *Exportation* of iron ore. | | | | | | |
| NORWAY. | | | | | | |
| Bar iron... | 5 cwt. | ... | 0 9 0 | 0 7 1 | ... | 21¼ |
| NORWAY—*Continued.* | | | | | | |
| Machinery for agricultural and industrial purposes... | ,, | ... | Free. | Same as raw material. | | |
| Pig and old iron for remelting ... | 300 lb. | 0 1 4 | | | | |
| Steel manufactures ... | ,, | 0 0 2½ | | | | |
| DENMARK. | | | | | | |
| Iron and steel wire ... | lb 110$\frac{1}{10}$ | ... | 0 7 0½ | 0 3 4½ | ... | 52 |
| Ironmongery, coarse and rough ... | ,, | . . . | 0 7 0⅜ | 0 3 6¼ | ... | 50 |
| Do. fine and polished ... | ,, | ... | 0 7 0¼ | 0 14 0¾ | 100 | |
| Do. incrusted, faulted and plated ... | 1$\frac{1}{10}$ lb. | ... | 0 1 1½ | 0 0 4½ | ... | 66¾ |
| Pig and old cast iron ... | 100 lb. | Free. | | | | |
| Bar and hoop ... | ,, | 0 0 10 | | | | |
| Ballast ... | ,, | 0 0 5⅝ | | | | |
| Nails and spikes, 3 in. and above ... | ,, | 0 3 0 | | | | |
| Do. under 3 in... | ,, | 0 4 8¼ | | | | |
| Plates, hammered and rolled, if exceeding ⅛ in. in thickness... | ,, | 0 0 10 | | | | |
| Do. under ⅛ in. (black). | ,, | 0 3 4½ | | | | |
| Do. white, or tin plates (in boxes, 12 cwt.) ... | 100 lb. | 0 5 3 | | | | |
| Anchors ... | ,, | 0 3 6¾ | | | | |
| Chains, steam boilers, tanks, and anvils ... | ,, | 0 3 6¾ | | | | |
| Castings, cannon, etc.... | ,, | 0 3 6¾ | | | | |
| Do. more highly polished | ,, | 1 8 1½ | | | | |
| Knitting implements, etc. ... | ,, | 3 15 0 | | | | |
| HOLLAND. | | | | | | |
| Iron, in blocks, pigs, ore, forged staves, rods, band and plate, and rails for railroads | ... | ... | 1 fl. a. s. | ½ fl. a. s. | ... | 50 |
| Anchors and cables ... | ... | ... | 6 ,, | 1 ,, | ... | 83¼ |
| Machinery... | ... | ... | 6 ,, | 1 ,, | ... | 83¼ |
| BELGIUM. | | | | | | |
| Tin plates, unwrought.. | cwt. | 0 10 5 | | | | |
| Steam engines, fixed ... | ,, | 0 6 3 | | | | |
| Do. for navigation ... | ,, | 0 10 5 | | | | |
| Locomotives ... | ,, | 0 14 7 | | | | |
| Carding machinery ... | ,, | 1 11 3 | | | | |
| Tenders, boilers, etc. ... | ,, | 0 8 4 | | | | |
| Unenumerated ... | ,, | 0 10 5 | | | | |
| Machinery, detached pieces ... | ,, | | | | | |
| Casts ... | ,, | 0 8 4 | | | | |
| Wrought iron ... | ,, | 0 10 5 | | | | |
| GERMAN COMMERCIAL UNION. | | | | | | |
| Iron, raw ... | cwt. | 0 1 0 | | | | |
| Pig iron, rails; raw, cast, and refined steel | ,, | 0 4 6 | | | | |
| Wrought iron, and in bars of ½ in. ... | ,, | 0 4 6 | | | | |
| Do. less than ½ in... | ,, | 0 7 6 | | | | |
| Wrought in a rough shape, for machinery, etc. weighing 1 cwt. and upwards ... | ,, | 0 9 0 | | | | |
| Do. weighing less than 1 cwt. ... | ,, | 0 18 0 | | | | |
| Ship chains ... | ,, | 0 9 0 | | | | |
| Iron for fittings of locomotives ... | ,, | 0 9 0 | | | | |
| Steel, polished plates ... | ,, | 0 12 0 | | | | |
| Needles, knitting, etc. varnished wares, etc.. | ,, | 7 10 0 | | | | |
| FRANCE. | | | | | | |
| Steel, raw, drawn... | cwt. | ... | 2 1 8 | 1 8 4 | ... | 32 |
| Do. cast, drawn ... | ,, | ... | 2 1 8 | 1 16 7 | ... | 12¼ |
| [The alterations in French duties noticed in paper.] | | | | | | |
| SPAIN. | | | | | | |
| Pig iron ... | 101 lb. | ... | 0 1 8 | 0 2 1½ | 27½ | |
| Bar iron ... | ,, | ... | 0 12 6 | 0 10 8½ | ... | 14¾ |
| Steam engines ... | ,, | ... | Free | 3 fl. a. s. | Dty. imp. | |
| Other engines or machinery ... | ,, | ... | Specific | a. s. | ... | |

| COUNTRIES. | per | Rates of Duty. No change. 1846 | Rates of Duty. Changes made. 1846 | Rates of Duty. Changes made. 1853 | Increase per Cent. | Decrease per Cent. |
|---|---|---|---|---|---|---|
| | | £ s. d. | £ s. d. | £ s. d. | | |
| SPAIN—*Continued.* | | | | | | |
| Cutlery—knives and forks, per doz. pair ... | from | ... | 0 0 10 | 0 0 $7\frac{1}{2}$ | ... | 25 |
| | to | ... | 0 1 8 | 0 2 0 | 20 | |
| Rails, wheels, carts, etc. for working mines ... | 101 lb. | 0 2 7 | | | | |
| PORTUGAL. | | | | | | |
| Pig and bar iron ......... | 100 lb. | ... | 0 1 5 | 0 0 $4\frac{3}{10}$ | ... | $74\frac{1}{2}$ |
| Sheet ......... | ,, | ... | 0 1 $0\frac{1}{2}$ | 0 0 $6\frac{4}{10}$ | ... | 48 |
| Hoops ......... | ,, | ... | 0 1 $0\frac{1}{3}$ | 0 0 $6\frac{4}{10}$ | ... | 48 |
| Chains, anchors, etc. ... | ,, | ... | 0 2 1 | 0 1 $9\frac{6}{10}$ | .. | 14 |
| Wire ......... | ,, | ... | 0 5 $7\frac{1}{4}$ | 0 6 9 | 21 | |
| Steel, unwrought......... | ,, | ... | 0 2 1 | 0 0 $8\frac{6}{10}$ | ... | 68 |
| Tools of all kinds......... | from | ... | 0 11 $3\frac{2}{10}$ | 0 13 6 | 20 | |
| | to | ... | 1 2 $5\frac{1}{2}$ | | ... | 40 |
| Scissors ......... | ,, | ... | 14 1 3 | 6 15 0 | ... | 52 |
| Knives, wooden handles | ,, | ... | 2 16 3 | 2 14 0 | ... | 4 |
| Do. bone......... | ,, | ... | 5 12 6 | 3 7 6 | ... | 40 |
| Do. ivory ......... | ,, | ... | 13 10 $0\frac{1}{2}$ | 4 1 0 | ... | 70 |
| AUSTRIA. | lb | | | | | |
| Iron, raw ......... | $100\frac{26}{100}$ | ... | 0 8 $4\frac{1}{2}$ | 0 1 6 | ... | 82 |
| Bars......... | ,, | ... | 0 12 0 | 0 5 0 | ... | $58\frac{1}{2}$ |
| All cast, hammered, and wrought work, household wares, agricultural implements, etc... | lb $100\frac{26}{100}$ | from | 1 4 0 | 0 10 0 | ... | $58\frac{1}{4}$ |
| | | to | 6 0 0 | | ... | $91\frac{1}{2}$ |
| Fire-arms, razors, pen knives, surgical instruments, etc......... | ,, | ... | 6 8 4 | 2 10 0 | ... | 61 |
| SARDINIA. | | | | | | |
| Rails for railroads ...... | cwt. | ... | 1 4 0 | 0 4 0 | ... | $83\frac{1}{4}$ |
| Anchors ......... | ,, | ... | 0 8 0 | 0 4 0 | ... | 50 |
| Wire ......... | ,, | ... | 0 8 0 | 0 4 0 | ... | 50 |
| Carriage springs ......... | ,, | ... | 1 4 0 | 0 12 0 | ... | 50 |
| Rods and agricultural implements ......... | ,, | ... | 0 10 0 | 0 5 0 | ... | 50 |
| Machinery, such as weavers' cards, etc......... | ,, | ... | 0 4 0 | 0 2 0 | ... | 50 |
| SWITZERLAND. | | | | | | |
| Pig and bar iron ......... | $110\frac{1}{4}$ lb | ... | 0 0 $1\frac{1}{2}$ | 0 0 3 | | |
| Steel, unwrought......... | ,, | ... | 0 0 $1\frac{1}{3}$ | 0 0 $7\frac{1}{2}$ | | |
| Do. plated wire......... | ,, | ... | 0 0 $1\frac{1}{2}$ | 0 2 11 | | |
| Hardwares, unwrought, cast, plates, stoves, wheels, etc. ......... | ,, | ... | 0 0 $1\frac{1}{2}$ | 0 0 $7\frac{1}{2}$ | | |
| Cutlery of every description ......... | ,, | ... | 0 0 3 | 0 6 8 | | |
| Machinery of all sorts... | ,, | ... | 0 0 3 | 0 6 8 | | |
| [The per centage increase in the new duties is omitted, as the duties in 1846 were only nominal in effect; and the new duties, although apparently very high in comparison with the old duties, are but moderate when compared with those levied in other countries.] | | | | | | |
| TURKEY. | | | | | | |
| Iron in bars ......... | 125 lb. | ... | 0 0 $3\frac{6}{10}$ | 0 0 $2\frac{6}{10}$ | ... | 28 |
| MEXICO. | | | | | | |
| Pig iron ......... | 101 lb. | ... | 0 6 0 | 0 4 0 | ... | $33\frac{1}{4}$ |
| Bar iron ......... | ,, | ... | 0 12 0 | 0 6 0 | ... | 50 |
| Steel ......... | ,, | ... | 0 8 0 | 0 6 0 | ... | 25 |

## DISCUSSION.

Mr. P. L. SIMMONDS said that the subject which they were met to consider had been most ably brought before them, but there were one or two points connected with the iron trade which he wished to lay more fully before the meeting. This had been well termed a metallic age, and from the various purposes to which iron could now be applied, the term appeared to him to be most expressive. It would seem that their Colonial demand for iron was likely to go on increasing from year to year. And Mr. Scrivenor had well shown that this country was better able to supply that demand than any other. It had also been shown that the Colonies possessed vast mineral stores as yet undeveloped, should those of England fail, of which, however, he did not think there was any prospect. He would not go into details relative to the various purposes to which iron could be applied, but as Mr. Scrivenor had alluded to the net-work of iron roads by which this country was intersected, he might be allowed to add some few particulars to that gentleman's observations. Three years ago they had in this country only 7,000 miles of railroad under traffic, on which 2,500 engines were at work, whilst, including sidings, double lines, &c., they had now probably 25,000 miles at work, in the construction of which about 1,500,000 tons of iron had been consumed. In four or five years the United States would probably be traversed by 30,000 miles of railway, there being now in operation in the States upwards of 15,000 miles. In the British American Colonies there were also several thousand miles of railway in the course of construction, and on the Continent the number of miles in operation was probably not less than 12,000 miles. But there were other and most important purposes to which iron was being applied, such as the building of palaces, warehouses, dwellings, steamers, &c. Five years ago only eight per cent. of their steamers were built of iron, whilst now the proportion was not less than 70 or 80 per cent., and there was no doubt iron vessels would very shortly supersede wooden vessels altogether, if some anti-fouling composition could be discovered to keep their bottoms clean, and preserve the iron from the effects of the sea. When they saw that boiler-plates were being made weighing $1\frac{1}{2}$ tons, engine-shafts of four tons, and cylinders of 28 or 30 tons, it was clear that the demand for iron must go on very naturally increasing. There were likewise other stupendous structures tending to increase the demand for iron. The high level bridge at Newcastle consumed 5000 tons of iron; the Menai bridge, 11,500 tons, and there was now constructing in Canada the Victoria bridge, across the St. Lawrence, which would be nearly two miles in length. There could also be no doubt that the conveniences and comforts of life were spreading far and wide the demand for gas and water pipes; and it was only about two months since that a firm in Glasgow took a contract for 36,500 tons of gas and water pipes; and the city of Melbourne alone required 19 miles of these pipes, and Rio Janeiro about 30 miles of gas pipes. Calcutta and other eastern towns were also in the market for contracts for pipes, lamp posts, gasometers, &c. There were several very valuable remarks made by Mr. Scrivenor on the consumption of iron in the United States, to which he thought he might be allowed to add one or two observations. A great increase had taken place in the value of iron and steel imported into the United States after the alteration of the tariff in 1846. Thus the imports of 1847 were valued at 5,500,000 dols. In 1848 they had increased to 12,500,000; in 1850 to 16,250,000; in 1851 to 17,500,000, and in 1852 to 21,500,000, and the increase was still going on. In 1842 the American import of bar and pig-iron was 100,055 tons, and the extent of production in the States amounted to 230,000. In the year 1846, under the altered tariff, the imports were 69,625 tons, and the home production 76,500 tons; but in 1851 the imports were 341,750 tons, and the production 41,300. According to the official returns of 1850, the production of pig-iron in the United States was 564,775 tons, and the wrought-iron made was stated at 272,044 tons. At the same period, the number of works for pig-iron were 375, and 422 were devoted to the manufacture of wrought-iron, of which number not less than 311 were in the coal state of Pennsylvania. Should the home supply of England prove, at any time, unequal to the demand, they had abundant deposits of iron-stone in many of their Colonies, viz. in Australia, in Canada, Nova Scotia, and many parts of India; and not only so, but they had plenty of wood, and in some places valuable deposits of coal to assist in its working and developement. Four years ago a very valuable report was made by

Major Drummond to the East India Company on the subject of India iron, in which he said, "The centre of India, from Nerbudda to Assam, abounds in coal and iron stone formation, capable of yielding iron similar to that of Great Britain—the ore containing from 30 to 50 per cent. of metallic iron. The Himalayas, Gwalior, and other districts possess in great abundance the richer ores capable of yielding the superior iron of Cumberland, Sweden, and other parts of Europe. Accompanying these last are extensive forests, from which can be obtained in profusion the fuel necessary for their reduction, viz., wood charcoal." Much further important evidence could be adducad to prove the supplies of iron which might hereafter be obtained from India. He perfectly agreed with Mr. Scrivenor, that they would be able to hold their ground for a very lengthened period against foreign states; for, notwithstanding the high price of labour, the power they now possessed by the use of machinery was so great, and the saving thereby effected so important, that they felt the deprivation of labour much less than formerly. The monetary crisis of 1847 gave a temporary check to the production and export of iron from this country; but the gold discoveries, the extensive emigration, and the general prosperity of the Colonies, gave an additional impetus to the trade during the last few years, so that the make of iron in this country now approximated to 3,000,000 tons per annum. He understood Mr. Scrivenor to stop short in his paper with regard to his statements of the value of the metallic industry of the country. If he mistook not, that gentleman only gave the value of their machinery, hardware, and other iron manufactures down to 1851, when it was stated at 8,500,000*l.* Had he pursued his investigations, he would have found that the value had much increased since that time. Indeed, from 1849 to 1852, the value of their exports in hardware, machinery, &c., had steadily increased at about the rate of 1,000,000*l.* per annum, but in 1853 they reached 17,500,000*l.*, being an increase, in one year, of upwards of 6,000,000*l.*, and the exports of the present year, although they had been somewhat checked by adverse circumstances—the war—the glut of the Australian markets—the commercial disasters of America, &c., showed no falling off. Indeed, they would probably reach 18,000,000*l.*, the value for the first 10 months of the year being 15,250,000*l.* These facts he had deduced from the returns of the Board of Trade, and, therefore, they might be relied upon as accurate. He would not go through all the detailed accounts with which he was furnished, but would content himself with calling attention to a few items. In 1849, the declared value of the hardware and cutlery imported was rather less than 2,250,000*l.*, but in 1853 it had risen to upwards of 3,500,000*l.* The machinery and mill work in 1847 was 700,000*l.*, and in 1853 nearly 2,000,000*l.* In the same period their exports of iron and steel had increased from about 5,000,000*l.* to 11,000,000*l.*, and of tin plates, which formed a portion of iron manufacture, from 709,000*l.*, to 1,200,000*l.* The total showed that the declared value of iron manufactures exported had increased from 8,500,000*l.* in 1849, to 17,500,000*l.* in 1853, and in the present year it would probably exceed 18,000,000*l.* It must be remembered, in taking these figures into consideration, that the amount exported was little more than half their production. If they were, therefore, to double the declared value of their exports, they would arrive at about 36,000,000*l.* as the total value of the iron production of this country, exclusive of its other metallic produce; and the declared value, be it also remembered, was not equal to the real value. They would, however, see that in a little more than thirty years the value of their exports of iron had been increased by no less than 850 per cent. He did not know that he could add anything more to the observations he had already made, but he had thrown together these facts, believing that it was desirable to be in possession of the utmost information on the subject, and trusting that they might prove useful in its consideration.

Mr. W. Bird had attended the meeting more as a listener than as a speaker, and he was afraid, in the few observations which he proposed to make, he should not be able to add much to the instruction or interest contained in so able a paper as that of Mr. Scrivenor. There were so many valuable observations in that paper, and it embraced so wide a range, that it was almost impossible to pitch on any salient points on which to raise a discussion, or to bring objections against the observations made by the author. There was so much of the valuable paper laid before them in which he entirely agreed, that he was almost afraid to venture to make two or three remarks upon portions with which he disagreed. In the early part of his paper, Mr. Scrivenor endeavoured to show that the development of important manufactures was not materially affected by Government interference. He (Mr. Bird), on the contrary, maintained that, whenever the Government interfered with the manufacture of any article, it was invariably spoiled. So important a manufacture as that of iron—and he might be allowed to state that he spoke not of iron *per se*, but of cheap iron—could not for one moment exist, if by any extraordinary hallucination of Government, it was fettered by such a tax as that formerly proposed by Lord Henry Petty; and he trusted they would never have to oppose the imposition of such a tax. The date of the English iron trade, or of cheap iron, went no further back than the introduction of Neilson's hot-blast, which brought a large quantity of otherwise useless material into profitable working; yet so great was the prejudice in England against the hot-blast that it was a considerable time before it was brought into general use. When, however, it came into operation the production at once increased, and of so great importance did it become to the interests of the country, that whereas in 1832 the exports were only 146,000 tons, in 1853 they had increased to 1,250,000 tons. Indeed, in twenty years the exports had increased tenfold. The greater portion of that increase, as well as a large part of the home consumption, which had increased nearly threefold, or from 550,000 to 1,500,000 tons was to be attributed to the improved facilities, and the reduced cost of transit. The demand for iron caused by the railways, had produced a corresponding advantage in the reduction of the cost of its transit. This was a matter of great importance, and, therefore, he could not agree with Mr. Scrivenor, that the increase of these facilities abroad would make other countries independent of England. The more they encouraged the extension of railways on the continent—and thereby improved the facility of transit, the more able would we be, even with the disadvantage of the existing duties, to convey our pig-iron throughout the continent. If railway facilities were increased, English iron would become a staple article to assist in the payment of their cost, and, with their extension over the larger portion of Germany, the increase of the iron trade would, *pari passu*, advance. He did not, therefore, look upon the extension of railways as likely to shut them out from any portion of this trade, but rather as giving a greater area for its development. The facilities of transport, though largely increased during the last ten years, were not so great as to give them any cause of fear at the natural demand for iron from this country being in any way interfered with. Even in the Zollverein, Mr. Scrivenor stated, the production of iron had greatly increased; but they might depend upon it that where so much depended on the bars of rivers or freshes, on the state of the roads, and horse and cart traffic, it could not materially increase. Indeed, if there should be an epidemic amongst thirty or forty horses, or a waggoner got drunk, many furnaces in Silesia would be affected. He had received a letter only yesterday from his son, who was in that country, stating, of course in jest, that the roads were so bad that they had lost a horse and cart with a load of pig iron—no trace could be discovered of them. He could not help attri-

buting a large portion of the increase which had taken place in the consumption of iron to the low prices which prevailed in 1851, and to the effect of the Great Exhibition of that year. He had not the slightest doubt that the numerous foreigners who visited this country in that year, and saw the display which was made of raw materials, on their return home told the manufacturers of their respective countries that they must obtain their iron from this country. The result was that the price of pig-iron at Glasgow, which in 1851 was at 36s. per ton, had since been gradually rising, until it had at one period reached upwards of 90s. This showed that the Exhibition did great good to this country, and he believed that the exhibition which was to take place in Paris next year would be productive of equal good if our producers were careful to show good examples of raw materials. Mr. Simmonds had spoken of the railways, and though he might be correct as to the number of miles in operation, he (Mr. Bird) was convinced he was incorrect in regard to his estimate of the quantity of iron used in their construction. Mr. Simmonds had stated that quantity at 1,500,000 tons, but he believed that 2,500,009 would be nearer the mark. If, then, from abrasion or other causes, there was an average depreciation of the rails to the extent of ten per cent. in the year that would produce an annual demand of from 220,000 to 250,000 tons of iron per annum to make up for that depreciation. They would therefore see that every mile of railway laid down not only gave them a benefit in the first instance, but also caused a constant demand to make up for the abrasion or depreciation. The question of the effects of tariffs on the extension of the iron trade was one on which he begged most humbly to differ with Mr. Scrivenor. He thought that every fiscal regulation was an obstacle to the extension of the iron trade abroad, and altogether detrimental to national interests. On this subject Cambrelling truly remarked, "It is national in one respect—it is injurious to every interest and every section of the country." He was satisfied that the placing a duty on iron was to make it dear instead of cheap, and in order to make a producing iron country—destroyed that country as a consuming country. The advancement of a country in wealth and comfort was in proportion as it could obtain a plentiful and *cheap* supply of iron. Therefore they did an injury to a country, when, on the chance of making it a producing, they so far advanced the prices as to destroy it as a consuming country—as was the case in Prussia, here they had no rapid and cheap means of transit to carry their produce to market. If they took one of the largest works of Austria, which was within three miles of the Emperor Ferdinand's Northern Railway, they would find that the only means of transit was by common carts. It was no use making a country a producing one unless they had the means of conveying the article manufactured to the market when it was produced. To revert to the tariff regulations, there could be no doubt, if the Glasgow manufacturers could supply good pig-iron at 60s. or 70s. per ton—and before it was brought to the market it was raised by fiscal regulations to 150s.—th at the latter price must prove a great obstacle to the enlargement of trade, and therefore all argument and experience showed the value of cheap iron, and that the laying heavy duties upon it was politically and economically a great mistake. If they were to take a cargo of pig-iron and consign it to Vienna, its value would be raised by fiscal regulations to 10 per cent. above that of the Hungarian charcoal-iron, and yet it was admitted by Hungarians themselves that they did not mind paying more for a small portion of the Glasgow hot-blast iron to mix with their raw charcoal-iron. Let us follow a cargo of iron by the Elbe to Austria; it was stopped at Stade to pay an impost to Hanover, because one bank of the Elbe belonged to that country. If Hanover levied a duty, why should not also Denmark, which was situated on the opposite bank? After shifting the cargo at Hamburg into river boats, it was conveyed only a few miles, when it was stopped at Lunenburg to pay toll to Denmark; it then proceeded to Mecklenburg, where it paid another toll—at Brunswick, another toll—and, on entering Prussia, another—so that, in fact, there was nothing but toll upon toll until the cargo arrived at Vienna. Could it be supposed that these fiscal duties were no obstacle, as Mr. Scrivenor said, to the sale of iron at its destination. These tariffs were the primary cause of the want of transit facilities; and if the continental powers would take off the duties, this country would first find the rails with which to make the railways, and afterwards carry iron over them to pay by the traffic for their construction. He thought there was no subject of greater importance to the interests alike of the continent and this country than the one now under consideration. If those countries imported the raw material from England at a cheap rate, they would be enabled to send back to this country cast-iron ornaments which it did not possess, and for which a fair and equitable rate would be paid in the pig-iron exported.

Mr. Winkworth said, that he rose with some hesitation after Mr. Bird, who had so fully and ably touched upon the most important topics arising out of the valuable paper which had originated the discussion. There was, however, one point to which he might, perhaps, venture to address himself for a few moments, although to some extent he had been anticipated by his friend. He alluded to the striking illustration which the comparatively recent history of the export trade in iron afforded of the salutary effect of reduced tariffs. The Society could not fail to have been struck with the remarkable augmentation of exports to the continent which had followed the relaxed duties of which Mr. Scrivenor had furnished us with the details. He (Mr. Winkworth) had looked over the statistical information on the subject which he found on the table, and regretted to find that, owing to the exceptional condition in which that country was now placed by the war, which had made, so lately as 1853, the largest reduction on the import duty on iron of any of the European states—he meant Russia—the full advantage of the policy could not be realised. He felt some hesitation in alluding to this circumstance, but as it was not a question of politics, but simply of political economy, he perhaps might be permitted to say that he hoped no antiquated prejudices on this subject would be allowed to interrupt that unfortunately limited trade between belligerent countries through neutral states, which, up to this moment, had existed. He was old enough to recollect the Berlin and Milan decrees, by which the first Napoleon had attempted to destroy the continental trade of Great Britain,—a policy scarcely less suicidal and absurd than that which influenced a man to burn a quantity of Bank of England notes to punish the directors for ceasing to pay, under legislative authority, in gold and silver. There were many products peculiar to this country, which Napoleon's subjects would or could not do without, and which, therefore, they could only obtain at an enormous advance on the cost. So, then, of the articles which Russia could best supply to this country, namely—tallow, hemp, and, perhaps, corn—could there be any adequate reason why we should not be permitted to exchange them for commodities of which that country stood most in need, such, for instance, as iron, wrought and manufactured, always excepting implements of war? All trade, when resolved into its ultimate principles, was barter, and we need not fear that the precious metals would be exported in payment for these Russian products to any serious extent, as the adverse state of the exchanges, which was the pulse by which to ascertain the sanatory condition of external commerce, would, at the proper time, prevent an undue efflux. It should, however, always be borne in mind, that even these metals could scarcely yet be deemed indigenous to these islands, and must, therefore, be previously bought with, or exchanged for, our manufactures. Commerce was the pioneer of civilisation, and he incurred a fearful responsibility who, under an erroneous estimate of its obliga-

tions during a state of warfare, interposed additional obstacles to its free development.

Mr. R. F. Davis rose with considerable diffidence to address them, after the able manner in which the subject had been handled by Mr. Scrivenor, and by his friend Mr. Bird, whom he had been delighted to see get up to address them, as no gentleman was more competent to deal with the question. If they looked a little into the effects of the French tariff on pig-iron, they would find that it added 1*l.* 15s. 4d. a ton to its cost. One object of the discussion in which they were then engaged was not to demonstrate how cheaply they could make iron,—not to show others how badly they were off for want of it; but to explain to their friends across the water that their own interests were bound up in the obtaining a reduction of the duties on iron. There could be no doubt that such a reduction, while benefitting other countries, would also benefit this, because he believed there was no country in the world which possessed so close an approximation of the materials for the manufacture of iron; such a genial climate—such able hands—and so great an amount of capital to employ in the manufacture. It, therefore, became their duty to show to others that they were suffering by the imposts upon English iron. If a labourer had only to pay 1*s.* for the iron-work of his spade, for which he now paid 2*s.*, both himself and his country would be benefited. If they could show to their friends and neighbours, the French, that these duties were only benefitting a class, whilst they were naturally injurious to the general interests of the country, they would be doing them good service, whilst they were also promoting their own interests. The duties on the import of iron into France increased its price cent. per cent. When, therefore, Mr. Scrivenor said that these duties did not interfere with the development of the iron trade, as Mr. Bird had clearly shown, he evidently laboured under a great mistake. Whilst the French were making iron roads, what were they doing? Why resorting to expedients to evade the duty. Thus, if the Great Northern Railway of France bought 100,000 tons of iron rails in this country, upon their delivery a drawback, or reduction of duty, was allowed to the company, in order to bring it to the price of that of the French manufacturers. If, therefore, the price in France were 12*l.* per ton, and the iron could be delivered from this country at 8*l.* 10s., or 9*l.*, would it not be clearly a profit to the Railway Company, and consequently to the country, if the tariff duties did not exist? In fact, the operation he had described was just the same as though the London and North Western Company were in want of a great quantity of brandy for any purpose, and were to apply to the English Government to let them introduce it at 5s. instead of 15s. per gallon duty, because the latter was too high for railways to pay. If the French nation at large were made to see that they could not get a proper wheel to a barrow —that their agriculture was crippled for the want of iron ploughs—and that they could not obtain the advantages of water or gas as they might otherwise do, for the want of iron to make the pipes—facilities they might obtain from this country, he had no doubt they would press on their government the necessity of repealing the tariff, and thereby benefit themselves and this country at the same time. He was sorry to have to go further with the argument, but he did so because he thought the subject most important; and if it were desirable for this country to get a good customer, it was more desirable that their neighbours should also get a good article cheaply. His friend, Mr. Bird, had alluded to the great difficulties which existed in other countries to the transit of iron, where there were nothing but horses and carts to be employed. Was it not curious, then, that there was no proper communication between the great seat of the iron manufacture of England and London. If they wanted a ton of iron conveyed from South Wales to London, they must employ a horse and cart, unless, indeed, they forwarded it by sea. It was only the other day the Government entered into a contract for the supply of a quantity of a peculiar quality of iron, and they were obliged to wait for it for several days, because the horses and carts were so engaged, that they could not be obtained for its conveyance. That arose from the circumstance that the means of conveyance which was the most delightful, all for passengers who travelled by it, stood in the way of improvement, the only railway communication with South Wales being by the broad guage. If they were allowed a narrow guage into the district, they could very shortly open an iron road in communication with the rest of England, instead of having, as they now had, to depend upon horses and carts in the centre of the iron district. He would now briefly touch upon the subject alluded to by Mr. Bird, of the necessity of their iron manufactures being well represented at the Paris Exhibition, and he hoped the subject would not be lost sight of by the manufacturers. He did not know a better way of showing the impolicy of the tariff than by having iron well represented at the Exhibition, with its price marked upon it. If a Frenchman saw that he could get as good an article from England for 6*l.* as he was charged 10*l.* for in France, he would begin to ask why he should pay the additional price, and it would go a long way towards obtaining a reduction in the tariff. Sardinia was itself a producing country, and yet they sent to England for pig-iron with which to improve their own; though, of course, from its high price, they used but a minimum quantity. If the Sardinians could get the pig iron cheaper, they would not mind the duty being taken off, but would take the chance of competing with it. The axe in the wilds of America, and cheap iron in the old country, were at once advancing the cause of civilisation. Indeed, he might say, that the use of iron was a fair index to the civilisation of a country—as with the use of iron, civilisation and comfort advanced, and, therefore, he wished to impress upon all the necessity of taking off all trammels upon its use, as it was to the freedom of iron from impost that the Arts, Manufactures, and Commerce, in a great measure, owed their existence in this country.

Mr. G. F. Wilson had listened to the very valuable paper of Mr. Scrivenor with great attention, and there was only one remark which he wished to make with regard to it. In one portion of his paper Mr. Scrivenor had alluded to the great difficulties the iron masters had to contend with as regarded labour, more especially in Staffordshire. He was acquainted with one of the largest manufacturing iron firms in Staffordshire, who had been making experiments to get a hold over their workmen. He referred to the Messrs. Bagnall, of West Bromwich, and they had proved that the men were generally amenable to kindness, and, if so treated, came cheerfully under control.

The Chairman had listened with the greatest interest and entire satisfaction to the very able paper presented to them, and the equally able discussion by which it had been followed. It was not a subject on which he could pretend to any particular knowledge, but no person could have listened to the paper, or the discussion, without learning something. He might, however, be allowed to make a few general observations, showing how historical facts tended to illustrate great principles. It was a curious fact that one of the greatest statesmen of the day should, whilst young in life, have proposed an excise duty upon iron. He believed that now, if any one was to repeat the proposition, it would be looked upon as one of the most curious and outrageous features of the day. Whatever might have been the opinions with regard to it as a war tax in 1806, there could be no fear that it would ever be proposed in 1854. One of the greatest politicians had denied that there was any natural effect by the reduction of duties on consumption and production. He (Mr. Wilson) held that the iron trade was an extremely happy illustration, and one of the greatest proofs of the truth of his principles. He believed that it was not by protective duties that industry could be encouraged—but that, on the contrary, produce was reduced by imposts and restrictions. He

recollected that in 1823—and it was one of the oldest things he did recollect—that in the discussion in the House of Commons to which Mr. Scrivenor had alluded, on the introduction of the bill of Mr. Herries, at a time when the annual production of iron was only 45,000 tons—he recollected that an old and valued friend of his at that time — one of the most distinguished iron-masters — making a remark founded upon his observations and experience of the largest trade of the day. That hon. friend of his declared that, in his opinion, if the bill was passed into law, two years would not elapse before every blast furnace in the kingdom would be extinguished. And what was the result? why in six years it was found that the production had increased to 76,000 tons: and since the reduction of the duties, so rapid had been the progress of the trade, that the make of iron had increased from 450,000 tons in 1823 to 2,700,000 tons in 1852, and it was now stated to be about 3,000,000. If the United States and France possessed the inherent means of producing iron—and there could be no doubt the United States did so—and they wanted to develope their resources, they should begin by the reduction and repeal of the duties on the manufacture. They could now, fortunately, see the force of these great principles, and allude to them without being charged with interfering in politics—they being now universally acknowledged and appreciated as having conferred the greatest benefits upon England. These questions were, in fact, now looked upon as English, not political. He thought that it was self-evident, that the benefits thus secured, not only did good to the producer, but to the consumer. The benefits must be mutual to all parties concerned in the trade, the producer, the merchant, and the consumer; and it now appeared to be generally understood that the prosperity of a country depended upon free trade and free transit. That had been the cause of the advance in the iron trade, though their later progress might have somewhat depended on the value of iron as compared with the rates of exchange. There was one remark which had forcibly struck him as tending to clear away the mist and exaggeration with which the iron trade was surrounded. When they saw particular cycles in trade in which an article was rising 10 or 20 per cent. annually in the amount consumed, succeeded by a mania like that of railways, they became naturally afraid of a revulsion. There could be no doubt that in its progress from protection to freedom, the iron trade had been subjected to revulsions, and they found that distress had occasionally existed in the iron districts, and it was because of their large population that they laboured under some apprehensions on the subject. There had been a remark made, however, which he thought ought in a great measure to relieve them from apprehension—for though the iron districts, like all others, must still be subject to fluctuation, yet, that remark showed that the trade was in the main founded on a solid basis. Mr. Simmonds had remarked, that all the railways in the kingdom only contained 1,500,000 tons of iron; but Mr. Bird had improved upon the remark by showing that they contained 2,500,000 tons. When, therefore, they came to see that the make of iron for the year was upwards of 3,000,000 tons, they would see that the railways could not have exercised any very material influence on the trade, as the whole of the rails yet used was not equal to one year's produce of iron. That was a fact calculated to show them, that it was not upon railways or any peculiar department of the trade, they must chiefly rely, but upon the cheapness and perfection of their make, rather than occasional speculation, though that might produce a temporary effect upon prices. There was another observation of Mr. Bird's, relative to the renewal of rails, which was worthy of notice. That gentleman showed them that the wear and tear was likely to produce a continued demand upon the iron trade, of from 200,000 to 300,000 tons per year, or about ten per cent. on the whole produce, so that every mile of railway laid down carried with it a benefit to the future trade. That, he considered, proved the iron trade to be in a most sound and felicitous position; and when they saw industry expanding, and knew the various purposes to which iron was now applied, they would easily understand that it was more to the facilities offered by the railways for transit than to their construction they were indebted for their position. Some valuable observations had been made with regard to the Exhibition of 1851, and he was glad that the value of such institutions had been shown in that room—institutions of which their own Society might be said to be the foundation and representative—in bringing mankind together, and strengthening the bonds of thought and union throughout the world. It was not only, however, thus that they were beneficial; but by showing to others that which they could best do, they promoted alike the interests of the country and of labour. He thought that two great advantages must result from such meetings and gatherings—the extension of the principles of free trade and free institutions;—and he believed that wherever free trade existed, free institutions would be found to be not far behind. There was one advantage to be derived from these meetings, that they tended to show the true principles which should govern legislation in manufactures and finance—and to show that the true principles of prosperity consisted in the perfect freedom from imposts and enthralment of all articles on which the comfort and convenience of the people depended. He recollected an observation of M. de Tocqueville, that "no one understood the object of keeping up the price of iron." It was not alone in the price of iron that France suffered by these imposts, but they lost upwards of 2,000,000 in their agriculture. It was not only the high price of iron, but the awkward substitutes that they had to make use of, that told against them. Thus a wooden plough, or a wooden wheel, where iron ought to be supplied, caused a loss by their inefficiency. He was sure that, from meetings like the present, where discussion could be had upon these subjects, great benefits would arise; and it had given him great pleasure to be present, and profit by the discussion, as all must have profited who had heard it. He was sure, before he resumed his seat, they would all unanimously agree with him in awarding a vote of thanks to Mr. Scrivenor for his very valuable paper.

Mr. Scrivenor, when he entered the room as a stranger, was not at all aware of the manner in which the subject he had to bring before them would be treated. He was much gratified by the way in which the discussion had been conducted, and the fairness with which his views had been listened to and discussed. With respect to the great increase which had recently taken place in the exports, he was not unacquainted with it, though he had not alluded to it, not having the official papers by him; and he had rested all his statements on official documents; but the increase which had taken place in 1853 and the present year only went to strengthen and confirm his arguments. He must be allowed to observe that he had not intended to say that the duties on iron should not be done away with, because he thought all such duties ought to be removed; but seeing the large reductions which had lately taken place, he did not think it likely that they would for the present be further reduced, and therefore he did not think it necessary to enlarge upon the subject. When however he saw that iron ore in Staffordshire was at 22s. per ton, and coal at 10s., he did not think so much good would be derived from their being in the Exhibition as some gentlemen appeared to believe. He was glad to hear that the men in Staffordshire were so easily managed and he hoped the gentlemen alluded to would benefit by the improvement in their treatment.

The Secretary announced that at the meeting of Wednesday, the 20th instant, the following

Paper would be read:—"On the New Process of Printing Bank-Notes by Surface Printing from Electro-types," by Mr. Alfred Smee, F.R.S.

## INSTITUTE BOOK ORDERS.

November Account.

| | Full Price. £ | s. | d. | Red. Price. £ | s. | d. |
|---|---|---|---|---|---|---|
| Annan, Mechanics' Institute | 12 | 7 | 0 | 9 | 6 | 5 |
| Darlington, Mechanics' Institution | 8 | 4 | 6 | 6 | 2 | 8 |
| East Retford, Literary and Scientific Institution | 2 | 5 | 8 | 1 | 16 | 5 |
| Hants and Wilts, Educational Association | 3 | 15 | 8 | 2 | 17 | 10 |
| Hastings, Mechanics' Institution | 9 | 6 | 0 | 7 | 8 | 5 |
| Hitchin, Mechanics' Institution | 2 | 19 | 6 | 2 | 5 | 10 |
| London, Bank of England Library and Literary Association | 3 | 13 | 6 | 2 | 18 | 6 |
| Odiham, Mechanics' Institution | 5 | 0 | 0 | 3 | 15 | 0 |
| Sevenoaks, Literary and Scientific Institution | 0 | 17 | 8 | 0 | 14 | 10 |
| Stamford, Institution | 4 | 19 | 0 | 3 | 18 | 9 |
| Tiverton, Literary and Scientific Institution | 10 | 14 | 3 | 7 | 17 | 4 |
| Worksop, Reading Society and Mechanics' Institution | 1 | 2 | 6 | 0 | 16 | 10 |
| | £65 | 5 | 3 | £49 | 18 | 10 |

Being a saving of £15 6s. 5d., or nearly 25 per cent.

## PROPERTY OF INSTITUTIONS.

In answer to a correspondent, signing himself "F.," the Secretary begs to state that, under section xx. of the "Literary and Scientific Institutions Act," 17 & 18 Vic., c. 112, the books and other personal effects of a Mechanics' Institute are vested in the governing body, except when, by the rules, they are vested in the trustees, and except the Institute be incorporated by charter, having special provisions relating to such property. Under section xxi. of the same Act, an Institution (unincorporated by charter) can sue and be sued in the name of the president, chairman, secretary, or clerk, as the rule may determine; and if no rule, then in the name of such person as the governing body may appoint for the occasion; and if no person be nominated, then the president or chairman may be sued on the section xxvi. A member embezzling property of the Institution, is punishable as a stranger. No enrolment is necessary.

## Home Correspondence.

### PROPOSED CONGRESS IN PARIS ON AN INTERNATIONAL CODE OF COMMERCIAL LAW.

The following correspondence has been handed to the Secretary for publication:—

12, The College, Doctors' Commons, London, 18th November, 1854.

My Lord,—When I had the honour to meet your Lordship at the Statistical Congress, held at Brussels, in 1853, we had frequent conversations on the subject of an International Code of Commercial Law, and your Lordship kindly supported the resolution passed by that Congress, expressing a wish and trust "that the great differences now existing in the mercantile legislation of different countries may be diminished, if not altogether removed." In a paper which I laid before the Congress, and which was published in the appendix to the official report of the Congress, p. 202, I suggested that a special Congress of Deputies from all Chambers and Tribunals of Commerce, from the most important mercantile places in the civilised world, should be held in Paris at the time of the Great Exhibition in 1855, to lay the basis of an International Commercial Code. The Society in Edinburgh, for the promotion of such an object, have considered such a proposal of the highest importance, and have entrusted me with the presentation of an address on the subject to his Majesty the Emperor of the French. I regret that I was unable, before ascertaining what instructions His Imperial Majesty might confer on the subject, to communicate it to your Lordship, in order that some allusion to the subject might be made in the address which your Lordship recently gave, as Chairman of the Council of the Society of Arts. I have since had the honour to receive a despatch from the Minister of State, M. Fould, dated the 8th instant, informing me that the Emperor took a personal interest in the address of the Edinburgh Society, and that the documents presented were, by his commands, remitted to the legislative section of the Council of State, with instructions to report thereon to the Emperor. From the contents of such a communication, and from other circumstances which have come to my knowledge, I have reason to hope that his Majesty will sanction the holding of the proposed Congress, and I have now the honour to transmit a copy of the address to his Majesty, and the answer received from the Minister of Commerce, for your Lordship's serious consideration.

I cannot over-estimate the important bearings of such an European Congress, both as regards the interests of commerce and the development of jurisprudence, and I would hail it as one of the most momentous events of the present century. It seems to me that the subject might come appropriately within the province of the Society for the Encouragement of Arts, Manufactures, and Commerce; and I would submit to your Lordship whether the Council of the Society should not take some steps with a view to express their sympathy for and deep interest in the promotion of an International Code of Commercial Law, especially as it would have the effect of enlarging the commercial relations between this country and France. The Council of the Society might, moreover, communicate with the President of the Board of Trade their views on the subject, in the hope that the British Government may afford to the French Government assurances of their readiness to send representatives to the same Congress. The Commission issued by Her Majesty's Government for assimilating the mercantile laws of the three United Kingdoms, would be enabled by such a Congress to learn the results of European experience on all the doctrines of mercantile law; whilst the proceedings of such a body would go far to settle many questions where much difference of opinion prevails.

I believe that a subject embracing such comprehensive interests affects deeply every section of this great commercial empire, and I would appeal, through your Lordship, as Chairman of the Society of Arts, to all the members of this Society, and especially to the Chambers of Commerce, and to the numerous Institutions in Union with it, to lend their powerful influence in promoting a Congress which is, on every ground, likely to prove of immense benefit to the Commerce, and, through Commerce, to the productive industry of the whole world.

I have the honour to be, my Lord,
Your Lordship's most obedient servant,
LEONE LEVI.

Right Hon. Viscount Ebrington.

Castle Hill, Southmolton, Nov. 20, 1854.

Dear Sir,—I have to thank you for your letter, and beg to return the accompanying documents. You do no more than justice in attributing to me a deep interest in

the subject of them. I deeply regret with you that the proposal of a Congress at Paris next year for laying the basis of a General International Commercial Code, was not, when I wrote my address, in such a position as to allow of my alluding to it there. Could I have been made aware in time of the auspicious reception which the proposal met at the hand of the French Emperor, and of his Imperial Majesty having referred it, with the copy of your admirable work just presented to him, for the consideration of the Legislative Section of the Council of State, I should certainly have taken occasion to mention the project as one of the subjects in which, in connection with the Exposition Universelle of 1855, we, in our capacity of a Society for the Encouragement of Commerce should be bound more especially to interest ourselves, though, indeed, along with its advancement, Arts and Manufactures could not fail also to be thereby benefited.

I hope, however, that the movement for the promotion of this admirable plan will not be confined to the enlightened memorialists of Edinburgh, but that many, if not most, of the Institutions in Union, will before long bestir themselves in its behalf. I am confident that in so doing they would consult not only the general interests of civilisation and progress throughout the world, but also pre-eminently the special interest of every class in this country, for, without commercial prosperity, our manufacturing and mining interests must languish, and without mining and manufacturing prosperity, how can our agriculture find good customers for its produce? Wishing you every success in these and all your other labours in the great cause you have so distinguished yourself by advocating,

I remain, dear sir, yours faithfully,

Leone Levi, Esq. EBRINGTON.

## THE LAW OF LIMITED LIABILITY IN PARTNERSHIPS.

Sir,—A physician has been somewhere defined to be an unfortunate person whose business it is to make health reconcileable with intemperance; so a patriot and a reformer may be defined—one whose business it is to make worldly prosperity reconcileable with indolence and folly. Both attempts are against the law of nature—one the physical, and the other the moral law—and they will never succeed. The proposed law of limited liability is, so far as this country is concerned, a new recipe, a new expedient, to enable people to get money, or great interest for their capital, small or large, some 10 or 15 or 20 per cent., without work, care, thrift, self-denial, or adequate risk. You advocate this fascinating project; and I infer, from a note in his lecture, that Mr. Mechi, a really practical man, is also an advocate; this I regret. I am not surprised when lawyers, philosophers, literateurs, poets, painters do so, but I am dismayed when men who have had a life-long experience in affairs forget the true difficulties which beset their early career. It is not that they ever wanted capital at large rate of interest, 10 or 15 per cent., a certainly ruinous rate—but that they wanted capital at reasonable living interest when they were young in life, and before they had been long enough in the market under the eyes of men to create a character, to give outward and visible signs—assuring to capitalists of their being persons of industry and thrift (homely vulgar qualities) and honesty, for when these are *known* to be possessed, capital in some shape or other is not wanted long; for capital more desires to unite itself with men of such qualities, than do such qualities wait the union with capital. It is only people who are *without* these qualities altogether, or *who will not wait* the due ripening time to develop and colour them before the world who want a law of limited liability to enable them to borrow money wherewith to carry out their projects at a ruinous rate of interest.

Money by the million is wanted, no doubt, in farming affairs, just as it is wanted in a multitude of other trades, but it is wanted because farmers (and others) cannot assure men of their aptitude to be entrusted with money; those who are esteemed trustworthy can borrow of country bankers to any reasonable amount, at four or five per cent. interest, in small or large parcels, from time to time, just as they require help, a watchful eye being kept on their mode of farming, on their style of living, on their deportment on the market day, whether they come there for real business, or whether the business is the pretence, and a long long frolic at the tavern their real object "in going to market." Mr. Mechi says, and no doubt he is correct, that he never loses his live stock by disease, but that such is the risk of loss with common bad management that Insurance Companies charge 20 per cent. premium; and that bad buying and selling to the amount of 5 per cent. would make a difference to him, on his 400 acres, of £250 a year; none but a very foolish person, then, would enter into a limited liability partnership with a farmer, (character unproved) where bad management causes such ranges as these. One hundred tickets in the lottery would bring a larger average gain than so many shares in farms! Farming is a trade which seems singularly unsuited to partnership of any kind; there are few partnerships among doctors, fewer still among farmers, because men cannot associate their *skill.* Skill, either in physic or agriculture, is a unit; it is in one man's own head, and he cannot divide it with another; labour and money may combine, but not skill of *judgment.*

Farmers do not make the gains they should do, because, like other persons, so many of them are deficient in skill and energy; they want already to get profit and sleep themselves; a sleeping partner would only make such things worse; and, besides, they do, as most other persons do, trade beyond their capital;—with a fortune of £2,500 they take 400 acres, which, according to Mr. Mechi, is just 200 acres too many. Again, any large investment in farming, *i.e.*, high farming—means, too often, investing capital in another man's land, who, it is feared, will get too large a share of the investment in the end; the evil is in the tenure of land, and while the lawyers want limited liability, they cloak the real grievance. No small portion of farming improvements is of a nature that a tenant would be unwise to make at his own cost to any great extent—draining, squaring fields, good roads, good barns, cattle sheds, and outbuildings. A man would be a fool who, under limited liability, advanced his money to be expended on such very needful and very gainful improvements. There is too much of this already—the tenant leaves too much of his capital buried in the earth, only to earn an improved rental for his landlord. No doubt landlords, who themselves are poor, for the same reason that they lack industry and thrift, should save of their rent rolls, and make profitable investment in improving their estates. It would be a nice thing, truly, for them and their lawyers, if under a law of limited liability, greedy widows, spinsters, and retired tradesmen, could join in taking a farm, their capital buried in *fixed* improvements which the tenants cannot take away nor get adequate allowance for, but which would yield *profit* during the tenancy to be eaten up and enjoyed. Plenty of persons, silly enough to do all all this are to be found—fools are thick as blackberries—and it is to induce, coax, such persons to risk absorbing their capital, that so many lawyers are agitating for limited liability. People must believe that they cannot get *large interest* for their own money but by industriously using it themselves, *other people* most assuredly will not earn large interest for them; and those who do not like to work must be content to take relatively small interest, such as the funds or mortgages yield, or be content to lose *their money* altogether.

Your correspondent, who writes so instructively on the manufacture of bread, says that millions might be well invested in the baking trade. This opens another chapter on thrift and industry, virtues so much desiderated by all working traders, especially including bakers. It is not limited-liability that bakers want, to be out of the power

of the miller, but self-denial. Nor does it seem very promising that such a trade—a working trade—can be managed profitably by a company, seeing the fate of the League Bread Company.

In another part of your Journal, complaint is made that joint-stock projects are in abeyance because of the law. Really this is no matter of regret—all the hundreds of millions that are invested in railways do not earn more than fund-interest, and other schemes of a less stable nature average even a less interest. The area for joint-stock schemes fills up every day, and it is not good, under the lure of limited liability, to tempt timid, thrifty fools to part with their little hoards, not a five per cent. of which will ever be returned to them again. Let all such work their own capital, or let them be content with three pounds per cent. per annum, which is really and truly enormous *lazy* interest for a man to get year by year without labour or risk; it is, in fact, the largest interest the world ever knew. One hundred pounds will now earn a man more interesting goods than it ever did in the history of this country. Men must not talk about the *low* rate of interest—they must rather rejoice in the very *high* rate of interest.

I. H. ELLIOTT.

## CAST AND WROUGHT IRON GUNS.

Sir,—The lump of cast-iron with a bore and a touch-hole, which has been in use for some centuries without any material improvement, is now found to be incompetent to the requirements of modern artillery practice. The cast-iron gun was originally an improvement upon the first form of cannon, a rude assemblage of staves and hoops of wrought iron; and one of our eminent engineers has advocated a return to that metal; but as long as cast-iron remains the only available material for shot of large calibre, soft iron will be more subject to wear and tear than cast.

The defects of the present gun are the deterioration of the structure of the metal itself by long continued and rapid firing, the irregular enlargement of the bore, and the blowing of the touch-hole. Durability and strength are only to be obtained by constructing the body of the gun of two different metals, a steel lining for the bore, and a cast metal jacket outside to give weight and strength. As the construction of such a gun might appear to involve formidable difficulties, I feel it incumbent upon me to describe one mode at least by which it might be accomplished with comparative ease in our large foundries and ironworks.

Prepare a mandril rather less than the intended bore, also a tapering bar of steel, for heavy guns at least two inches square at the butt. After scarfing the thick end, cause it to be rolled, by means of powerful machinery, while red hot, round the mandril, when, if the steel bar has been properly shaped in its cross section, the faces of the spirals will be accurately applied to each other from inside to outside. Then drive out the mandril, bring the spiral coil to the welding heat in a large reverberatory, and close the weld by jumping or with blows on end under the steam-hammer. The steel tube, when completed, must then be heated, and placed in the usual mould for casting the jacket round it, when, from heat and contraction, the whole will become one solid mass of metal. For light guns, brass or bronze may be used, and for heavy cannon cast-iron.

In order to centre the lower end of the steel tube or bore, a turned dovetailed plug, also heated, must be enclosed in the breech of the mould with a rabbet to fit the end of the tube. By this construction, the boring of the gun will be much simplified, it will be the same, in fact, as that in common use for boring musket barrels, only on a larger scale.

Steel, in its soft state, is far tougher than wrought-iron, and equally less brittle than cast-iron, therefore the bore so lined will be greatly more durable than in guns of either cast or wrought metal. Nothing, however, will resist the bad effects of rusty ill-cast shot, which are seldom truly spherical, and never smooth. I have lately published a method, not my own, of producing perfectly smooth cast-iron bullets, which is as follows—as soon as the shot is set, but still red-hot, it is shaken out of the iron mould into a trough or channel, which conducts it under a rapid tilt-hammer, the face and anvil of which are turned into hemispherical hollows, and while the hammerman turns the shot swiftly round with peculiarly shaped tongs, a pipe, with a watering-pot rose, directs a fine shower of cold water over all. In a few seconds a truly spherical and perfectly smooth globe is turned out as if from a lathe. The shot, while still warm, should be immediately plunged into boiling asphalte or marine glue, either of which will preserve it from rust for years.

In order to remove or lessen the inconvenience of the blowing of the touch-hole, nothing more will be necessary than to drill a hole of about two inches in diameter where the touch-hole should be, down to the bore, and tap it throughout with a good breech screw, into which may be screwed any number of plugs of any metal, with the true touch-hole ready drilled. The plugs should have a squared part at top, raising a little above the surface of the gun, for the application of the wrench or spanner, or it may be left round for gas nippers.

The extra cost of artillery constructed according to this or any similar plan can be no object, because good guns that will resist wear and tear will be more economical than bad, and any step that may have a tendency to shorten the evils or duration of warfare must be a step in the right direction.

A CIVIL ENGINEER.

November 30, 1854.

## THE ADULTERATION OF FOOD—BREAD.

Sir,—I sit down to make a few observations in reply to Mr. Reveley's article on the adulteration of food.

In the first place, it is positively wrong that any miller will give more for *old heated* wheat than for new; indeed, heated wheat is so objectionable, that we always avoid buying it, unless at a low price.

I believe it is correct that alum gives the bread a better appearance, but I cannot think that large quantities are used, neither do I think that it increases the "water holding" quality of the flour.

I never heard of bakers' chemists, but there are manufacturers of what is called "permanent yeast," who supply such bakers as do not know how to make it themselves. I believe it is made of yeast, malt and hops.

It is quite true that millers use alum, mixed with stone dust, to fill up the pores of mill stones; and I may add that it costs me 4*s.* or 5*s.* per annum to supply my nine pairs of stones. I am quite sure it does not cost more, nor have I ever seen a larger quantity introduced into any mill I was connected with.

I should say wheat ground at the rate Mr. Reveley speaks of would not be half-ground, and consequently would not produce any thing like the quantity of flour that is made from our mode of grinding. I consider four bushels per hour a fair quantity for a pair of four-feet stones to grind. It is possible to run seven or eight bushels through the stones in the hour, but not to grind it properly.

I should think Mr. Reveley's letter will call forth observations from others in the trade.

Yours truly,

H.

12th Dec. 1854.

## Proceedings of Institutions.

DERBY.—The annual general meeting of the members of the Working Men's Institute was held on the 28th of November, Mr. W. Hirst, the treasurer, in the chair. The report of the committee stated that the number of members had increased, and the classes had been considerably augmented during the past session. The following classes were now in active operation, and were uniformly well attended,—grammar, geography, reading, writing, and arithmetic. The library contains 600 volumes, and the reading-room is well supplied with newspapers and periodicals. Readings or short lectures were delivered every Thursday evening, and during the winter occasional lectures. The treasurer's balance-sheet showed an increased income during the half-year, and left a balance in hand of £5 17s. 6d.

NOTTINGHAM.—The first of a course of lectures for the season was delivered on the 24th of October, by the Rev. W. J. Butler, M.A., "On the Dead Sea and Cities of the Plain." The course comprises thirteen lectures, to be delivered fortnightly, and to which the members of the various Operatives' Libraries in the town will be admitted free. On the evenings of October 30, Nov. 1, 6, and 8, Professor Partington delivered a course of four lectures, "On the Progress of General Science, and the adaptation of the improvements to the useful arts." To this course of lectures working men were admitted at 1d. each, and a considerable number availed themselves of the opportunity of enlarging their circle of knowledge.

SHEFFIELD.—The sixth annual report of the People's College states that the average weekly attendance shows an increase upon that of last year. The number of students upon the books has been 472 males and 82 females, making a total of 554. There have been 36 classes in operation. Classes for reading, writing, and arithmetic are in operation every evening, for those whose early education has been neglected; and there are also classes for the study of grammar, drawing, geography, book-keeping, singing, elocution, composition, logic, French, and German. The committee contemplated the formation of industrial classes, and, in order to test the feeling of the public generally towards such classes, the late Mr. James Haywood delivered a course of lectures to the students and the public, in the Council hall, "On the Application of Chemistry to the Sheffield Trades." These lectures were so far successful that the Committee were emboldened to proceed with the plans, when the unforeseen and melancholy death of Mr. Haywood altogether frustrated their designs. The Committee have not abandoned the idea of forming industrial classes, but see no immediate prospect of carrying out this important branch of education. The receipts during the year have been £220 10s. 2½d., and the expenditure £217 13s. 2d., leaving a balance in the hands of treasurer of £2 17s. 0½d.

TENTERDEN.—A lecture in connection with the Mutual Improvement Society was delivered at the Town-hall on the 30th ult., in aid of the Patriotic Fund, by the Rev. E. Talbot. The subject was "On the Cloth Manufacture at Tenterden during the reign of Charles I."

## Miscellanea.

THE SUPPLY OF GUM.—The last American papers contain an account of an apparently important discovery in the far west. It is asserted that in the north of Texas, towards Arkansas, as well as in the state of New Mexico and the adjacent territory, gum has been found in inexhaustible quantities, and of a character scarcely, if at all, inferior to that imported from the East. It is gathered from the mezquite tree—a kind of acacia, abundant in that section of the country, especially in elevated and dry localities—and exudes spontaneously in a semi-fluid state from the bark of the trunk and branches, soon hardening and becoming nearly colourless by exposure. July, August, and September are the months for collecting it, and the quantity from each tree varies from an ounce to three ounces, which may be greatly increased by incisions. Even as it is, a good hand, it is said, would probably be able to collect from 10lbs. to 20lbs. a-day. Should it command one-half of the prices paid for gum arabic, the gathering of it will, in the opinion of the United States Superintendent of Indian Affairs, by whom it was tested, afford employment to thousands of wild Indians of the plain, so as to constitute it a most valuable article of traffic on the western frontier.

## To Correspondents.

In No. 106, page 33, col. 1, line 26, for *Tartons*, Charles—read *Sartoris*, Charles.

## MEETINGS FOR THE ENSUING WEEK.

MON. Chemical, 8.
Statistical, 8.—Mr. Horace Mann, "On the Statistical Position of Religious Bodies in England and Wales."
TUES. Civil Engineers, 8.—Annual General Meeting for Election of Officers.
Linnæan, 8.
Pathological, 8.
WED. London Institution, 7.
Society of Arts, 8.—Mr. Alfred Smee, F.R.S., "On the New Process of Printing Bank-notes by Surface Printing from Electrotypes."
THURS. Numismatic, 7.
Antiquaries, 8.
Royal, 8½.
FRI. Philological, 8.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS,

*Delivered on 13th Dec.*, 1854.

Par. No.
2. Barnstaple Borough: Special Certificate.

*Session* 1854.

411 (1). Conveyances of Mails by Railways: Index to Report.
418. Nizam's Territory: Papers.
462. Bank of England, &c.: Returns.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Dec. 8th*, 1854.]

*Dated 10th October*, 1854.

2168. G. W. Knocker, Dover—Motive-power.

*Dated 17th October*, 1854.

2216. G. and E. Scheutz, Salisbury-street—Calculating machinery and printing results.

*Dated 18th October*, 1854.

2225. W. Eassie, Gloucester—Securing goods on and loading railway trucks.

*Dated 9th November*, 1854.

2374. J. Halliday, Manchester—Carding machine. (A communication.)
2379. J. R. and T. Berry, Rochdale, and T. Royds, Salford—Spinning machinery.

*Dated 10th November*, 1854.

2390. E. A. Lépine, Madrid—Opthalmological powders and collyrium.
2393. J. Wain, Oldham—Spinning machinery.

*Dated 17th November*, 1854.

2434. R. Peters, 89 Union-street, Borough—Steam engines.

*Dated 20th November*, 1854.

2450. J. Cumming, Glasgow—Looms.
2452. R. Reefe, Trim, Ireland—Dressing flour.
2454. W. B. Adams, 1 Adam-street, Adelphi—Projectiles and projectile weapons.

*Dated 21st November*, 1854.

2456. T. Craig and A. Daniels, Manchester—Railway signals.
2458. F. Russell, Massachusetts—Mowing machine.
2460. A. Tylor, Warwick-lane, Newgate-street—Crimping machines.
2462. W. L. Thomas, Anderton, Devon—Projectiles and gun wads.

*Dated 22nd November*, 1854.

2464. R. Terrett, Hercules-buildings, Lambeth—Knife-cleaning machine.
2466. J. H. Johnson, 47 Lincoln's-inn-fields—Incrustation of steam-boilers. (A communication.)
2468. C. Gibson, Draycott, Derby—Brick and tile making machinery.

*Dated 23rd November*, 1854.

2469. W. Hurst, Salford—Railway chairs.
2470. J. Wright and J. Walmsley, Alfred-place, Newington-causeway—Bedsteads.
2471. W. A. Vérel, Macduff, N. B.—Grinding bones.
2472. E. Eaborn and M. Robinson, and J. Kendrick, Birmingham—Apparatus for holding hats in public assemblies.
2474. G. Collier, Halifax—Mohair plush.
2475. G. Collier, Halifax—Pile fabrics.
2476. S. Shaw, Plaistow—Marking metal plates, and new template.
2477. J. B. Hellier, Schelestadt, France—Spinning machinery.
2478. C. W. Ramie, Jersey—Razor straps.
2479. H. J. Duvivier and H. Chaudet, Paris—Treating gutta-percha.
2480. E. Edlund, Stockholm—Electro-magnetic telegraph apparatus.

*Dated 24th November*, 1854.

2481. S. A. Carpenter, Birmingham—Buckle. (A communication.)
2483. R. Cunliffe, Accrington—Brick and tile making machinery.
2484. R. William and D. Mills, Blackburn—Looms.
2485. J. Hartley, Sunderland—Perforated glass.
2486. C. M. T. du Motay, Paris—Treating soap.
2487. W. Ely, 38, Broad-street, Golden-square—Ball cartridges.
2488. J. D. M. Stirling, Blackgrange, Clackmannan—Metallic tubes.
2489. H. Bessemer, Old St. Pancras road—Projectiles and projectile weapons.
2490. T. De la Rue, Bunhill row—Compositions for printing rollers.

*Dated 25th November*, 1854.

2493. J. Henderson, Lasswade, Midlothian—Carpets.

*Dated 27th November*, 1854.

2497. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Inkstands. (A communication.)
2499. F. Delacour, Paris—Fire screens.
2501. J. Crofts, and W. Cartwright, Birmingham—Projectile.

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## WEEKLY LIST OF PATENTS SEALED.

*Sealed 8th December*, 1854.

1291. Antoine Louis Péter, Lyons—Improvements in treating a certain kind of indigo.
1313. Frederick John Julyan, 20 Gerrard-street, Soho-square—Improved methods of producing musical sounds.
1340. William Brunton, Camborne—Improvements in metallic pistons.
1385. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improvements in machinery for picking or opening cotton and other fibrous materials, and all kinds of waste rags and old materials, to prepare the same for the operation of carding, or for other operations.
1423. Edmund Cockshutt, Preston—Improvements in bungs or adjustable stopper apparatus for casks and other vessels.
1491. William Pole, Storey's-gate, Westminster—Improvements in the construction of railways.
1758. Walter Blundell, 29, New Broad-street—Improved apparatus for treating or preparing any part of the human body requiring to be surgically operated upon for the purpose of totally or partially benumbing the sense of feeling at the desired part of the human body.
2009. Samuel Collins, Birmingham—Improved castor for furniture.
2024. Alfred Tylor, Warwick-lane, Newgate-street, and Henry George Frasi, 84 Herbert-street, New North road—Improvements in water-closets.
2073. John Simon Holland, Woolwich—Improvements in large and small fire-arms, and in the preparation of their charges.
2173. Pierre Etienne Proust, Orleans—Apparatus for greasing or lubricating axles and other rotating portions of carriages and of machinery.

*Sealed December 12th*, 1854.

1304. John Edwin Piper, New-road—Improvements in the preparation of linen, cotton, and other fabrics, to produce a factitious leather.
1307. Thomas Mara Fell, 74, King William-street, and William Cooke, Curzon-street, St. George's—Improvements in ventilators.
1325. John Allin Williams, Baydon, Wilts—Improvements in machinery or apparatus for ploughing and cultivating land.
1326. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improvements in water-mill machinery.
1343. Charles Reeves, Birmingham, and William Wells, Sutton Coldfield—Improved method of manufacturing certain kinds of metallic tubes.
1356. John M'Innis, Liverpool—Improved composition for coating the bottoms of iron ships to prevent their fouling, and other useful purposes.
1392. Robert Michael Letchford, Whitechapel—A match stand and holder for holding matches while being ignited.
1394. Thomas Skelton, Plaistow—Improvement in or addition to tillers or yokes.
1395. Richard Archibald Brooman, 166 Fleet-street—Improved projectile for ordnance and small arms, and a sabot or plug to be employed therewith, which sabot or plug may also be used with other projectiles. (A communication.)
1397. Richard Archibald Brooman, 166, Fleet-street—Improved mill for grinding and pulverizing paints and various vegetable and mineral substances.
1450. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in stopping bottles and in drawing off aerated or other liquids contained therein.
1459. Christopher Thomas Tiffany, Leeds—Improvement in the manufacture of brushes used in gig mills and machinery for brushing pile fabrics.
1483. Peter Armand le Comte de Fontaine Moreau, 4, South street, Finsbury—Improvements in apparatus for breaking in horses.
1500. Henry Richard Cottam, 20, Argyle square, King's-cross—Improvements in horse mangers.
1503. Lorenzo Tindall, Scarborough—Improvements in bruising or reducing grain or other substances.
1504. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture of carbonates of soda.
1519. Victor Gustave Abel Cuvier, Selon-court—Improved apparatus having for object the combustion of fuel and the utlization of the gaseous products for heating and other useful metallurgic purposes.
1543. John Baptiste Chauvet, fils, Aix, Provence—A new system of anchor.
1562. George Wade Kelsey, Hope farm, near Folkestone—Improvements in air engines.
1888. John Gray, M.D., Dublin—A self-acting flushing apparatus, which may be arranged for registering the quantity of water or other liquid flowing through it.
2103. Moses Poole, Avenue-road—Improvements in condensers.
2119. William Blythe, Oswaldtwistle, and Emile Kopp, Accrington—Improvements in the manufacture of soda ash and sulphuric acid.
2124. Christopher Nickells, Albany-road, and James Hobson, Leicester—Improvements in apparatus used when weaving piled fabrics by the aid of wires.
2143. George Collier, Halifax—Improvements in the manufacture of carpets and other terry fabrics.
2162. William Crosskill, Beverley—Improvements in the construction of portable railways.
2174. Jean François Jules Alexandre Boullet, La Chapelle St. Denis, near Paris—Improvements in the manufacture of steel.
2182. James Timmins Chance, Birmingham—Improvements in manufacturing articles from the minerals or rocks of the descriptions commonly called basalt or trap, sometimes rowley-rag, and whinstone.
2204. James Hadden Young, 66, College-street, Camden-town—Improvements in brooms or brushing apparatus.
2228. Ernest Gessners, Aue, near Schneeberg, Saxony—Improvement in gig mills.
2276. François Lambert, Rue d'Enfer, 72, Paris—Improvements in compounds to be used as cosmetics.
2312. James Cooper Hall, Monkwearmouth—Improved windlass.

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## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| Date of Registration. | No. in the Register. | Title. | Proprietors' Names. | Address |
|---|---|---|---|---|
| Dec. 7. | 3668 | The Turnout Bedstead ........................ | Theodore Jones ............... | 17, Clement's-lane |
| " 9. | 3669 | An improved Tongued Elastic Boot ...... | William Collinson .........<br>Henny Penketh Mather... | Liverpool<br>Stafford |

Journal of the Society of Arts.

*FRIDAY, DECEMBER* 22, 1854.

## EXAMINATIONS OF INSTITUTE CLASSES.

The Council desires to call the attention of the Institutions in Union to certain alterations which have been made in the "Memorandum respecting the proposal to examine and grant diplomas to students of the classes in Institutions in Union with the Society of Arts," lately issued. From a considerable correspondence which has taken place in reference to the list of subjects, it appears that some misapprehension has existed, and the alterations have been made with a view of explaining more fully the meaning and intention of the Council.

In the place of the list of subjects, the paragraph preceding the list of subjects, and the subsequent paragraphs explanatory of them, the following is now substituted:—

"The following list of subjects for examination was brought under the consideration of the Conference in July, 1854, and is now put forth with a view to indicate the extent to which it is hoped that the progressive improvement of the Institutions, and the development of popular education, may render it requisite to provide for the examination of candidates. The Council has no expectation that for some time to come the Institutions will be prepared to present well-qualified candidates for Examination in many of the following subjects, but, in the meanwhile, arrangements will be made for examination in such subjects as may be taught in the Institutions, and it is hoped that the range of subjects may be enlarged in each succeeding year.

"1. Mathematical Sciences.
"2. Experimental Sciences.
"3. Sciences of Observation.
"4. Mechanical Sciences.
"5. Social Sciences.
"6. Moral and Metaphysical Sciences.
"7. Fine Arts.
"8. Literature.

"Under the first head are included Arithmetic, with its application to Book-keeping and Accounts, Geometry, Algebra, Trigonometry, with their application to Land-surveying and Navigation, Mechanics, Hydrostatics, Pneumatics, Optics, and Astronomy.

"Under the second, Chemistry, Laws of Heat, Light, Electricity, Magnetism, Metallurgy, Photography, &c., and the Mining, Manufacturing, and Agricultural Processes dependent on them.

"Under the third, Geography, Geology, Mineralogy, Zoology, Comparative Anatomy, Physiology, Botany, Meteorology and Microscopical Observation, &c., and the Mining, Manufacturing and Agricultural Processes (including Management of Stock) dependent on them.

"Under the fourth, Machinery, Engineering Construction, Economy of Materials and Labour in Construction, Architectural Construction, (including buildings for dwellings, manufacturing, farming, and other purposes), Naval Architecture, &c.

Under the fifth, Economy of Trades, Manufactures and Commerce, Political Economy, Domestic Economy, and Social Science, &c.

"Under the eighth, History, Grammar, Composition, French, German, Italian, &c."

## LIST OF LECTURERS.

For the third time the Secretary begs to acquaint the Institutions that the name of Mrs. Butler, 3, Oakley-square, Regent's-park, was inserted *in error* in the List of Lecturers. The Highgate Literary and Scientific Institution nominated Mrs. Fanny Butler, late Mrs. Fanny Kemble, whose address is, care of John Mitchell, Esq., Old Bond-street, London.

## INTERNATIONAL CODE OF COMMERCIAL LAW.

It having been brought before the notice of the Council, that the question of holding in Paris, during the Exhibition next year, a congress of deputies from all nations, to discuss the importance of an International Code of Commercial Law, was now under the consideration of the French Government:

It was Resolved, That the Council considers the holding of the Universal Exhibition at Paris, in 1855, affords a favourable opportunity for discussing the Improvement of International Commercial Law, and will forthwith seek the opinion and co-operation of the Chambers of Commerce of the United Kingdom on the subject.

Ordered, That the Secretary communicate the foregoing resolution to his Excellency the French Ambassador in London, and a request that he will bring it before the notice of the French Government.

Ordered, That the Secretary communicate the foregoing resolution to the Chambers of Commerce, asking for their opinions on the subject, and whether, in the event of their opinions being favourable, they will be disposed to send a representative to Paris to take part in the discussion.

## SIXTH ORDINARY MEETING.

Wednesday, December 20, 1854.

The Sixth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 20th instant, Henry Cole, Esq., C.B., Vice-President, in the chair.

The following Candidates were balloted for, and duly elected ordinary members:—

Burke, Edmund. | Griffiths, Frank.
Young, John.

The paper read was

### ON THE NEW BANK OF ENGLAND NOTE, AND THE SUBSTITUTION OF SURFACE-PRINTING FROM ELECTROTYPES FOR COPPER-PLATE PRINTING.

By Alfred Smee, F.R.S., Surgeon to the Bank of England.

I feel some delicacy in appearing before the Society of Arts upon a matter of so much importance to the commercial community as the printing of the Bank of England notes; nevertheless, from the part which I have played in this matter, I trust the members of the Society will not think that I am exceeding my duty in bringing the matter before them.

In the month of November, 1851, I had the honour of presenting a report to Mr. Hankey, the Governor of the Bank of England at that period, that from facts and observations which had come under my notice, I believed that the time had arrived when surface-printing from electrotypes could be advantageously employed for Bank of England notes, and that they could be both printed and numbered by ordinary printing-presses, with considerable saving of expense and increased identity of appearance. In presenting this report I further stated that many difficulties presented themselves, and, therefore, I would suggest that a trial be permitted upon the cheque, and when the production of this was brought to perfection, we might carry on our processes upon the Bank note, with such extended experience as the printing of the cheque might afford.

Heretofore the notes and cheques of the Bank of England had invariably been printed from copper and steel plates, in which the lines were engraved or cut into the metal. Into these hollows the printers rubbed the ink, which, in process of printing, was transferred from the plate to the paper. In surface-printing the reverse state

of things exists, as the design, instead of being cut in the plate, is left in relief, and the ink being applied to the eminencies by means of the rollers, is transferred in the press to the paper to form the impression.

For plate-printing, a single cut with a graver forms a groove which holds the ink. For surface-printing a line must be cut on both sides, and equally finished on both sides. This materially increases the difficulty of engraving, yet the difficulty simply resolves itself into one of labour, skill, and expense.

Having an original design the means of multiplication must be perfect, and here, although I foresaw many difficulties, yet my electro-metallurgical experience indicated that the perfection which the Bank required, and the mercantile community demanded, might be obtained. With a sufficiently excellent original and ample power of duplication, the very important question which had necessarily to be solved was the capacity of the surface press to give such a print as would serve our purpose.

In plate-printing the paper is pressed into the grooves, or design, and there is no tendency of the ink to spread, but in surface-printing there is a liability for the paper to be pressed round the edge of the letters, or, from the pressure applied, for the ink to be spread over the margin, when an extended print would be produced from the original design. I foresaw that the success of surface-printing for bank purposes must depend upon the power of the press to yield rapidly perfect impressions. In this matter my experience was in a great measure founded upon the observation of the impressions of the *Illustrated London News*, and periodicals of similar character, when I observed that even with their rapid production, under the most unfavourable circumstances, at times we obtained either entirely or partially perfectly sharp impressions, without any appreciable lateral extension of the ink. From this I concluded that it was only necessary to study the conditions necessary to have a clear impression, and in this matter surface-printing would rival plate-printing, and besides give us all the advantages which are pre-eminently the characteristics of typography.

In accordance with this report, Mr. Hankey at once directed the experiments to be commenced, and subsequently allowed me to act with Mr. Hensman, the engineer, and Mr. Coe, the superintendent of printing; and though each of us had our separate departments in which our individual labour and knowledge was most useful, we consulted together on every matter, and by our mutual exertions, acting together to one end for the benefit of the Bank, we have been enabled to overcome every difficulty, and to bring the process into practical operation for all the manifold varieties of cheques and notes which the Bank of England requires for its purposes. Independently of the original idea, which was exclusively my own, the responsibility of settling the various processes for carrying out the system devolved equally upon Mr. Hensman, Mr. Coe, and myself, but upon Mr. Hensman and Mr. Coe falls the labour of conducting the operations.

The original form or pattern of the various notes and cheques which have been adopted, was accomplished and settled under the direction of Mr. Hankey and the Court of Directors, before any of us commenced our labours, and though the particular manner in which the note was designed added very materially to our difficulties, it was an imperative condition with the Bank that we should in no way deviate from that design; but we were compelled to reproduce it exactly as designed, a condition which has been so rigorously adhered to, that in only one case has any deviation been made. In that instance the lines have simply been allowed to be somewhat more open than in the original design, as it was found that even in the original plate the work had been made so fine, that the successful printing could not be insured for large quantities.

When we found that we were bound to copy implicitly designs specially adapted to plate-printing, we almost despaired of success, for in all other instances where surface-printing has been adopted, the design has been suited to the nature of the printing. This difficulty, however, only served as an incentive to further exertion. though I must confess that as we proceeded, step by step, we were by no means certain that we should not be compelled to abandon some part of our original design. With the exception of these stringent conditions, we were permitted to conduct our operations entirely in our own way; and to the kind consideration of Mr. Hankey, the late Governor, and Mr. Hubbard and Mr. Weguelin, the present Governor and Deputy-Governor of the Bank of England, our success must in a great measure be ascribed.

The cutting of the original design is necessarily the basis of future operation. The whole of the written part of the note was originally cut by Mr. Beckett, the engraver to the establishment, but the Britannia was designed by Mr. M'Clise, and engraved by Robinson. This engraving was the basis of our operations. After various experiments, the cutting of the Britannia in a manner suitable for easy duplication was executed on a steel die, by that veteran engraver Mr. Thompson, whose artistic feeling is fully recognised by the public. The other parts of the notes and cheques were in a great measure cut by Mr. Skirving, in some cases upon pieces of brass, in others on plates of copper, about ⅛ an inch in thickness. In no case is the original ever employed for printing, but is simply used to make moulds, so that, throwing out of consideration accidental mechanical or chemical injuries, they will retain their integrity for any length of time without change, and will enable any number of duplicates to be made therefrom. From our inquiries, we have reason to think that there are very few persons who have attained sufficient perfection to execute this class of work in the manner which the Bank requires, but the finished manner in which Mr. Skirving has executed his part of the work has met with the highest approbation. It is the province of supply, however, always to be equal to the demand, and, therefore, if surface-cutting increases, we have no right to suppose there will be dearth of labour or talent in that department of art.

For the duplication of the original designs, we have recourse to the power afforded to us by the processes of Electro-Metallurgy. For the purposes of the Bank of England, we have had recourse to the various forms of battery apparatus described by myself in the *Philosophical Magazine* for June 1840, and subsequently in my "Elements of Electro-Metallurgy." We employ, as a source of power, the Platinised Silver Voltaic battery, which many of the members of this Society may remember was brought under their notice some years ago. It was devised when I was a student of medicine at King's College, and resided in my father's house in the Bank of England. With friends entirely devoted to other than scientific pursuits, I was placed in an awkward position by the discovery of the principles on which it was founded. I brought it here unknown to any member, and after a long investigation a gold medal was awarded for its invention. For fourteen years it has stood the test of experience; and when we see that by its agency the plates of the maps of the Ordnance Survey have for years been deposited; when we see at the present time that by it the types of the Bank England notes and cheques are formed; and lastly, when amongst other purposes we find that it daily transmits the power from the Observatory at Greenwich to indicate the correct time in London, I trust the Society, in consideration of its application to these truly national objects, will not consider that their medal has been altogether bestowed in vain.

At the Bank we employ large batteries, in vessels holding several gallons of the acid charge. The platinised silver plate is of fair thickness, and the zincs are so arranged that they can be readily changed. The purer we can obtain thick-rolled zinc the more economically can we conduct our process, for then we are not subjected to the inevitable loss which arises if tin, a very frequent

impurity, is present. We are careful, for the sake of economy, very thoroughly to amalgamate the zinc; in fact, we prefer to repeat the process once or twice, that no local action may exist.

For charging the battery we use dilute sulphuric acid, and generally mix the fluids in the proportion of one-eight acid to seven-eighths water. It is convenient to adjust the mixture to a specific gravity of 1130, which gives a strength suitable for battery purposes. A battery charged with this liquid will last in action nearly three weeks before it is completely exhausted; but practically, after it has done efficient duty from 7 to 14 days it has beome feeble, it exhibits the natural decay of old age, and we generally respite it from further work and substitute a new charge, to resuscitate its former life and vigour. When the battery is thoroughly exhausted the solution has a specific gravity of 1360, and the solution contains 144 grains of zinc for every 1000 grains of bulk, if evaporation and condensation has been compensated by the daily addition of sufficient water to make up the original bulk.

To ascertain the changes which are occurring in the battery we commonly employ an hydrometer; but I have specially constructed an instrument which I call a battery-meter. The point corresponding to specific gravity 1130, is called unity, and the interval between that part and 1360 is divided into 144 parts. By this division every degree represents one grain of zinc dissolved in 1000 grains of bulk of the fluid. The opposite side of the scale, between the same parts, is divided into 60 parts, each of which is, for every 1000 grains of bulk in the fluid, about $\frac{1}{1000}$ of an inch in the thickness for every superficial inch of surface, upon which the copper is reduced in the precipitating trough. In this division a little allowance has been made for some local action of the zinc. By this instrument we really weigh the zinc which has entered into combination with the oxygen of the water in which it is subsequently dissolved. By the attraction between the zinc and the element of the water the power is produced wherewith the plates of the bank-notes are made, and this attraction differs not in kind from the attraction between the coals and air in the act of combustion which gives us the power in the steam-engine. In the electro-metallurgic battery, however, is perhaps observable the first instance of the estimation of the primary change of matter, to determine the amount of work actually performed. In the steam-engine the coals burnt will not necessarily give us a satisfactory clue to the work done; and even in the animal, the most perfect of all machines, the food the soldier eats will not indicate the number of miles traversed, or of the enemy killed.

In an application of the battery-meter we have an illustration of a law which governs all physical phenomena. Without a change of matter we can have no physical force; and all physical force is referrible to a corresponding change of matter. In our electro-metallurgic apparatus we obtain an effect equal to the original change of matter within a very trifling per centage, a result which must be regarded as a glorious triumph of human improvement. If by the use of the battery-meter these great laws are popularized, and lead to a more universal reference of effect to cause, it will amply repay any little trouble which has been bestowed upon it.

To contain the battery with its charge, we generally employ the best salt-glazed stone ware. Strange as it may seem, no form of earthenware permanently resists the attacks of the metallic saline solution. They pass into the innermost texture of the material, and, even with vessels for holding writing ink, disintegration eventually ensues. Upon the whole, earthenware is preferable to glass, because it is less brittle, and I trust that the mention of the subject may lead some member of the Society to produce a cheap material, as impermeable as glass, and as durable as pottery.

At the Bank of England we generally find it convenient to employ parallellopiped-shaped vessels. Those made of mahogany, and lined with gutta-percha, are convenient and economical. For most of our purposes, we use the vertical trough, because the subject can be readily inserted and removed for inspection. For rapid deposition we employ the horizontal trough, in which the subject is placed at the bottom, and the copper pole above. In the use of this apparatus some refined chemical laws are involved. In the first place, sulphate of copper possesses a low diffusive power, and is carried, by virtue of that property, so slowly through the fluid, that if we relied upon it failure would surely attend our labour. Secondly, the saturated solution of sulphate of copper formed at the positive pole is so heavy that it descends from the place of its formation like a cataract to the bottom of the vessel. Lastly, the part of the solution deprived of its copper, becomes so light that it rapidly rises to the top. For all rapid deposition we seek to form our new salt at the top of the apparatus, that it may descend to the place where it is required, and the light fluid may rise to mix with the denser portion. Practically, the vertical trough is suitable for the purposes of the Bank, but however important may be the requirements of this corporation, the laws of nature are paramount, and will not vary to suit its convenience.

Up to the present time the best standard salt for the reduction of copper by electro-metallurgy, is the sulphate, and, with the occasional exception of the nitrate, is invariably employed. We always have a neutral trough containing a simple solution, three parts saturated. For general purposes we use a saturated solution diluted with dilute sulphuric acid of battery strength, to the extent of from one-half to one-third of the bulk. We are careful to use recrystallized sulphate of copper, distilled sulphuric acid, and distilled water, as all impurities are hurtful. For our positive pole of copper it is very desirable to get good metal, and probably the sheathing of the innumerable Russian vessels we intend to capture will best serve our purpose, as the Russian copper is proverbially pure and free from tin.

If we regard the precipitating trough we can but regard it as a very curious and wonderful chemical laboratory, in which two processes are being conducted at the same time, and in precisely equivalent proportions. In it we have the best of all chemical factories for the production of sulphate of copper by the combination of the plate of copper with the acid of the salt, and in it we may perceive the most perfect of all foundries wherein the metal is cast upon the mould atom by atom, with a skill which rather shows the perfection of nature than the deficiencies of the operations of man.

As a general rule we employ a single battery with one trough. Where we desire rapid action, we employ a compound battery of two cells in series, but this entails a double cost of battery power. In a great many cases, where time is of no object, we employ a compound trough with a single battery, that is to say we arrange two troughs in series with one battery, a contrivance whereby we use our battery power twice over, and obtain two equivalents of copper, one in each trough, and consequently at half the cost. This form of apparatus is no trouble to manage. We have placed it in one of the iron safes for which the Bank is so famous, and wires are carried through the wall to supply the electric power. Here, unseen, and without labour or attention, the process goes on by night and by day, on Sundays and holidays, and when the deposit has acquired sufficient thickness, the mould is taken out and the deposit removed.

The deposited metal is of excellent quality, and a part of one of the Britannias, when carefully weighed, was found to have a specific gravity of 8·85. To ascertain the ductibility of the metal, I sent one of the scraps to Messrs. Horne and Thornthwaite, and one pound of metal was found to be capable of being drawn into three and a half miles of wire.

The authorities of the Bank are justly jealous of fire, and therefore we have not been able to keep our rooms or solutions at an elevated temperature, which is very de-

sirable for many purposes. It is far better that we should be put to inconvenience, and our processes retarded, than that one single document should be jeopardized by our operations.

After having procured suitable originals, with proper means of duplication, the next process which we have to consider is that of obtaining perfect moulds. Where the original is of wood, gutta percha is generally employed, but it is necessary that the mould should be used as soon as made, as it will shrink gradually till it is no longer fit for the purposes required. When gutta-percha is employed it is blackleaded, by the process described by Murray, and rewarded by a medal from the Society of Arts. It is placed in the solution, and the copper grows over it. All blacklead is not equally good, and when it has remained in the air for some time, we find it advisable either to heat the blacklead or use a little bisulphuret of carbon, or other volatile fluid, to drive off the adherent air.

Occasionally, when we have metal originals, and are pressed for time, we employ clichee moulds, but we never employ them when they can be avoided. The Britannia, I have already stated, is engraved on steel, and moulds are made from it by striking it upon pure soft lead, fixed upon brass plates, by which process very perfect moulds are secured.

For all our other originals, when we desire perfection, we rely upon electro-moulds, and electro-moulds alone. For this purpose the original is placed in the precipitating trough, and a thick electro-mould deposited. There is very little risk of adhesion, and very little difficulty, with moderate care, in obtaining a perfect mould. I need hardly mention that it would be a serious matter to place the original on the wrong side, for great would be the horror of the operator, on peeping into the trough, to see his costly original to have wasted away, instead of receiving the deposited metal.

When the electro-mould is sufficiently thick, a wire is soldered to it; it is waxed on the back and sides, and used for the deposition of the duplicate. In the use of the electro-mould there is much risk of adhesion, which requires skill to prevent. Sometimes we employ the film of air which I have already described in my "Electro-Metallurgy;" sometimes we employ with good success the vapour arising from sulphuret of ammonia, a process which has been specially devised for the purposes of the Bank. In both these cases the moulds are inserted into the solution in a dry state, and little bubbles of air are apt to adhere, and be carried down into the solution, to the great detriment of our electro cast. Upon pondering over this inconvenience I thought it would be desirable to have a process whereby the mould could be inserted in a wet state. After some thought, and many experiments, it occurred to me that we might use the layer of metal in the infinitely divided state which it is employed in my battery. With care many metals in that state will answer, but I give the preference to platina. When the process is carefully performed I have seen the most perfect success attend the platinising process. Nevertheless, commonly enough, without care, we find that there is a liability for little adhered drops of water to be carried down, which in the electro process have been covered with metal, and the casts show slight indents, which are fatal to success. Upon the whole I regard this process as an addition to our knowledge, and it is particularly applicable to deeply cut wavy line work.

The casts of the Britannia are generally deposited so thick in the compound trough that they can be turned down to the required form and size. Other subjects are generally backed with solder, and turned to their proper thickness. In cases where the lines are very thin, and at the same time deeply cut, the metal must be aggregated very carefully, otherwise the metal grows on each side of the holder of the mould, and a slit is left down the centre of the metal. In some cases this would be a fatal inconvenience, and where it is indispensable to avoid it, we use a feeble battery power, with a stronger solution of sulphate of copper in the precipitating trough.

All depositions in electro-moulds require for the highest perfection the utmost care. It would be tedious to the Society to dwell upon all the little points which require attention. Nevertheless, with proper care, no mode of duplication has ever been devised which is attended with similar identity. In all our electro-casts, whenever the most trifling air-bubble is found, it is thrown out directly, as the few halfpence required as the cost of the deposit of a small quantity of copper, is nothing as compared with the supply of perfect notes to the public.

Although circumstances have led me to study more especially electro-metallurgic operations, yet it is important that electricity should take its proper place, and not be pressed into our service on every occasion, whether it be suitable or not. In the bank-note it was a matter of debate whether in some parts the steel die and punch should not be used, but for various reasons it was decided to use a steel original, with lead moulds, for electro casts. There are some cases, however, in which, the punch and die system, or even the transfer system of Perkins, might be advantageously applied in the typographical art.

The electro casts, when ready for printing, are mounted on solid brass blocks, and many tools had to be constructed for this purpose. In this detail there is involved the difference between making and manufacturing the formation of one article, and the production of an infinite number. By this system of tools if any part of a form is damaged another piece is immediately inserted. The same screw-holes in the plate and the same screw is used for the new piece; and, by every portion being made to one gauge, an exactness is given to the system which it would have been impossible to have obtained by leaving such details to the caprice or judgment of the workman. By this system every part of the note is maintained in exactly the same relative position, and thus identity in the form of the note is absolutely secured. At the Bank a large stock of electrotype plates are always ready to be mounted at a moment's notice, and if one happens to be accidentally damaged, another is ready for insertion in precisely the same place as that which preceded it. The electro-copper is so durable that there is scarcely any limit to its wear, and at the *Times* newspaper one cast is said to have printed nearly 20,000,000, and yet not to have been completely worn out. The limit to the duration of electro-casts for the purposes of the bank-note has yet to be discovered, as above a million have been printed with no perceptible effect. This duration alone is a matter of considerable importance, as by it a constant identity is more particularly insured.

There is, perhaps, no part of the process of the manufacture of the note of more importance, and more replete with curious interest, than the production of the paper, by Mr. Portal, on which it is printed. The mill is situated in Hampshire, on the river Test, and this beautiful stream supplies the water to drive the machinery necessary for the production of paper.

The motive power of the mill is obtained from a turbine, an horizontal water-wheel, new to this country, but much used in Belgium and France. It is applicable to places where the fall is either slight or great. It is reckoned that by this contrivance from 70 to 75 per cent of the whole force is obtained, while the vertical breast wheel, which would have been required for this situation would not have afforded more than from 60 to 65 per cent. of the initial power. In using this turbine the quiet state of the water below the mill is not a little remarkable, for instead of the bubble and boil, it is as smooth as the mill-head.

The new bank-note has a new water-mark, and the design which has been adopted is attributed to Mrs. Wyndham Portal, who suggested the form of water-mark which has been approved. These alterations in the water-mark constitute an important part of the new note, and the

tinting is effected by means of Smith and Brewer's patent—an invention which is considered as a valuable addition to the mechanical appliances of paper-making, and was rewarded by a medal at the Great Exhibition of 1851. They have carried out their contrivances in the Bank. The essential part of this process is the use of steel-faced dies, which are engraved with the desired pattern, after which they are hardened, by being heated in leather charcoal, and then suddenly plunged in water. These dies are used with copper or tin forces in a stamping machine, to give an impression upon plates of sheet brass, and these plates when embossed are filed on the back to the requisite proportions, to allow the moisture of the pulp of the paper to pass through the apertures. The different pieces of brass, when struck, filed, and put together at the paper-mill, by Mr. Brewer, form the mould for the paper, and are so arranged that each mould is designed for two pair of notes.

In practice, great advantages attend the use of this patent. In the first place, identity in the water-mark of the paper is secured, a matter of no small importance when the subject of bank-notes is considered, and moreover it is specially adapted to give gradations of tints, lights, and shades, which, for the first time, has been introduced into the paper of the Bank of England notes.

If we contrast this elegant and simple method of mould-making with that previously adopted, the difference is sufficiently striking. In a pair of five-pound notes prepared by the old process there are 8 carved borders, 32 figures, 168 large waves, and 240 letters, which have all to be separately secured by the finest wire to the waved surface. There are 1,056 wires, 67,584 twists, and the same repetition where the stout wires are introduced to support the under surface. Therefore, with the backing, laying, large waves, figures, letters, and borders, before a pair of moulds are completed there are some hundreds of thousands of stitches, most of which are avoided by the new patent. Moreover, by this multitudinous stitching and sewing the parts were never placed precisely in the same place, and the water-mark was, consequently, never identical. In this process we may detect principles which are not only valuable to the Bank, but to all public establishments having important documents on paper, as it affords to the public one more test whereby they may readily discover the deceptions of dishonest men.

For the preparation of the paper, cuttings are selected from the finest pieces of linen of the purest and whitest colour. These are carefully dusted, placed in the machine, and reduced to pulp. This pulp is passed through the finest strainer to the vat at which the paper makers stand. To ensure as far as possible identity even in the paper, Mr Portal has put up machinery constructed by Mr. Donkin, in which all the improvements and adaptations heretofore adopted by machine paper are brought into operation for bank-note papers. The mould is dipped by hand into the vat of pulp, and a sufficient quantity taken up to make the note. This, as soon as the water is drawn off, is passed to a man, who puts it on a blanket, which slowly moves at a regular pace, and brings a new part into play for each mould of four notes as they are made. After the notes are placed in the blanket, they are carried under successive rollers till the water is squeezed out, and the pulp acquires consistency. This part of the process has performed the duties of the flannel and powerful press of the old system. The paper then, instead of being removed by a boy, as in the old process, is carried by machinery to the next part of the machine, where it is dried by passing over warm cylinders. This part of the machine answers to the old drying-room. When dry it is spontaneously carried to the sizing apparatus, where it is sized with the whitest and purest size, when it is finally dried in the last compartment of the machine by passing over heated cylinders. By all these processes which have been in use in these machines, which make paper by the mile, paper made by the hand-mould is dried, sized, and dried again in the short space of half-an-hour, instead of requiring an interval of many days, as in the old process.

Mr. Portal, however, does not so much look to the rapidity as he seeks identity, for in all cases the pulp, being subjected to precisely similar conditions, may be expected to afford precisely similar results.

When the paper is dried, it is moderately glazed, to give a smooth surface for printing. Formerly the paper used invariably to be wetted previous to printing, and a pretty-looking apparatus existed in the Bank for wetting the paper, by excluding the air from a receiver with an air-pump, and then allowing the water to rise and wet the paper. This wetting, however, damaged and weakened the paper, and hence it was very desirable to take advantage of the power of surface-printing to be applied to dry glazed papers. The smoothness is given by placing the sheets of paper between plates of copper, and subjecting them to a pressure sufficient on the one hand to give a fine and true surface, and yet not sufficient on the other to damage the water-mark.

When the paper is rolled it is carefully inspected, and every damaged sheet thrown out, for if any little speck remains it is liable to injure the electrotype in the subsequent printing; and, after one inspection, the paper is reinspected by two of the sharpest-eyed of the sharp-eyed inspectors of the mill. The paper is then inspected as to its gage, as, occasionally, a sheet shrinks considerably in its manufacture. The paper is again inspected, to see that every sheet is placed with its face uppermost, after which it is counted and packed up ready to be sent to Mr. Marshall, the chief cashier of the bank.

These numerous processes of inspection are performed by females, and they generally belong to families who have been engaged in the manufacture of bank-note paper for 150 years. Each inspector is seated in a green box, opposite to a north light; but the ladies who have honoured the Society with their presence this evening will probably think that the inspectors are subjected to some torture, when I state that in the room they sit, rigid silence is expected, and the whole number of females daily perform their allotted duties without gossip of any description.

The strength of the paper made in the manner above described is very great when we consider the nature of the water marks, which is calculated to render it weaker than it would otherwise be. To be sure that no change is being made in the materials, its strength is actually tested by a simple machine, and a sheet of note paper, although so thin, will always bear a weight of fifty pounds, and sometimes as much as seventy-five pounds, before it breaks.

The printing-ink for the bank-note is also a matter which has received attention. The properties of ink, when carefully prepared, are very curious, and require considerable judgment to adjust them to particular papers. To Mr. Winstone, the printing-ink manufacturer, has been intrusted the preparation and adaptation of the ink for the note, as it required somewhat careful treatment for the peculiar arrangement of the blacks and lights in the note. The black colouring material is made by burning coal-tar naphtha, and collecting the smoke in large rooms. This smoke, or lamp black, is placed in a retort, and heated to a high temperature, to drive off all volatile matters, when the ink becomes consolidated and improved in colour. This is subsequently ground with a suitable varnish, to a proper consistence to rest firmly on the delicate lines of the Britannia, without spreading to produce a rugged edge, and yet completely fill the black patches of the letters of the designation. In the bank-note it is also expected that the ink should dry sufficiently to allow handling immediately after being printed, a property which Mr. Winstone's chemical knowledge has enabled him to produce. To my mind, whatever may have been the results heretofore attained, the typographical art for rapid production has much to be improved by the adjustment of the distributive machines

to the ink, and the ink to the distributive machinery. For the peculiar viscidity and tenacity of the ink, the weight of roller and rate of motion should be adapted to the character of the ink. At present no laws have been deduced upon this matter, but extended experiments upon perfect work will, perhaps, eventually give us a knowledge of the relation which ought to exist between roller and ink.

In my original proposition to the Governor of the Bank I suggested that, in the first instance, the hand press should be employed, because by it the pressman could more perfectly manage the ink, and have everything requisite for the adaptation of the typographical system to the bank-notes before the selection of a printing machine was made. The authorities of the Bank, however, determined, at the instance of Mr. Hensman and Mr. Coe, at once to attempt the use of the machine, and these gentlemen made an investigation of nearly every printing-machine in use before the kind of machine to be employed was selected. It was found that the machines in greatest repute by the best printers were not sufficiently perfect for the Bank, inasmuch as the type did not always fall in the same place in regard to the tympan, a circumstance which interfered with the overlaying, so necessary to fine work, and in no case was the inking apparatus sufficiently good for this class of work.

For the cheques they considered that the double platten was the best machine which was in active operation at that time. For that reason a machine by Hopkinson and Cope was adopted, and the cheques were printed by it, as also some of the notes.

For the other bank-note a new platten has been specially constructed by Messrs. Napier and Son, with contrivances for both the tables and the inking-rollers to traverse, by which means an effect is produced equivalent to rolling with a single hand-roller twenty different times. In this machine a plan of great value is employed, as the form of every note is made to one gauge, and every denomination has its separate tympan and overlaying. By these means, when a note-plate is once made ready for press with its overlaying, it is always ready at a moment's notice, without further preparation for taking impressions. This appears to be a contrivance which has added additional power to the system which, under the circumstances, well meets the requirements of the Bank.

Counting machines are appended to each end of the machine, that no impression can be taken without being registered, and when 100 impressions are printed a bell strikes, to call attention to the fact. In Napier's machines 3,000 notes are printed per hour, and two boys are required to feed with paper, and two to take off the printed notes.

After the note is printed, as a part of the system, it was proposed that it should be numbered and dated at the ordinary machines instead of the Bramah's machine heretofore employed. These machines are also double, requiring two boys to feed and two to take off. By this working the note is completed, and handed over to the cashier to be examined and counted. By this part of the system the note is decidedly superior to that of the old, the printing by the new process being very much improved as a mere question of printing.

Curiously enough, the numbering apparatus originally invented by Bramah, has been adapted, with the necessary modification, for the Napier's Gripper Machine, with an improved inking apparatus.

When the form is arranged in the printing machines, the first act of the printer is to obtain a perfectly level impression, equal in tint at every part, which is accomplished by filing the back of the blocks wherever he finds any elevation exists. This may be called a general picture, which possesses the general appearance, but without the lights and shades which give beauty and excellence to the impression. When the general picture is obtained to the parties' satisfaction, four impressions are taken upon thin paper, and according to the gradations of tint required, the impression is cut away, so that in one place no thickness exists, in others one, two, three, or all the thicknesses remain. For the darkest portion the four thicknesses are left, for the lighter none are allowed, and for the intermediate tints two or three thicknesses are left. The whole are then pasted together and placed over the electrotypes and by the contrivance of the overlaying, those parts which are desired to be darkest get the heaviest pinch, those parts required to be of a lighter tint are the least heavily pressed, and in this way the impression is in a great measure brought to perfection.

Upon the trial of this overlaying little alterations are made, to bring it to the utmost uniformity. In this part of the process much depends upon the skill of the superintendent of the printing department, who has the final examination, and when he is satisfied the printing is allowed to commence.

The time has long since passed away when scientific men would think of attempting to devise an inimitable note. A note to be inimitable must be made with a skill superior to the power of imitation of all men. The doctrine of inimitability should be buried with that of the philosopher's stone and the elixir of life; nevertheless, certain properties are demanded by the mercantile community, whereby a man may readily determine a good note. In this matter constancy of appearance is of paramount importance, and in this particular the new surface-note stands pre-eminent. The vignette is printed in every impresssion line for line invariably the same. The same expression of face is constantly maintained; the same number of lines in one impression is visible in the second, and however many number of thousands of notes may be issued, not the slightest possible variation within certain limits can exist. Moreover, the note is printed with a similar ink, and the same tone of colour preserved, that the public may be familiarised with a constant standard, and an uniform appearance will be marked in their mind.

Probably many of the members may recollect that the Society of Arts many years ago very warmly entered into the question of inimitable notes, and a very interesting little volume was issued by them on the subject. Some of these proposals were remarkable from the intricacy of their designs, but so far as the protection of the Bank is concerned no such intricacy is required, as the Bank is never at a loss to detect a forged impression, be it executed ever so skilfully, and the system pursued by the Bank is so perfect that no forged note ever has escaped eventual detection.

The doctrine even of difficult imitation is one which must be studied by physiological principles, and must be considered in reference to the faculties of the eye and the properties of the mind. By actual measurement I have ascertained that the eye can see perfectly over a range of 2° 18′, which for twelve inches distance would represent a space of half an inch diameter. However, it has been ascertained by other philosophers that an impression on the eye lasts for the one-tenth of a second, wherefore it follows, to look over very carefully every part of a note, no less a time than a third of a minute would be consumed, and probably in practice three times as much would be required. As nearly 30,000 notes are daily presented for examination, it follows that one gentleman must be employed 166 hours to inspect every single portion thoroughly. Practically, however, the work is perfectly performed by nineteen inspectors, and therefore they cannot enter into a minute and elaborate examination of every part of every note, but only judge by the general appearance of all manifestly good notes, and a careful examination of any one where there may be *prima facie* grounds for suspicion.

From such causes it is found by long experience, that any extraordinary complexity is not only useless, but delusive and dangerous, from leading the mind into details which cannot be successfully appreciated. The labour and exhaustion produced by minute inspection of any very fine work for any length of time is shown by

experience to be great, and, though to the psychological surgeon it presents many features of intense interest, yet the limits of this paper forbid me to enter into its consideration.

In speaking of identity, there is also another property of the eye to be considered, for although there can be hardly any such thing as absolute identity or likeness between any two objects, yet any objects which do not differ more than four seconds will appear alike to unaided vision, though, with the microscope great differences may be discernible. Whenever, then, throughout this paper I speak of identity, I refer to the identity observable by the unaided sight, and after all it is but a rough comparative indentity, a mere vision of identity when examined in a philosophical point of view. As far as the public is concerned, nothing can exceed the value of an uniform appearance; this the new note affords in the highest degree. Day after day, and year after year, the character of the paper will not vary. The same signature of "M. Marshall" which appears in the paper of one note will be repeated in the next. The same wave lines, the same rough edges on three sides, the same shadows in the water-mark will be brought continually before the sight. The Britannia will have the same expression of countenance, and will be repeated line for line, and dot for dot, for millions of impressions unchanged and apparently unchangeable. The very weight of the paper does not vary above two or three grains, unless damaged by wear, and the colour of the ink will be maintained as far as possible. As the stone is worn by water constantly dropping, so will the mind be impressed with one uniform appearance. With these constant appearances, the public should become familiar, and really in a country like this, where the circulation of notes is so large, and the Bank has taken such pains to secure identity, he that does not make himself acquainted with the appearance of a genuine Bank note does not deserve to be its possessor.

To attempt to construct an unforgeable or inimitable note would be a mere delusion and snare. The public should know that everything which has been made can be copied, and without due care, whether they are numismatists, and look after Darics and Queen Ann's farthings, or antiquarians, and collect old bibles or ancient manuscripts; whether they seek to buy gold dust or sell precious stones; whether they transact their business by bills, notes, cheques, or coins, they are in all cases liable to fraud and deception, and ever will be liable so long as evil remains in the world.

Bank-notes are perhaps as little or less liable to be falsified than most other human inventions, in consequence of the certainty of the eventual detection of the fraud, and the great risk of punishment from the care and vigilance employed to trace out delinquents.

All questions of fraud are amenable to certain principles, which, on this occasion, it is not my province to consider. Whatever knowledge may have been obtained upon this subject has been obtained at the Bank, and may be regarded as the property of the Bank, which I have neither the liberty to communicate, nor am I granted permission to discuss. At the desire of the Bank, many experiments have been conducted upon chemical means of multiplication. Without entering into details, I am led to adopt a principle for the prevention of chemical changes, namely, to put the paper in the same chemical relation as the ink which we desire to protect, and in this way we obtain security against changes in both writing ink and printing ink. In these experiments new fields for investigation were found, but it is not in my power in this paper to enter into their consideration.

As far as the Bank is concerned, the new system has insured increased excellence with diminished expense, but probably its adoption by the Bank will lead to a far more important use in the arts. Since the printing of the cheques, the government have adopted surface-printing for the receipt stamps, and more recently for their new bill stamps. For extensive production and uniformity of expression, surface-printing stands pre-eminently as the master. Although the daily production of the *Times*, and the weekly production of the *Illustrated London News* may justly be termed the typographical wonders of the world, yet the care bestowed upon the note to render its unlimited duplication perfect, has a tendency to materially influence the printing art in this department in a beneficial manner.

One application of surface-printing, although disconnected with bank-notes, I cannot pass over in silence, as I think the Society of Arts should recommend the adaptation of surface-printing to the Ordnance Maps, and though I am fully sensible of the difficulties which would attach to this new system, and fully estimate the perfection of these plates, nevertheless I feel persuaded that all difficulties may be surmounted, and every Englishman may be in a position to have a correct map of the land of his fathers, at a price not exceeding that of an ordinary newspaper.

In regarding the future operations of the Bank, I cannot but think that the results which have been described are the first step of the commencement, and not the end of those improvements which will take place in the production of bank-notes. If the use of the steam press exceeded my own propositions, yet in many respects the result has fallen short of my anticipations. Considering the great importance of an uniform note of a certain standard of perfection, it was necessary to take the most prudent course, nevertheless I cannot bring my mind to suppose that the processes can possibly stop where they are. In the first place, the original cutting of certain parts of the note will be far more highly finished than it is at present when increased skill is brought to bear upon it. With regard to the printing, hereafter, probably four, and possibly six or eight will be printed and subsequently numbered at a single operation.

We are all too apt to think that art will stop at our point, and not progress, but it is the property of invention ever to move forward. The point at which we have arrived must be the step from which future improvements must spring, and proceeding step by step, the highest possible excellence will doubtless eventually be secured.

There are certain characteristics which are common to the whole class of Bank of England notes which should be known to all the world. In the first place, every note has three of the natural edges of the paper, and one cut edge. In the centre of every note is a water-mark composed of waved lines, and the words "Bank of England," are inserted in the substance of the paper at the upper and lower portion, with a fac-simile of the autograph of Matthew Marshall, the esteemed chief cashier of the corporation. The Britannia is printed on notes of all denominations, and all notes have the words "I promise to pay the bearer on demand."

The entire class of bank-notes include twelve genera, as each of the eleven branch establishments issues notes with the town upon it, as Manchester, Liverpool, Birmingham, Leeds, Newcastle, Leicester, Bristol, Portsmouth, Plymouth, Hull, Swansea, and these, with London, form twelve establishments issuing notes.

Each genus comprises several species, as notes are of several designations. Thus, in London nine notes are issued,—£5, £10, £20, £50, £100, £200, £300, £500, and £1,000 notes. In every branch, notes are issued up to £100, and at the two important commercial towns of Liverpool and Manchester, notes of £500 are issued in addition. In every genus of note the denomination up to £50 is placed in the water-mark in letters, and twice in shaded figures.

Every species of note is made up of innumerable individuals, each of which has an individuality as distinct and determinate for a bank-note as the individuality which characterises every human being, and also characteristics as marked in the eyes of the Bank, to distinguish one from another, and no more likely to be mistaken than our chairman is likely to be mistaken by you for

our secretary, even when you are so perfectly familiar with their likenesses. This individuality is given by a number and date being added to the denomination. The number is of no use alone, the date is of no use alone, but the number, date, and denomination together conjointly mark the specific individual; and any person having these particulars can learn at the Bank to whom the note was issued, and when it was issued, the date of its return to the Bank, and the person to whom money was paid for it, with many other matters of its pedigree and family history, which are only objects of interest to its mother, the Old Lady of Threadneedle-street.

It is not generally known to the public that there are two letters preceding the numbers on every note, and which with the number, tells the whole story of the note. Therefore, if the public will but take down the letters and numbers, they can learn every other particular on applying to the Bank.

To give an idea of the extent of our operations, I find, in casting them up, that there are 66 kinds of bank-notes, and about 50 varieties of cheques, which had to be prepared. Besides these, there are 25 kinds of bank-bills, issued from eleven different places, independently of 60 day-bills, and various matters which would not be interesting to the meeting, further than to show that the Bank has not merely adopted surface-printing to a bank-note, but to all similar documents of a similar character which they require.

Had time permitted it would have been interesting in this paper to have considered the progress of typography, and traced, step by step, the successive improvements which have taken place before it could have been adapted to Bank of England notes. In such an investigation we must commence with Tung-Taou, A.D. 924, who appears to be its first inventor. From the works of the Chinese and Japanese we should pass to the Biblica Pauperum; the illustrated Bible of the period, printed by blocks, between 1420 and 1470. Then we should consider the moveable types of Caxton, and works printed by this benefactor of the human race. Upon examinations of the choicest specimens of Faust, Schoeffer, and Caxton, Shöensperger, and other great printers, we find that even at the beginning of this century, when Baskerville, Didot, Bensley, and Bodini, produced their finer specimens, surface printing, as at all adapted to the present form of the Bank of England note, was only in its earliest infancy.

If we examine forms of notes printed by typography, we shall observe that the note of the Bank of France and the Belgian note are so produced, but in these cases the character of the note is adapted to the style of printing, and even there the number printed is so small as to appear insignificant when compared with the number issued by the Bank of England. At the former establishment about 300 impressions are printed every day; at the latter, nearly 30,000 are produced, as 9,000,000 notes are issued per annum, representing near £300,000,000 of money.

I remember, when a boy, the waggon-loads of machinery which were carted away from the Bank, which had been used for the production of the four millions of one-pound notes, which had been printed and never issued. Of these I cannot learn that one exists as printed for circulation, and the character is so different, that it throws but little light upon the application of typography to the present note. The same observations which apply to the suppressed one-pound note apply equally to the paper-duty stamp, which is familiar to every stationer.

When we consider the great difficulties which the peculiar water-mark of the Bank note paper has entailed, it never could have succeeded had we not applied a very much improved inking apparatus, assisted by the excellent composition rollers of Messrs. Harrild, the whole being materially helped by a totally novel method of preparing the form for the press. As far as my examinations have gone, the typography of our cheapest periodicals far surpasses in sharpness of impression the very choicest efforts of preceding ages.

The theory on which my report was founded was deduced from a multitude of facts, and the result has proved that inductive reasoning has not deserted us when brought into practical operation.

The examination of typography has strikingly shown that invention is rather due to the period than to the man; and as those who have gone before have taken advantage of the inventions of our predecessors, and again we in turn have received the benefit of their labours, so our successors will use our experience as a stepping-stone to attain their results.

If we examine the note through its different stages, we cannot help being struck with astonishment at the care which has been taken to protect the public from imposition. In the manufacture of the paper every sheet must be accounted for, and the legislature has wisely provided that no person, under the pain of transportation, may manufacture, sell, or expose for sale, paper with the words "Bank of England" in its substance, or any curve bar lines, or any denomination in writing. When it is received in the Bank it is again counted and arranged by a decimal system, under the care of the treasurer, before it is stowed away. When issued to the printer, the same number must be handed over to the treasurer, and when it receives its final imprint and is converted into the representative of money, it is received by the cashier, who again examines and counts the number. These perfect notes are deposited in a place of security till life is given to them, by being carried as a credit into the Bank books. When it passes into the hands of the public it is amenable to laws which are known to the authorities of the Bank. Each denomination has a different average duration of life, like individuals in different cities, and some are never heard of again, like people who go to foreign lands, and their fate ever remains unknown. When the note returns to the Bank, after inspection, it dies, never to be resuscitated. The signature is torn off, the denominations are punched out, and it becomes a piece of waste paper. The registry of its death is taken by a system devised by my brother, Mr. William Smee. This system, which is remarkable for its simplicity and rapidity of execution, has been in use with great success for many years, and those who are partial to the details of scientific book-keeping, will discover many devices of interest, but which it is foreign to the purposes of my paper to consider in detail. After the death of the note is registered, it is then deposited in the vaults for reference for 10 years, when it is burnt. The object of retaining the notes for so long a period is exclusively for the accommodation of the public, for although such a course entails a very considerable cost to the Bank, yet the value of the information which is daily being supplied from this cause, shews the importance of it to the monetary community. It is not an easy matter to utterly destroy so large a number of notes as those which are issued by the Bank. Experiments have been tried to reduce them again to pulp, but they have never altogether succeeded, and no plan answers so well as their destruction by fire. A large iron cage is built in the middle of the yard, including a light brick furnace pierced with holes. In this cage the notes are placed and burnt by sackfulls at a time, and nothing is left but a little white ash. Formerly the paper was coloured with smelt, and this was left at the bottom of the furnace as a curious blue mass. The same care which is taken in the manufacture of the paper, and in its transition through its various stages, is maintained to its final destruction, so that from the linen pulp to the cinder, no person can become possessed of a single sheet without committing a felony, immediately liable to detection. As the final result of the changes Bank-notes undergo, I am enabled to show you a piece of the blue ash, a portion of the white ash, and a curious mass resembling peat, which arose from the conversion of a number of Bank notes into a peculiar substance from years of exposure to wet and pressure.

In bringing this paper to a conclusion, I am fully sensible of its defects, and regret that so important a subject should have been treated in a much less efficient manner than the members of the Society have a right to expect. The original intention was simply to have described surface-printing from electrotype for the purposes of the notes and cheques of the Bank of England, and if a wider scope has been given to these remarks, I trust that they have not been found tedious to the members of the Society, nor have been altogether uninteresting to the mercantile community. If, hereafter, the adoption of this system of Bank of England notes shall have been found to be beneficial to the arts, I shall feel amply rewarded for the anxious thought and labour which I have bestowed upon it—a feeling which is equally experienced by Mr. Hensman and Mr. Coe, who have, from the first, made very exertion to bring the system into successful operation.

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The time at the disposal of the meeting did not admit of the following paper being read :—

## OBSERVATIONS ON THE MEANS AVAILABLE FOR SECURING BANK NOTES, CHEQUES, AND SIMILAR IMPORTANT DOCUMENTS AGAINST COUNTERFEIT AND ALTERATION.

By William Stones.

The following remarks on the means available for securing bank notes, cheques, and similar important documents against counterfeit and alteration, were intended to be read as a portion of the paper formerly submitted by the Author to this Society, on the subject of the manufacture of paper, but the time allotted would not allow of its being entered upon on that occasion. Now that the "Printing of a Bank Note" has been announced as the subject of a paper, it seems a fitting opportunity to offer a few remarks on this more general though kindred question, the importance of which is far from being generally understood, even by those most interested. It is also much to be lamented that, from inattention or ignorance, not only are the sources of security little understood, but a false security is frequently induced. Several instances have recently come to the knowledge of the writer in which a very good defence against one description of fraud has been relied on for security from other means of forgery, in reference to which the supposed protection was entirely inapplicable. As well might the careful housekeeper lock, bolt, and bar the window, and retire to rest without fear of plunderers, forgetful that the door had been left open.

The importance of this subject will be obvious on consideration of the enormous values continually changing hands by means of these documents. From an official return it appears that the payments made through the Clearing House in the year 1839 amounted to upwards of nine hundred and fifty millions, the average for each day would consequently be rather more than three millions, and of this sum more than two millions eight hundred thousand pounds were represented by paper. Even these figures do not express the full amount of the current paper transactions, as the Joint Stock Banks were not members of the Clearing House at the period mentioned.

The evil resulting from inattention to the security of these documents is evidenced by the following extract from Knight's "London":—"The first forgery of a bank-note occurred in 1758, when the person who forged it was convicted and executed. In 1781 it was decided that the Bank was not liable for the payment of a forged note. A more easily-fabricated instrument was never issued, and detection only ensued when the note reached a certain department of the Bank, where its spuriousness was detected by certain private marks. The consequence was, that forgery, which was a comparatively rare crime before 1797, became a very common offence, and every year public feeling was outraged by the execution of numerous victims to the facility with which the wretchedly-engraved notes of the Bank were imitated. In 1820 there were 101 persons convicted of forgery, and 272 for having forged notes in their possession. In 1818 the number of persons executed for forgery was 24."

The frequent reports in the newspapers of cases of forgeries are sufficient to indicate that the question is still worthy of most serious attention, although one of our fellow creatures may not now be hanged every fortnight for offences of this class.

In discussing this matter several points must be borne n mind—

i What we should endeavour to obtain—What is practicable on an extensive scale—The means of securing the objects in view, and those plans which may give sufficient protection against one form, may afford no security against some other mode of forgery.—And that two classes of persons are to be protected, the one all alert, attentive, and suspecting; the other comparatively inattentive, unsuspecting, and off their guard.

It is evident that the private marks known to the bank clerk, and the absence of which is to him the signal for suspicion and increased care, are of no avail as protection to the public.

The great object is to paralyse or neutralise the incessant efforts of the skill and audacity of the forger, by accumulating difficulties in the accomplishment of his project, and to do this with due regard to the inattention, inexperience, and want of skill of the public.

It would seem that a true safety paper can be efficacious only in proportion as its characteristic signs speak to the eyes of the general public, and not exclusively to those of the expert and practised; for the professional eye is quick in observing points which escape general observation

It may now be inquired, What marks or signs should papers of this character possess? Undoubtedly—1. These papers should be readily distinguishable from ordinary paper at first sight, and by every person. 2. They should be incapable of imitation in such a manner as to deceive the most superficial observer cognisant of the genuine paper. 3. And attempts at alteration should be indicated by the paper itself, without the assistance of an experienced person being required for the discovery.

Commercial documents are exposed to two descriptions of forgery:—I. Imitation or counterfeit of the whole document, either by fraudulently re-engraving and printing, or transferring from an original document by means of lithography or zincography. II. Partial alteration of amounts by chemical means.

It is obvious that cheques, drafts, and similar papers, are more liable than bank-notes to the second kind of forgery, and that all are equally liable to the first description of fraud.

Having noticed the standard to be aimed at, we proceed to review some of the means more or less available for obtaining the desired security. These are—

A. Peculiarities in the pulp or manufacture of the paper.

B. Chemical preparations introduced at the time of manufacture or subsequently.

C. Watermarks or devices introduced for the purpose of distinguishing any given paper from all others.

D. The style and subject of the engravings.

E. The inks used in the printing.

### A.—PECULIARITIES IN THE PULP OR MANUFACTURE OF THE PAPER.

The texture of paper may be caused to vary as much as the texture of other manufactures. As bank-notes, shares, loan certificates, &c., have generally considerable wear, a point of some importance is to impart strength to paper intended for such purposes; this gives a peculiar character to the paper, and by which it may be easily distinguished from ordinary paper, as will be evident from an inspection of the specimens now produced. Some Foreign banks adopt the plan of having different coloured papers for the different denominations of value, as blue for 10 dollars, green for 20 dollars, pink for 5 dollars, &c. How far this is an advisable plan admits of question, for,

in addition to the fading of a colour, the circumstance of receiving a piece of coloured paper is apt to induce a false security, by assuming without inspection that the document is of a certain supposed value. Paper made of differently coloured pulps has been adopted in some instances; the two sides or faces of each sheet differing in colour. The introduction of silk gives a peculiar and unmistakable character to paper with the pulp of which it may have been mixed. It may be noticed with reference to the Bank of England, that its notes being destroyed on their first return to the Bank, and not issued a second time, so much regard is not paid to the strong texture of the paper as to the security to be obtained from the nature of the water-mark, to be mentioned under our third section. The preservation of the natural or uncut edges of the paper is esteemed a great security, as manifesting that the paper has been made with the definite object of being employed for a special purpose, and not a piece of paper cut from a sheet. This almost necessarily implies the possession of suitable machinery, and consequently to some extent the genuineness of the document, as it is rarely found that persons with the means of legitimate manufacture are connected with frauds, unless by inadvertence they become the unwitting aids of others.

B.—CHEMICAL PREPARATIONS.

The use of chemical preparations has chiefly had reference to the detection of partial alterations of the writing on cheques, &c., so that on the application of any solvent to dissolve the ink, such solvent should have at the same time a perceptible effect on the paper. Various vegetable colouring matters readily acted upon by the chemical reagents, have been used with this view, and the result has justified the expectation. One of the first, I believe, who suggested the application of these substances, was the late Mr. Robson, the projector of the London Directory, not long since deceased in a workhouse. He deserved a better fate. As a check against alterations in drafts sent to a distance (and not the less suitable for securing cheques), I would mention the plan frequently adopted by some of the Scotch banks, viz., to discharge the colour from a tinted paper by writing the words expressing the amount of the draft across the paper in a chemical reagent, rendering a double alteration necessary before a forgery could be successful. Under this head may be mentioned the introduction of ingredients to prevent the transfer of engravings by the Anastatic process; of these the one most recommended is phosphate of copper, the incorporation of which with paper pulp prevents the transfer, the application of nitric acid used in that operation causing a deposit of copper on the zinc plate and thus preventing the forgery. As far as this particular mode of forgery is concerned, the protection thus afforded is sufficient. Without changing the colour of writing paper, it can be rendered sensitive by the introduction of a mixture of the ferrocyanide and iodide of potassium and starch.

C.—WATER-MARKS.

These are marks made in the paper in the course of its manufacture, by inserting in the mould or frame, some substance which shall cause an irregularity in the quantity of pulp deposited, the result being a design or water-mark. Various arbitrary symbols have been introduced from an early period, and certain of these have been assigned to definite sizes of paper. For those who may be curious in the antiquities of this subject, the accompanying Diagram* may possess some interest. On the lower portion, the symbols in present use are delineated from "Imperial" to "Pott." The figures in the upper portion are the devices used by the earlier makers. The hand open, surmounted by a star, there is little doubt gave name to the papers now called hand-papers, as small-hand, lumber-hand, royal-hand, &c. A sheet made in the year 1649, has been found with the device of a large hat, and we learn from Fuller that there was at that period a description of paper termed "Cardinal." The star with eight points included in a double circle, is the mark of John Tate, the first paper-maker in England. The fleur-de-lis surmounted by a crown, strongly implies that this paper was originally imported from France; the device is retained in demy to the present time, and modifications in some other sizes. The post-horn, from the general practice of the boy who conveyed the mail to blow his horn, was probably not adopted until after the introduction of the General Post, and is retained almost unaltered at the present day. The particular kind of paper termed "pott," appears to have derived its name from the flagon or drinking vessel, which was commonly used as the water-mark, to which the initials of the maker were frequently added. The flagon has been changed to the Arms of England. The foolscap doubtless gave name to the paper now distinguished by that singular title, although it has resigned its mark, and adopted various others, as Britannia, and a rampant lion, with a cap of liberty on a pole. The marks in the paper used by Caxton and other early printers, were the ox-head and star, the shears, the hand and star, and the P. The rampant lion, with the motto "Pro Patria," and the ox-head derived their origin from the circumstance of their being the arms respectively of the province of Holland Proper, and of the town of Coesfeldt, in Westphalia. The bundle of arrows had reference to the number of states comprising the United Provinces, and our present English mark is most probably a modification of the old mark. Originally designed as trade-marks, they have been so improved by processes more or less expensive, that water-marks have become sources of great security. It is evident, that by the artistic and elaborate designs which can now be introduced into papers, the documents used by each bank or company may be rendered so unique, and, therefore, not obtainable in the general market, that the forger would at once have an almost insuperable difficulty thrown in his way, as no respectable manufacturer would part with a specially prepared paper, except to the authorised recipient. Specimens illustrative of the nature of the securities afforded in this respect were exhibited.

D.—ENGRAVING.

Having passed in review the securities which paper in itself is capable of affording, the next important matter has reference to the printing imposed upon the paper. What securities can it afford?

To do justice to this portion of the subject more time would be required than is at our command. So important was this question formerly considered, that about 30 years ago, the Society of Arts deputed a committee to investigate the matter, and the suggestions then elicited are well worthy of attentive perusal. The subject has since been taken up by the French Academy, and although I do not consider they have been successful in their inquiries, the principal points of their report are subjoined, as they may be of interest: "This clever artist, M. Grimpé, taking up the idea of the Academy, sought to obtain the desired end, viz., the prevention of forgery, either by altering the writing, or effacing it altogether, by means of a delible device. For this purpose he endeavoured to procure a microscopic device, which extended all over the surface of the paper, and was composed of lines too fine to be reproduced by hand, and which being printed with delible ink, should be open to attack by all the agents which affected writing, and when once effaced could not be restored by the most skilful hand or by any printing process. The principle consists in covering the paper with a microscopic device, printed on both sides, with delible ink, by means of a cylinder. Fine lines, capable of being reprinted upon paper, may be traced upon a plane or cylindrical surface, either by an engine-turning lathe, or other suitable means, such as a steel roller, having the device upon it in relief, and which by strong pressure may be reproduced in intaglio upon a copper cylinder. This

* The Diagram was exhibited at the meeting, but is not here reproduced.

latter process is the one adopted by M. Grimpé. From an experience of eleven years, your Commission is confirmed in its previous opinion. After having successfully tried various geometric figures as suitable for composing the device, such as concentric circles, hexagons, &c., all opinions were in favour of the microscopic stars, which are upon the paper submitted to the Academy. This device has been found to present insurmountable obstacles to its reproduction by hand. With regard to the absolute identity of these stars to one another, we will merely observe that they are produced by a single steel punch or die, upon which a single star is engraved. This punch, which is very highly tempered, is caused to stamp the stars all over a soft steel cylinder, which is then tempered, and by being made to act upon other untempered cylinders, the device may be reproduced upon any number of them; these cylinders may then also be tempered, and may be made to reproduce the device upon copper cylinders, from which they may be printed on the paper. Thus has the plan been carried out, which we had unceasingly and perseveringly advocated. To state it simply, it consisted in covering the two surfaces of the paper, (without changing its nature), with a device which could not be imitated by hand or transferred on to stone, and which might be printed with ordinary writing ink. It is the plan proposed by M. Grimpé, and improved upon in some respects by the suggestions of others, which has been alone found to possess all these advantages."

Notwithstanding such high authority as the Academy, some serious objections to the plan they recommend exist. 1. The employment of a *microscopic* device may be a very good means of check by a bank clerk sitting at his desk with a microscope fixed before him, but to the public generally, invisible marks to the open eyes are of much the same value as visible marks to shut eyes. The injury is done before the detection of the forgery. 2. The facility this plan offers to the forger will be apparent when it is considered that the supposed security consists in the repetition of the same figure, and that one so easily formed as a geometrical figure requiring no design, but simply care in imitation. For the same reason exception must be taken to the almost microscopic repetitions in some bank-notes of such words as "One Pound," &c. 3. That which we are accustomed to expect we too often assume we see, and the mind misleads the eye. Thus, supposing the microscopic stars or words on a genuine document to have been carefully noticed by any person, on seeing a paper with similar stars or words so near in resemblance as a forger would take care they should be, the receiver would most probably assume the document to be genuine. The design, from its excessively minute character, gives the idea of a tinted ground rather than of a definite pattern or a series of words.

It is not my intention to describe the various plans of engraving and printing further than to indicate the sources of the variety which is at our disposal for accumulating difficulties in the way of crime.

For this purpose we may divide engraving and printing subjects into the following classes:—1. Intaglio engraving, depending upon the human hand, and which may consist of either—: A. Portraits. B. Vignettes. C. Scroll-work. D. Plain and ornamental writing.—2. Machine intaglio work, not depending upon the human hand, automatic, either :—E. Rose engine work with all its capabilities of complexity and variety, resulting from deviations in the arrangement of the machine. F. Anaglyptograph or line tracing, by which machine medallions and raised work are rendered on flat surfaces in such a manner as to exhibit great beauty and effect. 3. Lithography, or printing from stone, well adapted, when various colours are required to be introduced, and when exceedingly fine work is not desired. 4. Surface printing. This may be either from wood or type. Hitherto it has been generally considered that fine work could not be executed by the ordinary letter-press, but of late, from the improvements in the art of electrotyping, fine engraving can be rendered workable at the letter-press, and as copies can be multiplied by the electro process without limit, should the fine surface wear down somewhat quickly, as no doubt it must, by being printed at the letter-press, new copper blocks can be introduced at a trifling expense.

With all this variety from which to choose, some presenting considerable difficulties to the forger, it is rather singular that for the engraving of cheques, bankers for the most part should remain satisfied with the most easily imitable of the long list named, viz., plain writing.

The judicious combination of these kinds of engravings in the same document would present insuperable difficulties to an imitator. For example, an important document might contain such a selection as the following :—1. An elaborate engine-turned scroll. 2. A scroll engraved by hand, skilfully executed. 3. An analyptographic design. 4. A head, engraved by one of the best artists. 5. Ornamental and plain writing. I apprehend that the mechanical and artistic skill and appliances requisite to successfully imitate such a combination as the above, would not be found in any set of forgers, certainly not in one person. I am decidedly of opinion that the impression produced by an engraving of the human head is more easily retained in the memory, and any diversity noticed, than any other design, whatever may be its character. The difficulty which has generally presented itself, that of multiplying accurate copies without the expense of re-engraving, may be obviated in two ways—by Perkins's process of softening and subsequently hardening steel, or by taking electro copies.

### E.—INKS.

Few observations must suffice on the subject of printing and writing inks. Printing inks may be considered of two characters—aqueous and saponaceous. Under the first term I include what are called vegetable inks, and which are used with the same object as tinting paper in the pulp, viz., to present a ground on which the amounts are to be written, and which tinted grounds indicate any attempt to remove the superimposed writing. Ordinary black printing ink does not possess any security on this head, and unless the printing be well dried the transfer to zinc is easy. Although there is danger from this cause for plain writing and simple work, I have yet to learn that with well-dried elaborate work the process is successful even in the hands of the most expert. It is also asserted that the vegetable inks can be similarly transferred, but I am not aware whether the truth or incorrectness of this assertion has been impartially tested.

Of writing inks the most usual is the one of which oxyde of iron is the base; many substitutes have been tried, but this still maintains its position. To remove this ink, recourse is generally had to oxalic acid to dissolve the salt of iron, or chlorine to break up the combination of the oxyde of iron with the gallic acid, and the oxyde is then easily removed by washing the surface with weak hydrochloric acid, which dissolves the iron. Thus is explained the *rationale* of the action both of tinted papers and vegetable printing inks. The application of the above-named, or similar chemicals, to dissolve the writing ink has a chemical action upon the colouring matter of the paper or vegetable ink, and the written black ink cannot be successfully removed without bleaching or discolouring the paper or vegetable printing ink.

It may be noticed that the French Academy proposed an ink of which carbon should form the principal ingredient. This ink is directed to be made by diluting Indian ink with water acidulated by means of hydrochloric acid, in such quantity as to give it a density of 1·010. It resists very well all chemical agents, and even mechanical erasure, providing the ink has sufficiently penetrated the paper. I believe this ink never came into use.

In conclusion, I would urge upon those interested in these matters, that protection is to be sought in the accumulation of checks to forgery, rather than in the

superiority of any one particular form of security. Tinted paper may be very good as a protection against partial alteration of a genuine cheque, but if the paper can be procured at any stationer's, it surely is no security against an engraver copying a cheque clandestinely. Illustrations of this principle could be multiplied to an enormous extent. There is another source of fraud, against which no skill in the preparation of bank-notes or cheques can afford protection, I allude to the stealing of genuine documents, that is, so far as the printing is concerned, and these thefts may occur when the document is either partially or wholly completed. In the former case the advantage of accumulating difficulties is not slight, as the skilful eye will frequently detect the stage at which a forged document passed into the hands of a person unable to complete it in the same style as the previous portion of the work, and this may frequently furnish a clue to the thief.

The foregoing observations are the results of some years' attention to the subject, and I have waited long in the hope of seeing it taken up by abler hands; but no one has spoken, and yet many hundreds of pounds have been lost through forgery by individual firms in this city within the last twelve months, and which I believe might have been avoided had the parties given half an hour's attention to this question. I have endeavoured to be impartial, but am not a believer in a universal remedy of any kind. More details could easily have been given, but my desire was to lay down and explain a few principles, leaving every one to provide for the peculiarities of his own case, rather than to dilate upon any special branch of the subject.

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The SECRETARY stated that he had received a communication from Councillor Auer, Director of the Imperial Printing-office at Vienna, in reply to an inquiry he had addressed to that gentleman on the subject of the papers which had just been read, and of which the following was an extract:—

"According to my experience the fabrication of bank-notes or other similar papers is threatened with counterfeiting particularly from the following graphic processes, viz., autography, anastatics, photography, and copies of the engraving (calcography and chemitypy). Any new process that does not effectually remove the possibility of imitation by means of any of these processes, will not answer the purpose. As for the imitation by means of drawing, it is of no great consequence, because the multiplication is too difficult and troublesome to be carried to any great extent. The chief attention must, therefore, be directed against the possibility of counterfeiting by either of the aforesaid processes. We have endeavoured to solve this task *by a combination of processes*, including the natural printing process, each opposed to the other in its manner of printing, by which method forgeries are rendered very difficult, because they cannot be accomplished by a single individual, but require the co-operation of several—thus considerably diminishing the probability of being kept a secret. Though the execution of several sorts of paper-money was, from want of time, not so artistically perfect as I could have wished, yet we had the satisfaction to experience but very few instances of forgery—a result we solely owed to our principle, that is to say, to the above-mentioned combination of printing processes. This, in a few words, is the result of my experience concerning the printing of bank-notes. Our experience in this matter is the richer, as the greatest variety of paper-money is in continual use in our country, and as every new discovery, every improvement in the fabrication of such papers, is communicated to our office for the purpose of being judged and tested by experiments. Thus we have by degrees accumulated a very considerable quantity of experience relative to a great variety of distinct processes, which, however, are so intimately connected with one another, that it is nearly impossible to communicate them separately."

The CHAIRMAN said, he feared that the manufacture of bank-notes was in the hands of so few, that there was very little for the many men of science he saw around him to say on the subject. There were, however, one or two points on which he would like to say a few words. One of the most extraordinary changes which had taken place during the last 25 years, was that with regard to bank-notes. They had seen the changes which had taken place with respect to the position of the soldiers who were now fighting in the east, who had proved that education did not make them the less fitted for the performance of their duties. But the most extraordinary mark of improvement he thought was to be found in the circumstance, that the Bank of England now allowed the process of making a bank-note to be explained and shown, rather than hanging people for attempting to imitate it. He understood that since the abolition of hanging for forgery, that crime had materially diminished. The safety against imitation of bank-notes consisted in their reproduction to any number, in so perfect a state as they now were, which could not have been done under the old system. Under that system, however great the care and attention, each plate would have some trifling difference, making it more difficult for the clerk to judge of their genuineness than at present. As the notes on the table could not be allowed to stay there after that evening, and as they would be put in circulation on the 1st of January, he advised the ladies and gentlemen present closely to examine them, so that they might be able to judge of the genuineness of the next notes they received. He ventured to throw out, as a hint, in consequence of the *entente cordiale* which now existed with their neighbours the French, that the Bank of England should allow their process of making notes to be exhibited at the Exhibition in Paris next year. He was sure every lady and gentlemen present would cordially agree with him in awarding a vote of thanks to Mr. Smee for his very valuable paper. There was present an ex-governor and the Deputy-Governor of the Bank of England, and he was sure that the meeting would return thanks for their extraordinary liberality in allowing these explanations to be entered into. Unless any gentleman, from the waifs and strays he had picked up, wished to open a discussion, he should proceed to give their thanks to Mr. Smee, but if they did, he should be happy to hear them. He thought the prevention of forgery would form an interesting subject for discussion on some future evening. The chairman here exhibited two Austrian bank-notes—one of the value of 3d., and the other of 5d.—to show the extraordinary number of notes issued in that country.

The Secretary announced that the paper to be read at the next meeting, Wednesday, January the 17th, 1855, was "On the Smoke Nuisance, considered historically, morally, scientifically, and practically," by Mr. George Muir, of Glasgow.

Also, that the following arrangements had been made for succeeding meetings:—

Jan. 24. Mr. W. Longmaid, "On Peat and other Vegetable Charcoal, and some of its Uses."

Jan. 31. Mr. S. C. Homersham, "On the Chalk Strata considered as a source for the Supply of Water to the Metropolis."

Feb. 7. Mr. Thomas Dickins, "The Commercial consideration of the Silk-worm and its Products."

Feb. 14. Mr. Harry Chester, "The Planning of School Buildings."

Feb. 21. There will be NO MEETING—it being Ash-Wednesday.

Feb. 28. Professor John Wilson, F.R.S.E., "On the Iron Industry of the United States."

March 7. Mr. J. B. Lawes, "On the Sewage of London; its Composition and Value as a Fertilizer."

## PARIS UNIVERSAL EXHIBITION OF 1855.

### Offices in Paris for British Section.

Marlborough House, London, Dec. 15, 1854.

Sir,—I am directed by the Lords of the Committee of Privy Council for Trade, to inform you that they have hired a house in Paris, situated in Rue du Cirque, No. 14, for the offices of the British section of the Universal Exhibition. It is the wish of my Lords to make this house as extensively useful as possible to the committees who have been co-operating with them in securing a creditable representation of the industry and of the fine arts of the United Kingdom, as well as to the officers who may be sent to Paris by my Lords to yield the necessary assistance, information, and support to the exhibitors.

With this view it is intended to devote about eight rooms to be occupied as offices by the agents of the various committees in the metropolis, the provinces, and the dependencies of the United Kingdom, and when such agents are duly accredited, to give them every facility for the transaction of their business.

My Lords consider that it is very desirable not only that the French people should see the British goods displayed in the Exhibition, but that facilities should be given for obtaining all the information possible with respect to price, rate of production, the facility with which orders can be executed, &c.; and it is considered that an office in a central situation, adjoining the Exhibition, where such information could be obtained with readiness, would be of great service to the French public, and to the exhibitors of the United Kingdom and its dependencies.

The accommodation being limited, and the extent to which Committees and Colonial Commissions may be disposed to make use of the facilities offered, being uncertain, it is of course impossible to announce what accommodation may fall to the lot of each Committee, particularly as this very proposal may lead to arrangements between several Committees to have the same agent. In that case it might be possible to give such agent a room to himself, otherwise it will obviously be necessary to put two or more into the same room, and for them to arrange to receive business visits at different hours, or on different days of the week. In addition to this accommodation, a large room might be occasionally disposable for Committee or other meetings.

The accommodation will not be sufficient to allow of the same facilities being offered to the agents of individual exhibitors; but it is proposed to provide means by which during the arrangements, and during the Exhibition itself, Exhibitors may, should they think proper, have their letters sent to the same address.

As these kinds of arrangements require some consideration, and it is not necessary absolutely to fix their details at the present moment, my Lords will be glad to be favoured with any remarks which your Committee may have to make upon this subject.

It perhaps may not be out of place to remark that it will be necessary for my Lords to reserve to themselves the power of putting a stop to any proceedings which might arise out of the facilities now offered, and which might be in any way unsuitable or injurious to the interests of all.

I have the honour to be,
Sir,
Your obedient Servant,
H. C. OWEN, *Secretary*.

## CHINESE AND AZTEC PLUMAGERY.

By D. J. Macgowan, M. D.

(From the *American Journal of Science and Arts.*)

Those natives of North-Eastern Asia who in modern times have been drifted to the opposite shores of the Pacific were generally fishermen, mariners, or persons unacquainted with mechanical operations, and it is altogether probable that from the period of the first disaster by which they were driven to America, to that of the last shipwreck on that coast, very few artizans, and no scholars, have in this manner changed continents; nor, judging from the low state of civilisation of the more northern peoples, could it be expected that adventurers by the way of Behring's Straits or the Aleutian Islands would carry with them a knowledge of any arts but the most simple and rudimentary. Hence, we shall look in vain for many resemblances in the industrial operations of the dwellers on the eastern and western coasts of the great ocean. Nevertheless, there is reason to believe that were we better acquainted with the state of arts amongst those farthest advanced in civilization in Polynesia and America, we should recognise modes of operation identical with those of China too numerous to be accounted for either as coincidences, or as independent inventions. A striking illustration is furnished by Capt. Wilkes,* who gives a drawing and description of an instrument for drilling holes, which he found in use by the inhabitants of Fakaafo or Bowditch Island. This is undoubtedly a Chinese implement, being the most ingenious of all their tools. It is employed for perforating small holes by all workers in metals, but appears to most advantage in the hands of needle makers, who use it for drilling eyes in the small wires of which these are made.

Whether plumagery or the art of working in feathers, which was formerly practised in this part of the world, and also by the Aztecs of Central America, originated with Asiatics, or Americans, or with both, must be left to conjecture: in any view of the case, the fact is invested with interest. Attention was attracted to this subject by perusing the chapter devoted to an inquiry into Aztec civilisation in Prescott's History of the Conquest of Mexico, where the distinguished historian shows that the ancient Mexicans excelled in the arts of plumagery and jewellery, in both of which they appear to have followed the same methods that are adopted by the Chinese.

Confucius informs us that in remote antiquity, ere the art of weaving silk or hemp was understood, mankind were clothed with the skins of beasts and feathers. How the latter were held together is not stated, but it must have been in a rude manner by cords or thread: at a later period feathers were in general demand, as ornaments to banners and articles of attire; and subsequently for the manufacture of door-screens and caps. Tradition states that garments made of feathers and resembling fur dresses were presented to the Emperor Shauhau, who reigned twenty-five centuries before our era. The earliest allusion to robes *woven* with feathers, occurs in the history of the Tsin dynasty. In the year 272 A.D., Dr. Ching, the court physician, presented the emperor with a gown made of feathers from the golden-headed pheasant. His Majesty, being the founder of a new dynasty, was anxious to induce economical habits among his subjects; he therefore immediately ordered the splendid garment to be publicly burnt before the palace door, and issued on the following day stringent prohibitions against the presentation of articles of luxury.

The Emperor Wuti, who flourished in the latter part of the fifth century, had a son who was notorious for his extravagance, having among other costly articles, a robe woven with peacock's feathers. History further informs us that it was the custom of emperors to make presents every eleventh month of robes made out of the feathers of the variegated king-fisher to certain ministers of state.

* Narrative of the U. S. Exploring Expedition, by Capt. Wilkes, U. S. N. vol. v. p. 17.

Taisung, A.D. 976, changed the custom so far as to substitute silk for plumagery. Again, at a later period, the imperial records relate that the Princess Ganluh engaged a skilful artificer to collect feathers of every description, to make of them two dresses, which should, when looked at in front, present one colour, when viewed sideways another, and when held up to the light a third. When completed, she presented them to the empress, and they were so much admired that the fabric became very fashionable among officers and people, so much so that the hills and forests were swept clean of down and feathers, and vast numbers of birds were ensnared for their plumage.

More instances might be adduced to show that at different periods extending through many centuries plumagery was well understood. Garments thus manufactured were necessarily rare, their use being confined to persons of rank and wealth, and it may be doubted if even among the Aztecs whose country unlike China had vast forests crowded by the feathered tribe, the material was so abundant as to allow the inhabitants generally to shine in borrowed plumes.

The foregoing examples, drawn from the popular encyclopædias, throw no light on the mode of manufacturing this elegant material. Something, however, may be gathered on this subject from a work styled "New Conversations on things seen and heard at Canton," by a native of Suchau, who spent many years in that city in a mercantile capacity, in the latter part of the last century. In a short section devoted to *Bird Clothes*, he says, "There are several kinds of birds, the feathers of which are woven into a peculiar cloth by the southern barbarians. Among them is the celestial goose velvet, the foundation of the fabric being of silk, into which the feathers were ingeniously and skilfully interwoven, on a common loom, those of a crimson hue being the most expensive. Of these wild goose feathers, two kinds of cloth were made; one for winter, the other for summer wear. Rain could not moisten them; they were called 'rain-satin,' and 'rain gauze,' respectively. Canton men imitated the manufacture, employing feathers of the common goose, blending them with cloth. This fabric though inferior in quality, was much cheaper. Goods of the same description were also brought from Hohlih (a state described by geographers as being adjacent to Samarcand, perhaps Bokhara), made of birds' feathers: they were twilled, the crimson coloured being most valued. The article was too heavy for garments. The Cantonese also learned to imitate this, making it like plain silk, and inferior to that from abroad. Peacock feathers are employed by Canton manufacturers in making variegated threads which are used in making beautiful capes for females." Another writer states that a tribe of the Miaut, in Kwangsi, manufacture clothes from the fine down taken from the abdomen of geese. The down and tufts of birds were probably the materials which were woven into textile-like fabrics.

From the above, it would appear that the Chinese have lost the art of weaving feathers. Plumagery is still practised, however, in the decoration of metallic ornaments worn by all classes of females, chiefly on the head. When silver is employed, the article is first coated with gold. The gaudy lustre of the gilt is softened by laying over portions of it a covering of blue feathers representing flowers, insects, birds, and the like, which imparts indescribable beauty to the silversmith's elaborate filagrees. The art appears to most advantage as practised by artificers whose occupation is the manufacture of garlands, chaplets, frontals, tiaras, and crowns of very thin copper, on which purple, dark, and light-blue feathers of gorgeous brilliancy are laid with exquisite taste and skill. From the size of these ornaments great scope is afforded for the display of various figures. Sometimes two dragons extend from below the lobes of the ears, meeting above the forehead, the variegated scales of which are represented by minute portions of feathers of various hues; at others, beautiful flowers are interspersed with elegant mosaic, and then again the head attire appears animated, as with every turn of the fair one, tiny genii, birds, and insects are set in motion from springs and wires which retain them in the midst of the fairy-like garland. A more tasteful, elegant, or gorgeous blending of art and nature than is exhibited in one of these head-dresses, perhaps no ingenuity has hitherto devised. To increase the effect, these ornaments are studded with pearls, produced cheaply and in great abundance by artificial means in a fresh-water muscle.* Commoner articles, such as earrings, and brooches for caps, are generally made of a small wreath of the forget-me-not, encircling one of these pearls. Half a dollar will purchase one of these when of silver, and a few cents the copper ones. The most expensive head-dresses cost less than five dollars, unless of silver.

As this elegant art has not hitherto attracted the attention of foreigners, the mode of procedure should be described; this may be done in few words.

On the table at which the workman sits, he has a fasciculus of feathers, a small furnace with a few embers for keeping warm a cup of glue, a small cutting instrument like a screw-driver, a pencil or brush, and the articles, either silver, gilt, copper tinsel, or pasteboard which are to be feathered. The thumb and index finger being smeared with glue, the feathers are gently drawn between them, which stiffens the barbs, causing them to adhere firmly together; and when dry the perpendicular blade is drawn close to the shaft, dividing it from the barbed portion. Holding this cutting implement as in writing *a la Chinoise*, the artist by pressing on the strips of barb with the knife, cuts them into the desired size and shape, which is a work of some delicacy—the pieces being very small, in the form of petals, scales, diamonds, squares, and the like, and requiring to be of the same size as the particular spot on which they are to be laid. Besides fingering this tool in the manner described, he holds the pencil nearly as we do a pen, dips it into the glue, brushes the spot to be coated, then expertly reversing it, touches with its opposite point a tiny bit of feather, which is thus lifted up and laid on the part for which it was fitted. Care is requisite also in giving a proper direction to this twilled work, for such of course is the appearance presented by the barbs.

The feathers most in demand for this purpose are from a beautiful species of *Alcedo*, brought from the tropical regions of Asia; they are employed for silver articles. King-fishers of coarser plumage, and less brilliant hue, found throughout the country, are used for ornaments made of copper or pasteboard. Blue always greatly predominates over lighter or darker shades, relieved by purple, white or yellow.

Whether Aztec silversmiths, whose ingenuity is so much lauded by the old Spanish chroniclers, practised this branch of plumagery or not is uncertain. There is reason to believe that what is said of their imitation of animals with moveable wings or limbs, of their representing scales of fish alternately of gold and silver, were nothing more than what is now done by the same craft in China; and which were esteemed very marvellous by Sir J. Mandeville (Voiage and Travaile), motion being communicated by wires and springs, and colours imparted by the plumage of choice birds. The construction of automata proper requires a knowledge of horological mechanism, never attained by either Chinese or Aztecs. Plumagery doubtless attained a far higher degree of excellence in Central America than in China, owing to the greater variety and extreme abundance of the feathered tribe in the dense and luxuriant forests of Mexico. Yet it is not likely that feather fabrics were so easily manufactured as to be worn by other than the nobles and affluent to whom in China their use was confined. Had the Chinese been as destitute of textile fabrics as the Aztecs, they would unquestionably have engaged in plumagery with greater success.

* Vide "Journal of the Society of Arts, Vol. I. p. 587, and Vol. II., pp. 33 and 72.

## Home Correspondence.

### MR. MECHI'S "BRITISH AGRICULTURE."

SIR,—Permit me to correct slight but important misprints in the report of my observations on Mr. Mechi's paper "On British Agriculture."

Mr. John Hudson, of Castle-Acre, in Norfolk, whose farm really is an illustration of a "great fact" in British agriculture, consumes not £600 of oil-cake, but £600 a *month* for oil-cake.

I did not call Mr. Mechi's remarks *wily*—that would be rude and unjust—but witty. It is Mr. Mechi's wit, enthusiasm, and imperturbable good temper which makes his discourses so attractive; his facts are, however, at times rather too hastily collected. For instance—To insure cattle costs I find about £3 per cent. taking horses, &c., all round, instead of £20 per cent., as he stated, to show what is very doubtful—the superiority of his system of feeding cattle on boards, where they look very uncomfortable.

As Mr. Mechi challenges criticism, by the publication of his essay and balance-sheet, I may venture to say further, that the balance-sheet consists of items so obscurely massed together (as, for instance, horses with his beef and mutton) that there is no opportunity of ascertaining from it how many pounds of meat he makes in a year, and at what cost. If he wishes to convince us, as he has convinced himself, that liquid manure has enabled him to double his live stock, I would recommend that he should give the following information next year, based on questions which some of the most improving farmers of the kingdom have answered without hesitation, to assist me in preparing some sketches of English agriculture for one of our most popular periodicals:—What number of cattle, distinguishing fattening and dairy; and what number of sheep and lambs does Tiptree Farm turn out in the year? What is the expense for purchased food, and what for artificial manures, distinguishing the cost of each?

These items would enable us to compare the cost of the flesh meat with the selling price.

We ought further to have a list of Mr. Mechi's implements, and an account of the course of his cultivation, so that we may know whether he relies entirely on liquid manure for all his crops, and, if not, how much solid farm yard dung, how much guano and superphosphate, he applies, and to what crops.

Does he sell or consume his straw?

I make these suggestions for the good of British Agriculture, that we may learn to be convinced, instead of being merely astonished at bold assertions. I agree with Mr. Mechi that nothing less than high farming, on the best principles, with the best implements, the best drainage, and the best arranged farm buildings, ought to be encouraged; but as he alludes so scornfully to the farmers of England, I must venture to say his precepts are better than his practice, and that he has neighbours in Essex whose fields are better drained, whose farm buildings are better arranged, whose implements are better selected, more scientific, and effective, and whose stock is in much better condition than what is to be found at Tiptree. Yours, &c.,

SAM. SIDNEY.

Farmers' Club, Bridge-street, Blackfriars.

## Proceedings of Institutions.

PEMBROKE-DOCK, SOUTH WALES.—A Conversazione of the members of the Pembroke-dock Mechanics' Institute having been announced for Thursday evening, the 7th instant, contributions of articles likely to prove interesting and instructive for the occasion, were requested from members and friends. The number of rare and curious objects in nature and art, brought together in consequence, from the town and neighbourhood, was to a surprising extent beyond all expectation. Few people could have possibly imagined that such a collection could be made in this remote spot of the kingdom. From the peer to the humblest artisan, almost everybody had some article of interest to produce. The science of astronomy was illustrated with globes, an orrery, a monster chart of the heavens, diagrams of the direct and retrograde courses of the planets amongst the fixed stars, a magnificent daguerreotype of the moon, &c., &c. The science of geology had its illustrative models, specimens of various strata, rich and rare minerals, ores, &c. Natural history had its stuffed birds and reptiles, preserved specimens of the serpent tribe, insects, fishes, shells, corals, &c. Universal history was illustrated by ancient and modern coins and medals, and various antiquities from all parts of the globe. The wonders of the microscope were exhibited, and that beautiful instrument the stereoscope was produced and explained. Exquisitely executed models of naval architecture were in abundance. An excellent collection of photographs and nature prints contributed by the Society of Arts attracted, however, the principal share of attention. There were also some remarkably fine photographs contributed by the Earl of Cawdor. Beautiful specimens of needlework, embroidery, wax flowers, and ornamental leatherwork, were furnished by ladies. The gratifying result of the variety and tastefulness of the display was, that by general request the hall was kept open for three days longer, from 10 A.M. to 10 P.M., when crowds of visitors of all ranks assembled; and the trifling charge for admission to non-members (6d. each) not only liquidated all expenses, but left a handsome balance in the hands of the committee. The experiment is well worth imitation in other small towns. It has decidedly raised the character of the Institute in the estimation of this and the adjoining counties.

SEVENOAKS.—On Thursday, December 14th, a very instructive lecture was delivered at the Literary and Scientific Institution, by Dr. Pettigrew, on the "Organ of Hearing in Man." There was a very full attendance. The Institution is indebted to its patron, the Marquis of Camden, for this lecture.

### MEETING FOR THE ENSUING WEEK.

Wed. Microscopical, 8.

### PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS,

*Delivered on 14th Dec.*, 1854.

Par. No.
1. Bill—Militia.
   Prisoners of War—Convention with France.
   America (Settlement of Claims)—Convention.
   America (Fisheries, Commerce, and Navigation)—Treaty.
   National Education (Ireland)—Twentieth Report, Vol. 2.

*Delivered on 15th December*, 1854.

1. Public Income and Expenditure (Balance-sheet)—Account.

*Delivered on 16th and 18th December*, 1854.

3. Navy Services, &c.—Statements.
4. The "Prince" (Warm Clothing Lost)—Statement.
   Queen's University in Ireland—Report.
   Agricultural Produce in Ireland—Returns.
   Austria—Treaty of Alliance.

*Delivered on 19th December*, 1854.

4. Bills—Enlistment of Foreigners.
5. Bills—Militia (Amended).
   Australian Colonies (Alterations in the Constitutions)—Further Papers.

*Session* 1854.

456. Public Petitions—Returns.
459. Select Committees—Return (a corrected leaf).

*Delivered on 20th December*, 1854.

5. General Committee of Elections—Mr. Speaker's Warrant.

*Session* 1854.

432. Churches (Metropolis)—Return.
509. Poor Rates, &c.—Return.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Dec. 15th*, 1854.]

*Dated 4th November*, 1854.

2339. W. J. Wright, Red Cross-street, Cripplegate—Application of tobacco stalk.

*Dated 7th November*, 1854.

2355. F. Baxter, Sneinton—Compound shell.

*Dated 24th November*, 1854.

2482. T. Culpin, 5, Devonshire-terrace, Blackheath-road—Waste-water preventer.

*Dated 25th November*, 1854.

2492. T. Greenshields, Derby—Treating cotton waste.
2494. W. Blundell, 29, New Broad-street—Surgical apparatus for benumbing sense of feeling.

*Dated 27th November*, 1854.

2496. J. Gillott, jun., and H. Gillott, Birmingham—Pens.
2498. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Wrought-iron wheels. (A communication.)
2500. C. Levey, Red Lion-street, Holborn—Weaving bags.

*Dated 28th November*, 1854.

2502. J. Clarke, Leicester—Looped fabrics.
2503. T. Restell, Strand—Umbrellas, parasols, and cases or covers, and walking sticks.
2504. T. Staunton, Bath—Motive power. (A communication.)
2505. A. V. Newton, 66, Chancery-lane—Furnaces. (A communication.)

*Dated 29th November*, 1854.

2506. C. Peterson, Chall, Isle of Wight—Material for textile fabrics and paper making.
2507. J. Taverner, Paris—Edible compound.
2508. T. and S. Knight, Southwark—Apparatus for heating water.
2509. J. Abraham, Great Crosby, near Liverpool—Draining.
2510. G. Gowland, Liverpool—Mariner's compass.
2511. J. Kealy, Oxford-street—Machinery for cutting roots.
2512. S. Smith, Nottingham—Pressure guages.

*Dated 30th November*, 1854.

2514. Sir J. C. Anderson, Bart., Fermoy—Economical railway.
2515. E. Welch, 50 George-street, Portman-square—Fire-places.
2517. J. B. A. Quiquandon, Ambert, France—Corks.
2518. E. Pettitt, Manchester—Machinery for drawing cotton.
2520. W. Taylor, Howwood-by-Paisley—Furnaces.
2521. J. Sands, 11, Austin-friars—Mariner's compass. (A communication.)
2522. C. Murray, Havill-street, Camberwell—Ordnance, barrels of fire-arms, &c.
2523. F. Le Mesurier, Guernsey—Cartridges.
2524. E. and J. Rowland, Manchester—Pistons.

*Dated 1st December*, 1854.

2526. E. Briggs and W. Souter, Rochdale—Gassing yarn.
2527. J. Arrowsmith, Bilston—Construction of forts, floating batteries, &c.
2528. J. Bernard, Club Chambers, Regent-street—Manufacture of boots and shoes by machinery.
2529. T. Wilson, 3, Moscow-road, Bayswater—Preventing the noise in omnibuses, &c.
2530. T. Restell, Strand—Guns.
2531. W. J. Cantelo, 4, Leicester-square—Barrels of ordnance and small arms and projectiles.
2532. T. Littleton, Saltash—Sewage manure.
2533. C. Iles, Birmingham—Metal bedsteads.

*Dated 2nd December*, 1854.

2534. R. C. Witty, 9, Torriano-avenue, Camden-road-villas—Artificial light.
2535. R. Hess, Holloway-road—Voltaic battery.
2536. D. Bazaine, Paris—Common road railway.
2537. L. Gantert, Glasgow—Dyeing and bleaching yarns.
2538. J. Biden, Gosport—Prevention of smoke.
2539. A. E. L. Bellford, 16, Castle-street, Holborn—Combustible gas.
2540. A. E. L. Bellford, 16, Castle-street, Holborn—Paper and pasteboard. (A communication.)
2541. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Palm leaf hats and carcasses for hats. (A communication.)
2542. J. Maudslay, Westminster-road—Ordnance.
2543. E. Dowling, Little Queen-street—Weighing machines.
2544. H. Strong, Ramsgate—Prevention of smoke.
2545. J. Lister, Ruthven—Dyeing materials.

*Dated 4th December*, 1854.

2546. R. Shaw, Portlaw, Waterford—Looms.
2550. E. H. Bentall, Heybridge—Locomotives.
2552. D. Collet, Paris—Transmitting power.

*Dated 5th December*, 1854.

2554. T. Almgill, Busby, near Glasgow—Water meter.
2556. J. H. Johnson, 47, Lincoln's-inn-fields—Electric telegraphs. (A communication.)

*Dated 6th December*, 1854.

2558. Lieut. A. T. J. Bullock, R.N., Woolwich—Life raft.
2560. C. Costard, and G. P. Collas, Jersey—Projectiles.
2562. J. Gedge, 4, Wellington-street South, Strand—Stopping bottles. (A communication.)
2564. A. Martin, Westminster—Indigo. (A communication.)
2566. E. De Mornay, 4, Cork-street, Burlington-gardens—Guns and projectiles.

*Dated 7th December*, 1854.

2568. J. Phelps, Croydon—Damping labels.
2570. J. Fairrie, Church-lane, Whitechapel—Preparing solutions of sugar for filtration.
2572. F. C. Blumenthal, and M. L. J. Chollet, Paris—Preserving meats.
2574. R. A. Brooman, 166, Fleet-street—Spinning frames. (A communication.)
2576. S. Heseltine, Harwich—Cannon, shot, and shell.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed 15th December*, 1854.

1354. George Henry Byerley, Paris—Improvements in machinery for the manufacture of bricks, tiles, quarries, tubes, and other such like articles.
1362. Thomas Rhoads, Vine-street, America-square—Improved method of framing school slates.
1376. Astley Paston Price, Margate—Improvements in the treatment of certain alloys of tin.
1388. Thomas Isaac Dimsdale, Hadley—Improvement in the manufacture of gas for lighting and heating purposes.
1390. William Ellsworth Osborn, Milton, New York—Improvements in breech-loading guns or cannons.
1627. Francis Preston, Manchester—Improvements in machinery for preparing cotton and other fibrous materials.
1805. Joseph Fowell Walton, Sarratt Hall, Hertford—Improvements in obtaining impressions from lithographic stones or plates.
1856. Julien Louis Pierre Jean Baptiste Hector Bouvet, Paris—Improved suction apparatus for pumping and exhausting purposes.
2056. George M'Naught, Glasgow—Improvements in saddle-trees.
2161. James Shanks, St. Helen's—Improved mode of manufacturing sulphuric acid. (A communication.)

*Sealed December 19th*, 1854.

1377. Astley Paston Price, Margate—Improvements in the purification of tin, and in obtaining useful products arising from purification.
1380. Charles Phillips, Offchurch, Warwick—Improvement of apparatus or machinery for reaping.
1386. Thomas Rudd, Pimlico—Improvements in stands for casks or barrels.
1407. William Palmer, Sutton-street, Clerkenwell—Improvements in candle lamps.
1457. Joseph Sunter, Derby—Improved drilling machinery.
1467. Thomas Elliott, Manchester—Improvements in safety valves, and apparatus connected therewith, which valves may also be used as steam valves.
1485. William Newzam Nicholson, Newark—Improvements in hay-making machines, part of which improvements is applicable to carriages generally.
1505. Lord Berriedale, 17, Hill-street—Improvements in the manufacture of paper, and in the production of textile materials.
1547. Charles, Sewell, Longton Lodge, Longton Grove, Sydenham—Improvement in spring hinges for doors and gates.
1553. Jean Baptiste Dechanet and Antoine Dominique Sisco, Paris—Improvements in the construction of railway carriages.
1569. John Lockhart, junior, Paisley—Improvements in the manufacture of bobbins.
1907. William Campion, Nottingham—Improvements in rotary knitting machinery.
2067. Joseph Boulton, 1, Coppice-row, Clerkenwell—Improvements in dry gas meters.
2109. Thomas Sheriff, Glasgow—Improvements in moulding or shaping metals.
2209. Nathan Thompson, junior, New York—Improvements in life-preserving seats.
2263. Gustavus Adolphus Somerby and Charles William Fogg, Massachusetts—Improved brake apparatus for railway carriages.
2265. Ferdinand Charles Warlich, Suffolk-street—Improvements in generating steam.
2275. Collin Mather, Salford Iron Works, Manchester—Improvements in machinery for boring in the earth, and for actuating a hammer for driving tubes into the earth and other uses.
2325. Joseph Francis, New York—The manufacture of waggons, caissons, and other vehicles applicable to transport military and other stores on land or water.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| Date of Registration. | No. in the Register. | Title. | Proprietors' Names. | Address |
|---|---|---|---|---|
| Dec. 18. | 3670 | Screw Jack | William Dicks | Floore, Weedon, Northamptonshire |
| " 19. | 3671 | Price's Crimean Army Stove | Price's Patent Candle Company | Belmont, Vauxhall. |

Journal of the Society of Arts.

*FRIDAY, DECEMBER* 29, 1854.

## VISIT OF ARTIZANS TO PARIS.

The committee charged with this subject met at ten o'clock on Saturday, the 23rd instant; present, Mr. Winkworth, in the chair, Mr. George Clark, of Paris, Mr. S. Redgrave, and Mr. T. Twining, Jun.

The committee, after receiving reports from Mr. Clark and the Secretary, of the progress making in the arrangements for the reception of visitors in Paris, and their conveyance there and back, resolved that it would tend much to facilitate the making definite arrangements if the committee could have information as to the probable number of persons likely to take advantage of them; and the Secretary was directed to address a letter to the Institutions in Union, requesting to be informed whether any clubs of artizans had been or were likely to be formed, either in connection with the Institutions or otherwise, for raising funds to enable them to visit Paris during the Exhibition of 1855, and the probable numbers, as far as could be ascertained at the present time.

## IMPROVEMENTS IN STEAM NAVIGATION.

It is now about twenty-five years since the first railway in this kingdom was opened, amidst the rejoicings of thousands of astonished spectators, most of whom had previously no conception of the speed which could be attained by this mode of locomotion. Even George Stephenson himself at one time limited, we believe, the speed to be attained upon railways at some *fourteen* miles an hour. Shortly after the successful trial of that experimental railway, the whole kingdom became agitated with an extraordinary impulsive desire to extend its advantages over its whole surface. That which, shortly before the opening of the Liverpool and Manchester railway, was looked upon with doubt and suspicion by the nation at large, now took firm hold of the public mind. "Confidence," it has been truly observed, "is a plant of slow growth;" and when we look back upon the objections and doubts which were opposed to the first effort of our great railway benefactors, we cannot but experience feelings of reproach and shame at our want of discernment, and at our ignorance in so long withholding our assent to what should have appeared to us plain and undeniable. It may be that the public judgment was not left free to exercise an unbiased opinion upon the question, for the private interests of a large and influential class of people were most strongly opposed to the introduction of the railway system throughout the kingdom. First, we had all those interested in the mail coaches, which everywhere traversed the country, opposed to railways; secondly, a numerous class of landed proprietors, who would not listen to any proposition to have their estates crossed by unsightly rails, and their ears assailed by steam-whistles and the rattle of railway carriages. Every conceivable argument that these persons and their numerous friends could urge against the introduction of the railway system, was advanced with all the bitterness and tenacity of a death-struggle; and so the public mind was poisoned to a great extent against what is now admitted to be the greatest benefit to the kingdom that can possibly be conceived. Who is there now who could forego the railway and its speed of thirty, forty, and even sixty miles an hour, and return back to the slow coach system of other years. We will venture to say, not one man in the kingdom who is not considered a fit inmate for an asylum of lunatics.

And yet, notwithstanding our great progress upon land, how is it that upon the water England has made such slow advances in the speed of her steamers, and in the accommodation to be found on board of them. Do we not hear now, from interested parties, the same cry against proposed improvements in the speed and accommodation of steamers, that we, in years long gone by, heard against the railway and its advantages. Is not the same feeling of *personal interest* as strongly at work now, to prevent any great and striking improvement in steam-ships, as it was formerly against railways. Surely it is. The writer of this paper has met with such universal opposition from all persons connected—as owners—with steamers, to his improved plan of steam-ship, by which a speed of not less than 21 miles, and probably, 25 miles an hour, or more, can be attained,—that he feels no hesitation in asserting that the feeling of supposed private interest is as strong against any great improvement in the speed of steamers, as it was formerly on the part of interested parties against our railway system. That feeling, with a few noble exceptions, has extended even to steamship-builders, and engineers. The great body of them are content with their present business; and so long as they can satisfy the public that their present models and patterns are good enough, they think they realize larger profits than if they had to adopt new ones. Thus the public interest is sacrificed to that of a few interested parties.

With these few preliminary observations—and which I have conceived abundantly called for from the opposition I have encountered, I now beg leave to state my plan for attaining the extraordinary speed proposed. It is well established, by numerous successful experiments made in the United States and in Canada, that to attain a speed approaching even to *twenty* miles an hour, great length is required in proportion to breadth of beam, in order to obtain fine lines, and to prevent too great an immersion of the vessel in the water by the power necessary to propel the steamer at high speed. The requisites to the attainment of great speed, are, 1st. Fine lines, 2ndly, great power; and 3rdly, light draught of water in proportion to the power employed. That vessels can be propelled through the water at a speed far exceeding that of the fastest steamer in this country, is evident, from the fact, that even sailing clipper-ships have run within 24 hours, upwards of 450 knots, or at the rate of more than 19 knots or 22 miles an hour. In America, river-steamers have frequently been propelled at the rate of 23 miles an hour; and upon Lake Erie,—where steamers are obliged to be very strongly built, and draw from 7 to 9 feet water,—the new steamer, *Queen of the West*, has lately been propelled at the rate of 25 miles an hour. The steamers that have attained this great speed are all propelled by low-pressure or *condensing* engines; and I do not recollect of an instance where any accident has occurred on board of them from carrying too great a pressure of steam. A year or two ago, an accident occurred upon the Hudson river, owing to a defective sheet of boiler plate; but at the time of the accident the pressure of steam was not great. As those steamers are all built of wood, occasional accidents have occurred from fire; but as I propose to build my steamers of iron, with ordinary care no accident can occur from that cause—at least from the boilers.

Great as is the speed that American lake and river steamers have attained, I am quite satisfied that it can be much increased. From the description of engines they use, they are compelled to give their steamers great breadth of beam, to prevent their being *crank*, and this great beam prevents their having such fine lines as they otherwise could have had. I have mentioned this defect to several of their great steam-boat proprietors, but such is their fancy for the *beam* engine, with the beam stuck up about 40 feet in the air,—that they will not willingly abandon it. No doubt, that description of engine is very simple, economical and effective, but still it has the disadvantage I have mentioned attending it; and which, in my humble opinion is fatal to the attainment of the greatest speed. It is also, I think, unsuited to ocean navigation.

By my invention, which can be seen by reference to my patents No. 215 and No. 630 for 1854, I am enabled to give greater length to steamers, in proportion to their breadth of beam and depth of hold, than can be given to them in any other way. Much finer lines and lighter draught of water are obtained, whilst a much greater power, in proportion to tonnage, can be used, than by any other mode of construction. Larger paddle-wheels than any now in use in this country can also be employed, and without wheels of large diameter, no very great speed can possibly be attained. In obtaining these desirable improvements I also obtain greater strength, owing to the peculiar mode of constructing the sides of my ships, and of strengthening them from the floor timbers up to the cabin floors. Although the details of my plan may not be perfectly understood by the general reader without reference to drawings, it is probable that the following brief description may be intelligible to most of those who read this paper:—

The ordinary mode of building ships is to give them a *sheer* which raises the bow and stem higher than the centre of the vessel, so that, in fact, the centre of the vessel is weaker than at any other point; the consequence is, that long vessels have a tendency to droop at either end. Instead of adopting this plan, I pursue one directly opposed to it, and while I preserve the sheer of the vessel and retain the present appearance of the main deck, I raise the sides in the shape of an arch, so that the sides of the ship, at the centre, shall be about ten feet higher than any other part of the vessel. At the top of the arch or raised side, I connect it with a strong bar of wrought iron, which extends the whole length of the raised side, and down towards the bilge of the vessel, forward and aft, so that the strain is distributed over the greater portion of those parts of the sides which would otherwise be too weak, in proportion to the extreme length of the ship,—this bar of wrought iron extending to about three-fourths the length of the vessel; and I connect the raised sides of the vessel about eight feet above the main deck, by iron beams across the vessel, which will form an upper or spar deck, and may be extended as far forward and aft as the builder may desire. I also add to the strength of the vessel, by having a centre kelson extending from the floor timbers to the cabin floor, with elliptical openings at proper intervals, so as to admit the passage or stowage of fuel and goods. As this kelson will extend from the bow to the stern of the ship, it will be a great support to the vessel, and tend to lessen the vibration which is generally felt in steamers propelled by powerful engines.

In addition to the great advantage of high speed, I am able to afford to passengers comforts to which they are strangers in the steamers used in the channels, in our coasting trade, and to the different European continental ports, where the voyages are comparatively short. Instead of having deck passengers exposed to the weather, they will be perfectly protected by an upper or light spar deck; and cabin passengers may either resort to comfortable state rooms—for I propose to have a sufficient number in the steamers for short voyages to accommodate at least 200 cabin passengers—or they can lounge upon comfortable sofas in large and elegant saloons upon the main-deck. Instead, then, of being exposed to the inclemency of the weather upon deck, and of being drenched with spray or rain, as passengers now generally are in crossing the channel, and of being compelled to travel in wet clothing for several hours by rail—thus laying the foundation for the catarrhal and consumptive diseases, which carry off their yearly thousands of victims,—passengers in my steamers will arrive at their destination free from such exposures, and without sustaining a loss in the destruction of wearing apparel perhaps equal to five times the passage money. All these drawbacks and preventives to travel being removed, and with a great increase of speed, and consequent saving of time, may we not reasonably expect that the passenger traffic between England and the Continent, and between England and Ireland, will be infinitely increased. Instead, then, of its being against the interests of the owners of channel and other steamers to promote the introduction of an improved class of steam-vessels upon their several routes, it appears to me that it is clearly their interest to adopt that plan which will not only add largely to their traffic, but also reduce the expenses to which they are now subject. For instance, between Holyhead and Kingstown there are, I believe, not less than eight or ten passenger steamers employed by two companies. With steamers such as I propose, four would give four departures each way every day, from Holyhead and from Kingstown. There would thus be a saving of from four to six steamers, and of the crews to man them, between the two ports. The same thing may be said of almost every other route where they have the advantage of a commodious harbour to enable long vessels to enter.

As it may be objected to my plan that steamers with upper spar decks would not answer the channel service, I may state that in 1830 the same opinion was confidently expressed in Canada, when it was proposed to construct steamers with upper or spar decks, in imitation of those upon the Hudson River, for service upon Lake Ontario. Before that time it was supposed that no steamers with such top-hamper could live upon Lake Ontario in a gale of wind; for the sea there is very similar to that upon the German Ocean. Experience, however, has proved that the fears of those who predicted their unsuitableness and failure were altogether groundless. At that time, storms were of very frequent occurrence, and steamers built with flush decks, and having all snug below, were often compelled to remain in port, or obliged to put back, owing to stress of weather. Now, however, we never hear of a steamer—built with a spar deck—being obliged to put back or to remain in port from the inclemency of the weather; and the dreadful storms of former years are seldom heard of now. The truth is, that the steamers now employed are far more seaworthy than the old class, besides being twice as fast, and infinitely more comfortable.

The advantage to trade, and, indeed, to every interest in the kingdom, which would result from the use of steamers that would bring distant countries within an easy journey of England, cannot be doubted. Looking merely to Denmark, Norway, and Sweden, the trade and passenger traffic with those countries might be infinitely increased, if the time and expense of the voyage were reduced, and the present discomforts to travellers avoided. The distance from London to Copenhagen is about 820 miles, and the voyage could easily be performed in less than forty hours, and at an expense not exceeding two guineas for first class passengers. At present travellers from England to Copenhagen, to whom time and comfort are objects, are compelled to travel by rail as much as possible, at great expense, and not as expeditiously as they could by water, if steamers upon my plan were put upon that route. I am not aware of the time required to reach Copenhagen by rail and steamer, but I feel assured it must be considerably over forty hours, and that the expense for first-class passengers cannot be less than four or five guineas.

It must be obvious to every one that our trade and intercourse with Hamburg, Bremen, Amsterdam, Rotterdam, Antwerp, Ostend, Boulogne, and Havre, would also be largely increased, if the distance between those places and London could be performed in about one-half the time occupied at present, and at about one-half the cost of the journey by rail and steamer.

Extending our views to more distant countries, steamers of the speed alluded to would bring New York within a week's sail of England; we should reach California and Calcutta in three weeks; Australia within a month; Bombay and Ceylon would be within sixteen days' journey of us; the West Indies within seven or eight days; Alexandria within a week; Constantinople would be reached

in less than nine days, and Sebastopol within ten days!

Surely, improvements that would effect such mighty changes are not unworthy the consideration of the merchants and manufacturers of England. Shall it then be said that your enterprise and energy are unequal to the attempt to bring this great improvement to the test of actual experiment. Shall the proposed ameliorations in our intercourse with the world languish and die for want of that support which capitalists alone can supply.

In order the better to appreciate the advantages of quick communication between this kingdom and the different parts of the world alluded to, we have only to look back a few years, and ask ourselves how we should like now to give up even our present imperfect means of reaching those countries, and resort to the slow sailing system of twenty years ago. It is very evident that one of the great reasons for the prosperous state of our foreign trade, is the easy and quick communication we have with foreign countries; and with the speed of that communication accelerated by at least 33⅓ per cent., it seems clear that corresponding advantages must result to the trade and commerce of the kingdom.

Looking at the question politically, what would not now be given by the Government for five or six steamers that could reach the Crimea within ten days, each with 1,500 troops on board, to relieve the over-taxed energies and exertions of our gallant little band of heroes, and their noble commander, who are there upholding the honour and power of England. We know not how long this war may be continued, and it would seem to be the part of wisdom to prepare in time to meet its exigencies. Steamers that could reach Cronstadt and St. Petersburgh in a little over three days may next summer be much required either as despatch vessels or transports for the conveyance of troops and stores. Why, then, should they not be got in readiness now, when the opportunity is afforded of building them. It may not be uninteresting to remark that the cost of a steamer which can carry as many troops as the *Himalaya*, and at a speed exceeding that of that vessel by 100 miles a day, will be at least *one-third* less than the price paid by Government for that steamer; and that I am prepared to contract, in connection with eminent ship-builders and engineers, for the construction of one or several steamers whose speed will be *guaranteed* at not less than seventeen knots an hour. Although we limit the guarantee to seventeen knots an hour, we do not the less expect a speed exceeding eighteen knots an hour, for it must be obvious that a prudent builder will allow himself an ample margin in the rate of speed, to prevent loss on his part.

D. BETHUNE.

17, Hanover-square, London, Nov. 20, 1854.

## AMERICAN PATENTS.

### ANNUAL REPORT OF THE COMMISSIONER OF PATENTS.

Sir,—I have the honour to report to you that the business of the Patent Office is now in a more satisfactory condition than at any previous period since my connection with it.

The number of cases undisposed of in the office on the first day of January last was reported to be five hundred and eighty-two. That number, however, was ascertained through an erroneous method of computation. By an actual count, the number of cases on hand at that time was ascertained to be eight hundred and twenty-three. A correct mode of computation was then introduced, so that the exact condition of the business of the office can hereafter be readily calculated from the monthly reports.

This arrearage in the business of the office, though much less than it had been six months previous, was such that several months always elapsed after the making of an application before it could be disposed of, which was a source of great disatisfaction to all applicants for patents.

During the three first months of the present year the increase in the business of the office was such that no sensible diminution in the arrearages was effected. In order to accomplish so desirable an object it was deemed expedient to place several of the assistant examiners in the performance of the duties of principal examiners. In that manner the end sought is now almost and will soon be entirely attained.

Instead of six principal examiners, each with two assistants, we have, since the first of April, had practically eleven principal examiners, each with one assistant. Most of the rooms are now entirely filled up with their work, and all will probably be so by the first day of December next. We have already, since the first of January last, issued upwards of sixteen hundred patents, and within the year the number will probably reach the nineteenth hundred, which will be about double the number patented last year. Applications are generally acted upon within a few days after they are made, and I have no doubt that the arrangement by which this result has been produced was judicious, and has proved satisfactory to the parties interested. I think it should be continued as the only method of disposing of the increasing business of the office with the proper promptitude and despatch.

About one year since I had the honour to invite your attention to the importance of several proposed amendments in the patent laws. The reason then given for the alterations suggested remain in full force now, and the recommendations then made are now repeated.

The amendments of most immediate and pressing necessity are those making provision for taking testimony—those in relation to appeals, and those prescribing a new rate of fees.

Many questions of great moment are frequently pending before the Patent Office, depending for a correct decision upon the testimony of witnesses, and there is no power provided to compel a witness to give testimony. Nothing is more common than for a witness to refuse to attend an examination, or to refuse to give testimony after he has attended, to the great perversion of the ends of justice and the object of the patent law.

The law now allows any person who appeals from the decision of the Commissioner to select which of the three judges of the Circuit Court he chooses before whom to bring the appeal. The chief justice of that court will probably never again be able to entertain an appeal, so that bringing an appeal before him is tantamount to its postponement during the term of his natural life, and even after his death there may be some question as to whether the delay will be at an end. By an abuse of this law a case has been suspended in this manner for near two years, and is threatened with indefinite postponement, to the great detriment of the party who is probably entitled to the patent.

The rate of fees was fixed at a time when the real value of money was much greater in proportion to its nominal value than at present. The pay of the clerks and labourers employed in the office has been very much increased by Congress, and in various other ways the expenses of the office have been greatly augmented, while the fees have remained unchanged. In addition to these causes the force of the office has been considerably increased during the present year, in order to dispose of the accumulation of business above referred to.

The consequence of all these causes has been that during the current year the expenses of the office have been continually exceeding the revenues, and such will continue to be the case until an augmentation of those revenues shall be provided for.

The permanent augmentation of the examining corps, or rather such a reorganisation as will place all its members on a proper footing, is a subject worthy of consideration. The assistant examiners who are performing the duties of principal examiners, may justly expect, at no distant day, the compensation attached to those duties and responsibilities. It would not only be highly gratify-

ing to me, but would be nothing more than justice to them to have the means and the authority to make their compensation commensurate with the grade and character of their actual service.

A bill was framed by the Senate committee at the last session of Congress, providing for these and many other amendments, or, rather, it amounted to a general reorganisation of the whole Patent Office system, including the above named provisions as a portion thereof. The passage of that bill, or of some other which shall at least embrace the features above alluded to, seems to be an object of prime importance to the proper administration of the affairs of this office.

I beg leave to commend these matters to your favourable consideration, in case you deem them of sufficient consequence to merit a place in your annual report.

I remain, sir,
Very respectfully yours, &c.,
CHAS. MASON.

Hon. Robert McClelland, Sec. of the Interior.

Patent Office, Nov. 1, 1854.

## THE DOWN-DRAUGHT SMOKELESS FURNACE.

At the last meeting of the Royal Scottish Society of Arts, Mr. Robert H. Bow, C.E., read a paper "On a Smokeless Furnace," illustrated by diagrams. After stating the conditions under which smoke is produced in a furnace as commonly constructed and managed, and the necessity for a very high temperature, combined with an abundant supply of oxygen, in order to effect the combustion of the smoke, the author described three general arrangements under which could be classified nearly all the furnaces that have been brought forward as smokeless; and maintained that the more practicable of these owed their success more to the regular manner in which the fuel was supplied than to any properties of the arrangements; and that, in order to effect the regular feeding of the furnace, somewhat complicated machinery was required, or an amount of attention was necessary on the part of the furnaceman that could seldom be counted upon. The author stated that his invention does away with the necessity for great regularity in the supply of the coal. In his furnace the draught is reversed—that is, the flame, air, &c., proceed downwards through and from the fire, and it is therefore proposed to call it "The Down-Draught Furnace." The principle of its action was stated to be very simple. The smoke liberated from the superincumbent coal, is, by means of the suction of the chimney, carried, along with a due admixture of air, down through the brightly burning fuel which forms the lower stratum of the fire, and thus becomes intensely heated and completely burnt. Contrary to what might have been expected, the combustion is very rapid: in some experiments, made in 1852, with a grate of five-eighths of a square foot in area, the combustion was at the rate of thirty pounds of coal per square foot of grate per hour; the height of the chimney being nearly thirty-five feet. This result is probably due to the self-clearing power of the furnace, and the comparatively dense state of the air when it mingles with the fuel. The combustion readily spreads upwards to the fresh coal from the action of the strong radiant heat. The author stated that a common iron grating cannot be employed in this furnace, as it would rapidly become oxidised or burnt. The following are some of the methods that may be adopted for overcoming this difficulty:—1st. The fuel may be burned in a V or L shaped cavity. 2nd, A perforated or open-work structure of fire-proof clay or stone may be employed to support the fire; and 3rd, Tubes containing water, either communicating with a boiler, or otherwise supplied, may be substituted for the fire-bars.

The invention was referred to a committee to report upon its merits.

## PHOTOGRAPHY.

Considerable interest has been excited during the past week amongst all concerned in practising this art by the proceedings in the trial of Talbot *v.* Laroche. Mr. Fox Talbot, as is well known, claims to be the inventor of the art, including of course the Daguerreotype, and in 1841 took out a patent for the process as applied to paper. He subsequently received from the Royal Society the Rumford Medal for his discoveries in connection with the art. Little appears to have been done for some years after the granting of the patent, and it was not till 1851 that much practical progress was made, when the Great Exhibition brought to light numerous beautiful specimens produced by modifications of the process as detailed in Mr. Fox Talbot's specifications. At that time Mr. Archer brought out what is known by the title of the Collodion process, by means of which an immense rapidity in the production of pictures was gained, as well as finer and more perfect results than the paper process was capable of producing. The great rapidity thus obtained rendered the process peculiarly fitted for the taking of portraits. Mr. Fox Talbot, under the terms of his specification, which were very large and comprehensive, claimed the collodion process as included within it, and many persons practising the art for gain took licenses from him. Mr. Fox Talbot, at the earnest representations of Lord Rosse, the president of the Royal Society, and Sir Charles Eastlake, the president of the Royal Academy, was induced to throw open his patent to the public generally, reserving only his right to the use of the art in portraiture, when exercised for gain, and not for amusement only. From the very first it was questioned how far the collodion process could be considered included in Mr. Fox Talbot's patent, and the present action was brought by Mr. Fox Talbot against Mr. Laroche for an infringement by using the collodion process for the taking of portraits for gain. The case was tried last week, and occupied two days and a half. The defendant disputed the validity of the patent as a matter of law, on several points arising out of the specification, which were reserved for the opinion of the Court above, and he put in issue the questions of fact, whether Mr. Talbot was the true and first inventor, and next, that whether the patents were valid or not, he was not guilty of infringement by using the collodion process. Evidence was adduced on the part of the defendant to shew that the real inventor of the process was the Rev. Mr. Reade, and that he had made it known and had exhibited pictures produced some time previous to the grant of Mr. Fox Talbot's patent, and that, besides this, Mr. Fox Talbot had been made aware of the fact at the time. The evidence of a number of scientific men and others was adduced on both sides as to the precise nature of the collodion process, and that specified by Mr. Fox Talbot.

The judge, at the conclusion, summed up the evidence in a remarkably lucid and impartial statement to the jury, evincing a thorough knowledge of the complicated subject, and the chemical and other matters which had been brought before the Courts. "The questions," he said, "the jury would have to determine were, *first* of all, did Mr. Reade know of the use of nitrate of silver and gallic acid in connection with iodide of potassium? But knowing it alone would not do, if he had had that knowledge before February, 1841, did he make it known to the public? And, if he did, Mr. Talbot was not, for the purposes of the patent, the first and true inventor. *Secondly*, on the plea of not guilty, was the use of collodion with nitrate of silver and iodide of potassium the same as Mr. Talbot's process, gallic acid being part of Mr. Talbot's process, and being absent altogether in the collodion? That, however, would not do, if in the collodion the same result was obtained by a chemical equivalent, and upon that they would have to consider whether gallic acid and pyrogallic acid were in substance, for this purpose, the same."

The jury, after an absence of three-quarters of an hour, returned into court, and delivered a written verdict, whereupon the judge, Chief Justice Jervis, said :—

"Now I will ask you the question. Do you find that Mr. Talbot is the first and true inventor?

"Foreman.—Yes; the publisher.

"Chief Justice Jervis.—That is, within the meaning of the patent laws—that he was the first person who disclosed it to the public?

"Foreman.—Yes.

"Chief Justice Jervis.—And you find that the defendant was not guilty?

"Foreman.—Yes.

"Chief Justice Jervis.—Under the Patent Law I will certify that he was the first and true inventor."

The result of the verdict is that the collodion process is not comprehended within Mr. Talbot's patent.

## ON CHARCOAL AS A DISINFECTANT.

By Mr. J. G. Barford, St. Bartholomew's Hospital.

(From the *Lancet*, Dec. 16.)

The substances with which we are acquainted as disinfectants or deodorizers are—chlorine, chloride of lime, lime, charcoal, &c., each of which possesses this power to a certain degree, but not all acting in the same manner. The disinfecting power of chlorine depends on its affinity for hydrogen, thus decomposing water or aqueous vapour by uniting with the hydrogen, while the nascent oxygen oxidizes the organic matter, so that unless aqueous vapour is present, chlorine loses a great part of its disinfecting power, and simply disguises the noxious effluvia, and is itself an irritating, offensive, and corrosive substance. Chloride of lime acts by the oxidation of the putrescent matter, but to do this effectually it requires the presence of an acid; thus, unless a considerable quantity of carbonic acid is present to decompose the hypochlorite of lime, and give rise to the evolution of hypochlorous acid, the chloride of lime will do but little as a disinfectant. Lime acts by the absorption of carbonic acid and sulphuretted hydrogen, leaving other noxious gases unaltered; thus they are all open to serious objections; but the one which practically will be found the most effectual, I believe, has received the least patronage. This is charcoal—a body whose disinfecting powers have long been known, but its mode of application has been quite neglected.

Dr. Stenhouse lately called attention to his very ingenious ori-nasal respirator, which depends on charcoal for its efficacy, the action of which is given in the *Journal of the Society of Arts*, for February, 1854. The respirator having been noticed in the *Lancet* of November 25, I need only mention it as an instance of the powerful disinfecting power of charcoal, but at once call attention to the plan I have adopted in the application of this agent as a disinfectant, bearing in mind the results of Dr. Stenhouse's experiments, which prove that charcoal not only absorbs noxious vapours and putrescent odours, but at the same time oxidizes them, or in other words, makes them undergo a slow but sure combustion, which must have its end in the conversion of deleterious gases into compounds whose physical and chymical properties would admit of an easy separation or removal from their bed of formation, and which on evolution would not be the least deleterious. I therefore, previous to its use, heated the charcoal thoroughly in a covered crucible with a small hole in its lid, to allow any oxidized material which it might contain to escape, taking care not to have the hole sufficiently large to allow the charcoal to undergo combustion; when thoroughly heated it was allowed to cool, so that on exposure to the air it should not oxidize; in this state it was put into shallow vessels, and placed wherever putrescent odours existed, and in a few minutes the whole of the smell disappeared; but in a day or two the charcoal lost its power. I then thoroughly heated it again, with the same precautions as before, and placed it to perform its duties a second time, which it did with as much efficacy as on the first application. Thus, by the repeated cleansing of the charcoal every or every other day, it does not deteriorate, but the same quantity will effectually remove noxious gases for an indefinite period of time.

With Mr. Holden's permission I was enabled to give it a most perfect trial in the dissecting-rooms of St. Bartholomew's Hospital, which at this time of the year must abound in noxious gases and putrescent odours. Thoroughly heating the charcoal, and placing it in shallow vessels about the rooms, it acted so promptly that in ten minutes not the least diffused smell could be detected. So quick and effectual was its action that arrangements are being made for its constant use. It answers just as well as a purifier of water-closets, drains, wards of hospitals, and sick rooms. As a purifier of hospital wards, both civil and military, it might be applied with great advantage, saving patients from the unpleasant smells and effluvia from gangrenous sores, and for this purpose a wire gauze construction, containing the charcoal, might be made to surround the affected part at some distance from the dressing; thus the patient himself and those in adjacent beds would not be subjected to the influence of the putrescent odours. All these the charcoal would effectually absorb, doubtless with advantage to the patient and his neighbours also. Other quantities of charcoal might be placed in shallow vessels about the wards, and purified every morning, as above-mentioned. Being at the command of the poor as well as the rich, it admits of universal use; and, though it may be objected to as a purifier of the wards of hospitals and chambers of the sick, under the fallacious notion that it would emit carbonic acid, and also on undergoing its daily cleansing would again give off the absorbed gases, yet this notion can never enter the minds of those who understand its action, seeing that carbonic acid cannot be generated unless the charcoal is heated in free contact with the air. This is prevented by having a covered crucible in which it can be heated to any temperature without undergoing combustion; and the supposition that the absorbed gases are given off again when the charcoal is heated will be removed by the fact that they are all oxidised, and converted into sulphuric, nitric, or carbonic acid, and water, &c., and the heating of the charcoal is for the whole and sole purpose of removing these bodies, which exist in so small a quantity that they could not be the least prejudicial, even if driven off in the centre of an inhabited room; but, of course, they all pass up the chimney. Thus charcoal is more efficacious than any other disinfectant when applied as above described, absorbing gases of whatsoever kind, not requiring the presence of any other substance to resist its action, but without stint or scruple collecting noxious vapours from every source, not disguising, but condensing and oxidising the most offensive gases and poisonous effluvia, converting them into simple, inert, staple compounds; it is simple and economical, coming within the reach of the poorest, and can safely be placed in the hands of the most ignorant, thus combining advantages not possessed by any other disinfectant.

## REDUCTION OF FRENCH POSTAGE

A new postal treaty has been entered into with France, the principal effect of which will be the reduction of the postage upon prepaid letters weighing not more than ¼oz. (a weight which includes the great majority) to 4d., instead of 8d. or 10d., as heretofore. This reduced postage of 4d. will carry the letter from any part of the United Kingdom to any part of France or Algeria. If the letter be posted unpaid the charge will be double. Under the provisions of this treaty the postage on letters passing through England or France will also in many cases be reduced. On all these points detailed information will be issued. The new treaty will come into operation on the 1st of January

## PUBLIC LIBRARIES AND MUSEUMS.

A bill, just prepared and brought in by Mr. Ewart, Mr. Brotherton, and Mr. G. A. Hamilton, proposes to repeal the Library Act of 1850, but not to invalidate by such repeal anything done in pursuance of the same act, or to disturb already established libraries and museums. The object of the bill appears simply to extend the benefits of the measure of 1855 to towns governed under local acts, and to parishes. For this purpose it requires the council of any municipal borough of which the population shall exceed 5,000 persons to call a public meeting, on the requisition of 10 persons paying the borough rate, in order to determine whether this act shall be adopted for the said municipal borough; and, if at such meeting two-thirds of the persons present and qualified as aforesaid shall determine that the act ought to be adopted, the same shall thenceforth take effect and come into operation in such borough. The expenses of carrying the act into execution are to be defrayed from the borough fund, and the council is empowered, if it think fit, to levy a separace rate for the purpose. "Improvement Boards" may adopt the act and charge the expense on the improvement rate, if the previous requisitions with regard to population and the decision of two-thirds of a public meeting be complied with. Parishes with the same population (5,000) may adopt the Act, with the consent of two-thirds of the ratepayers, and the vestry will then appoint from three to seven commissioners from the ratepayers, to carry the act into effect, to dispose of lands, and to sue and be sued as a body corporate. One-third of this commission will go out of office annually. The expenses are to be paid out of the poor-rate. The vestries of two or more neighbouring parishes, having an aggregate population exceeding 5,000 persons, may conjointly adopt the act in the manner already described, the expenses to be borne in proportion, and three commissioners may be appointed by each parish to manage the library or museum. No rate levied for the purposes of this act in any borough, district, or parish, is to exceed one penny in the pound. The councils are empowered to borrow sums of money for the purposes of the act, with the approval of Her Majesty's Treasury, and the Public Works Loan Commissioners are empowered to advance such sums of money. Lands, &c., may be appropriated, purchased, or rented, for the purposes of this act. The general management and control of the libraries and museums formed under this act is to be vested in the councils of boroughs, in the boards of districts, and in the commissioners of parishes; and all real and personal property purchased for any library or museum is to be vested in the same respectively. All libraries and museums established under this act are to be open to the public free of all charge.

## INSTITUTION OF CIVIL ENGINEERS.

### Annual General Meeting.

At the last meeting of the Institution, Mr. James Simpson, President, in the chair, the annual report of the retiring Council was read, and the meeting proceeded to the election of the President, Vice-Presidents, and other Members of the Council for the ensuing year, after which the medals and premiums which had been awarded were presented.

The leading events of the political world and particularly the occurrence of war, were alluded to, as having tended to arrest the progress of civil engineering works, whilst, on the other hand, the mechanical engineers had found ample employment in supplying engines, machinery, vessels, tools, and stores of all kinds for the use of the army, the navy, and the mercantile service. The fact of the aid of civil and mechanical engineers being so extensively sought for, in conjunction with the army and navy, was alluded to, and the cases in which their combined efforts had conduced so essentially to mutual benefit were shown. Allusion was also made to the novel expedient of sending out a corps of "navvies" and other artizans to lay, as it was expressed, "the first section of the railway from Sebastopol to St. Petersburg." The production of the Lancaster rifled cannon, and of the wrought iron ordnance, by engineers, and the investigation for the Government, by a member of the Institution, into the manufacture, boring, and firing of rifles, were noticed.

The few large works of civil engineering now in progress in Great Britain were then mentioned, and the impetuous onslaught of the Home Secretary upon the smoke and other nuisances of the metropolis was noticed, with the view of directing, to those points, as also to the general sanitary questions and to the sewerage of the metropolis, the attention of civil engineers, whose advice would be found trustworthy, and who would discriminate between sound systems and the nostrums and baseless schemes which were now ignorantly thrust forward.

The extensions of the feeding mains of the principal water companies to points high up the river, beyond the influence of the tidal range, and, in two cases, the removal of the entire establishments, in order to afford almost unlimited supplies of the best water for domestic purposes, was noticed; and it was pointed out, that it was now only necessary to afford such an ample supply of water, at a sufficient elevation, on the north side of the Metropolis, as would enable the sewers to be constantly flushed, and that their contents should be delivered at positions, so low down the Thames, as to preclude the necessity for the mechanical lifting of the sewage, excepting for a limited area, and for those portions under high-water mark, and thus the noble metropolitan river might be rendered as pure as was practicable, for a stream flowing amidst habitations, and necessarily subject to some degree of pollution.

A slight sketch was given of the progress of railways on the Continent,—in the Colonies,—in America,—and, in fact, throughout the world, and in every quarter members of the Institution were to be found earnestly pursuing their calling. On the Continent, the main lines were being extended, so as to bring the chief capitals of Europe within a few hours' journey of our Metropolis, whilst the Electric Telegraph accompanied and frequently preceded the lines, for that more rapid communication which had now become indispensable in mercantile, political, and social relations. In Egypt, and in India, portions of the main lines were in use. In the Colonies small local lines were at work and large schemes were projected. In Canada, the Grand Trunk Railway was noticed, as being fraught with immense commercial and political importance; the great work on its course,—the Victoria Bridge,—was described as spanning the St. Lawrence, at Montreal, by a wrought-iron tubular structure of, including the abutments and embankments, nearly 9,000 feet in length, employing for its manufacture 10,400 tons of iron. The Norwegian and Danish railways, recently opened, were described, as also the preparations made at Lowestoft for the encouragement of the trade with those countries. The railways in the United States of America appeared not to have taken any great extension during the past year, although the project of extending a line on towards California had been favourably received.

The successful opening and subsequent progress of the Crystal Palace at Sydenham was noticed; and it was shown that in the projection, the prosecution, and the support of this great work, many of the members had been actively engaged; and the same energetic aid was asked for the approaching "Exposition" at Paris, in 1855; the Council had given their best aid to the Government in the matter, and it was specially impressed on members to send only such models and specimens of works and machinery, as should sustain the high character of the British engineers and manufacturers.

A sketch of the statistics of railways in Great Britain was then given. It was also represented, how essentially the civil engineers could contribute to the investigations of antiquaries and archæologists, by immediately reporting to the Antiquarian Society the finding of any objects

during the course of excavations, and by transmitting the objects found to that Society, for a report, before depositing them in the national collection at the British Museum.

Sketches were then given of the subjects of the principal Papers read during the past session, for part of which Telford medals had been awarded to Messrs. Beardmore, Henderson, Smith, Hobbs, and Yates; and Council premiums of books to Messrs. Harrison, Clark, Simpson, jun., Peniston, and Chadwick, which, in the course of the evening, were duly presented; the President noticing, the advantages to be anticipated from the examination, by Mr. Henderson, of the great steamers and other large vessels of the present day; alluding, also, to that now building by Mr. Scott Russell, under the direction of Mr. Brunel, V.P.;—the valuable enquiries opened by Mr. Harrison's view of the state of the drainage of the district south of the Thames;—Mr. Beardmore's and Mr. Peniston's account of the works of improvement on the Lea, and of a tunnel on a railway;—Mr. Piggott Smith's paper on Macadamizing the streets of towns;—Mr. Simpson, junior, on the smoke question;—and Mr. Chadwick on water meters; all subjects of importance in a sanitary point of view;—Mr. Clark's description of the novel mode of propulsion exhibited by the 'Enterprise,' intended especially for the Deep Sea Fishing Company;—Mr. Hobbs, on locks, eulogising particularly the honesty of purpose, and the temperate enunciation of startling facts exhibited in the communication; and Mr. Yates's Paper on the Decimal Coinage, &c., in the investigation of which much industrious research had been shown.

Numerous valuable presents of books, maps, charts, &c., were announced, as also the presentation of the portrait of another Past-President, Mr. Joshua Field: special allusion was made to the bequest of the late Mr. B. L. Vulliamy, Assoc. Inst. C.E., of a large and very valuable collection of works on horology, second only to the collection in the library of the Clockmakers' Company. The thanks of the meeting were unanimously given, with a vote of condolence to the family, on the loss they, in common with all his friends, had sustained, in the decease of Mr. Vulliamy.

The past year had witnessed extraordinary mortality among the members; the deceases of two honorary members, nine members, and nine associates being recorded. Among them were the first honorary secretary of the Institution,—a distinguished Prussian Minister,—some very old and well known members and associates,—as also some younger men who promised to become ornaments to the profession,—and an associate member of council (Mr. C. Geach, M.P.), well-known and esteemed by all the Institution, as one of those energetic, enterprising men, who gave vitality to every speculation in which they engaged, and who, by the uprightness of their transactions, and the justness of their views, upheld, worthily, the credit of the British capitalist and manufacturer.

The great mortality in the Royal and other Societies was also noticed, and allusion was made to the intelligence, brought by Dr. Rae, of the melancholy fate of Sir John Franklin and his devoted companions, martyrs to the cause of science; and the meeting was called upon to unite with the Council in the expression of sorrow for the sad termination of the career of a man, who was equally distinguished by his devotion to his duty as an officer, his enthusiasm in the prosecution of scientific research, and his general public and private worth;—and as a parallel case exhibiting the devotion and the noble sense of duty of the officers of the British army, the case was cited of that "noble old man," the late Colonel Moore, who, on the event of the burning of the vessel bearing towards the Crimea part of the 6th Dragoon Guards, "with none of the excitement of action, or of the glory and enthusiasm of the battle-field to animate him, faced, in cold blood, the most terrible death that man could meet, and refused to leave the burning ship while any of his men were alive upon it."

The deceases announced were Messrs. Arthur Aikin (the first honorary secretary), and Peter Christopher Wilhelm Beuth—honorary members; Edmund Scott Barber, George Watson Buck, John Donkin, Alexander Easton, Henry Fowler, Daniel Pinkney Hewett, William Radford, William Stuart, and James Trubshaw—members; John Armstrong, Charles Geach, M.P., Nathan Gough, Benjamin Louis Vulliamy, Alderman William Thompson, M.P., Colonel John Neave Wells, R.E., Lieut.-Colonel John Augustus Lloyd, Captain Joshua William Coddington, R.E., and Lieutenant William Chapman, R.E.—associates.

Memoirs of the deceased members of all classes, were ordered to be printed as an appendix to the annual report

The resignations of fourteen members and associates were announced.

The financial statement showed the funds of the Society to be in a very prosperous state, since, by the voluntary contribution of the members of all classes, the printing debt had been paid, and, after giving the detail of a special general meeting of members, convened for the purpose of introducing some modifications into the byelaws, which had, however, been demonstrated to be unnecessary, and therefore were not made, the report concluded by announcing that two parts of volumes XI. and XII. (together upwards of 800 pages), of the minutes of proceedings, had been issued, and the editing and printing of all the remainder would proceed with all despatch.

The thanks of the Institution were unanimously voted to the president, vice-presidents, and other members and associates of council; as also to the auditors, the scrutineers of the ballot, and to the secretary, for their several services.

The following gentlemen were elected to fill the several offices in Council for the ensuing year:—James Simpson, president; G. P. Bidder, I. K. Brunel, J. Locke, M.P., R. Stephenson, M.P., vice-presidents; J. Cubitt, J. E. Errington, J. Fowler, C. H. Gregory, J. Hawkshaw, T. Hawksley, J. R. McClean, C. May, J. Penn, and J. S. Russell, members; and H. Hensman, and Sir J. Paxton, M.P., associates.

The meeting was then adjourned until Tuesday, Jan. 9th, 1855, when, it was announced, that the ballot for members would take place, and the discussion would be resumed on Mr. P. Barlow's paper, "On some peculiar features of the Water-bearing Strata of the London Basin."

## Home Correspondence.

### DISTRIBUTION OF PUBLIC DOCUMENTS.

Sir,—In the Journal of the 10th November last (No. 103), Dr. Purvis suggested the desirableness of supplying the *London Gazette* to Institutions.

The newspapers extract, and extract correctly, all that is really interesting that the general public should know from this purely official paper. I do not think that the members of the majority of the existing Institutions would care to be informed, with all the minuteness of an official document, that there is now a beacon to indicate the position of the Jœdderen Reef, or that there is a light on Winga Skeer, however interesting such announcements may be to the Greenwich Institute, nor would they be interested to wade through seven or eight pages of "Weekly returns of the quantities and price of British corn, imperial measure, as received from the inspectors and officers of excise," &c., &c., or as many pages of an "Account of the average amount of bank notes of the several banks of issue in England and Wales," &c., and, probably, were all the Institutions supplied with the Parliamentary papers, these would be regarded much in the same light as the *London Gazette*.

But I think the Council of the Society of Arts would confer a benefit upon us if they would appoint a Commit-

tee to act the part of the newspapers, and kindly select or point out such parliamentary papers, reports of committees and public bodies, evidence upon public questions, &c., as would be instructive to members of Institutions generally, or be valuable works of reference to preserve; and there are few Institutions, I think, who could not obtain such of these documents as they wished to possess when so pointed out, through members of parliament representing or interested in their behalf.

I am, sir, &c., &c.,
THOMAS EDGWORTH,
Treasurer of the Wrexham Literary and Scientific Institution.
Wrexham, Dec. 23, 1854.

## LIMITED LIABILITY IN PARTNERSHIPS.

Sir,—'Limited Liability in Partnership' has become now an expression so familiar to all the world, that it seems almost a paradox to ask those who use the expression and express opinions, some for and some against whatever this "limited liability" may be, what it is they really mean. Nevertheless, I strongly suspect that very few who use the term have any distinct understanding on the subject. For my own part I will at once confess that *I do not know* what is meant by the expression, and perhaps your readers will be yet more startled at my asking them "What is a partner?" If, however, every person will but place this question honestly before himself, the answer in, I fancy, every case will be, "I don't know." If we do not know what is a partner, the rest of the expression must mean—*nothing*.

Nevertheless, I am disposed to believe there is some very indefinite and ill-defined meaning attached to the phrase "Limited Liability in Partnership," by those who make use of it. Evil results have been seen to arise from contracts being fastened upon people into which they never entered or dreamed of entering; burthens thrown upon one to the relief of another never contemplated by either party, and all by force of this magic word "partnership." What is a partner? I don't know! The law has never told me, and until it does, I must continue not to know. What it ought to be I can discover, just as one has endeavoured to find out what copyright and patentright ought to mean; but as to what a partner is, the law is silent, and therefore so am I.

I think, sir, this plain statement of the case will be at once an answer to Mr. Elliott, and to the late Royal Commissioners on Commercial Law; by whom it has been decided, (Bramwell and Hodgson dissentient) that the commercial law of this country, and partnership law in particular, is in its utmost state of perfection.

Those who hold this opinion are bound to point out where that law is to be found. Ask for the law on any point, and after searching through Acts of Parliament contained in 90 volumes post octavo, and 900 volumes of reports, I may or may not find the point in question expressly decided and uniformly in one way. If I do, then there is the law upon it; if, as more usually happens, I do not, then there is no law upon the subject, and I can only express an opinion of what it is likely to be declared to be, *i.e.*, which of all possible psychological events on a particular occasion in the future is, I think, the most likely to happen, the psychological event in question being what shall happen in the mind of the judge when the question arises, the judge, that is, the legislator, *pro hac vice* and *ex-post facto*. Ask the Lord Chancellor what the law *is*, and according to your mode of asking will be his answer. Ask him in the proper manner, and he will not only tell you what the law is, or what he says it is, but also mulct you in some scores, hundreds, or it may be thousands of pounds, for not having known what you could not have known, because it was not in existence. Ask him in any other than this proper manner, and he will give you *his opinion* of what he says the law is, but really his opinion of what will most probably be enacted by the judges, including himself, whenever asked in the aforesaid proper manner, enacted I say, for though every judge tells you he sits not to make, but to execute the law, so long as there is no law, he makes the law as occasion requires.

Now, sir, I quite agree with Mr. Elliott in all his arguments, but I dissent from his attempted application of them. I do not suppose that any alteration, say rather establishment of the law on the subject of partnership or any other subject, will convert reckless and dishonest into prudent and trustworthy traders. A very different process to that of law-making is necessary to this end; nevertheless I do think a great deal may be done by the law in the way of facilitating industrial efforts, and especially by the removal of the shackles at present fettering it—such, for instance, as the intolerable uncertainty, expense, vexation, and delay, attending everything having reference to law. But, in replacing the present no-law by a system of law, I would earnestly recommend those to whom such a task (50 years hence, perhaps) may be intrusted, to try and find out what the law ought to be, and in accordance with what it ought to be, to make it. The science that shall enable them to do this is not at present in existence. Legal science, though the possibility of its existence has long been imagined, exists still only in imagination, yet is there nothing that should frighten us from attempting its investigation; and such investigation must be undertaken before any really good system of law can ever be hoped for.

For this reason I should not expect any *very* great results from the commission proposed by Mr. Leone Levi, though I should, indeed, be sorry to damp his ardour in the cause. I fear we are still too ignorant of what law should be, too little apt to adopt any steady guide in the determination of legal questions; and yet questions of law, or say of legal science, are *not mere questions of opinion*, but questions of correct or incorrect, true or false, balance of good upon one side or upon the other.

This, however, is little regarded, and the entire want of investigation into the principles of this science leaves all legislation to empiricism and opinion; nevertheless, I think such a commission as suggested by Mr. Levi would be of service, if but for the purpose of collecting data, and most especially if it should endeavour to establish one uniform system of measures of length, surface, capacity, weight, and value, among the nations joining in the commission. To this point I most respectfully draw the attention of Mr. Leone Levi.

I enclose my card, and am, sir,
Your most obedient servant,
L.

## MANUFACTURE AND APPLICATION OF PRODUCTS FROM COAL:—BENZINE.

Sir,—I shall feel obliged by your allowing me to correct some historical errors in a passage of Mr. Crace Calvert's paper on "Products from Coal," read before the Society of Arts on November 22, and printed at page 19, col. 2, of vol. ii., of your Journal.

"When this rectified naphtha (from coal tar) had been submitted to a series of further purifications, it had received from an eminent French chemist, named Pelouze, the name of 'Benzine,' which had the property of removing, with great facility, spots of grease, wax, tar, and resin, from fabrics and wearing apparel, without injuring the fabric, its colour, or leaving any permanent smell or mark, as was the case with turpentine. Benzine had, through his (Mr. Calvert's) exertions, been introduced into England, and had been found most valuable in brightening velvets, satins, &c. The numerous uses to which this valuable product could be applied in manufactures, must, in time, render it of extensive employment in place of alcohol and other fluids."

One part of the passage which I have above cited is true, another is not true. What is said of the utility of benzine,—that is to say of the substance "benzine," as Mr. Calvert must have meant,—not of the name "benzine,"

as he really says—is true. What is stated of its history is not true.

Benzine is another name for Benzole. The substance known by either of these names is not merely coal-naphtha purified. It is a certain definite hydro-carbon, as distinct a liquid as water, having peculiar properties of its own. This oil or spirit was discovered by Mitscherlich, the eminent German chemist, as a product of the decomposition of benzoic acid. To this substance, which, so obtained, is only an interesting, and rather precious, chemical curiosity, Mitscherlich, not M. Pelouze, gave the name "Benzine." This name afterwards was changed by some German chemists to "Benzole," in conformity with a useful fashion of giving similar terminations to the names of compounds of similar nature. Substances which contain nitrogen, and confer alkaline properties on water, received the termination "in" or "ine;" the names of hydrocarbon oils were made to end in "ol" or "ole."

Again, not M. Pelouze but I, discovered that benzine or benzole could be prepared in large quantities from coal-tar-naphtha. It is not, however, so easy to obtain it thus in a state of purity, as to prepare it mixed with a small quantity of other hydrocarbons, which do not not materially affect its properties. To this somewhat diluted product the name "Benzine" or "Benzole" may be given in practice, as we call a liquid containing spirit slightly diluted with water, "alcohol."

Again, I, and not M. Pelouze, nor Mr. Calvert, first observed the very useful properties which fitted this benzine or benzole for an abstergent of grease. Lastly, I, and not Mr. Calvert, made the "exertions" by which this most useful liquid was introduced into England. And I worked pretty hard at it, to the measure of my aptitude.

All that, so far as I can learn, M. Pelouze has had to do with benzine, is, that he has taken advantage of the chaotic condition in which our patent laws were a few years back, and has turned another man's, to wit my, labour, to good account. In 1847, it would cost a poor Englishman all his capital to secure patent-rights for his inventions at home, and would leave him nothing for the purchase of privileges abroad. I have been told that M. Pelouze is "making a good thing" of benzole in Paris; but I had been informed that not "Benzine," but "Essence Colin," or "Colla," or some such name, is the appellation which he has bestowed upon it.

Now, I am neither a dog in a manger, nor a fox at the grapes. Benzole has never yet yielded me anything but hard work, but I don't wish to prevent any brother-Frenchman, be he professor, or layman, from drawing much profit from my discovery. Neither will I say that French benzine, or essence, or income-in-francs, is, or would be, sour, or otherwise unpleasant. But I must say that I should be very sorry to be receiving reward on either side of the channel for another man's work.

What Mr. Calvert has to do with benzine seems to me to be this. I learn from the *Chemical Gazette* for October 16, 1854, p. 399, that letters patent have been granted to Mr. Calvert for making benzine from coal-naphtha and from other similar matters, and for applying his product to the cleansing of fur, wool, and woollen and other fabrics. And now Mr. Calvert appears to be making "exertions" towards "introducing" his patent to the public.

Now, however free any Frenchman, professor or layman, may be to make and sell benzine in France, where I could not afford to buy a "*brevet*," I do not feel that Mr. Calvert is thoroughly welcome to walk in and claim my discovery, and the rewards thereof, in London.

Mr. Calvert has made two discoveries:—first, that benzine or benzole may be made, by a certain simple process, from coal-naphtha;—second, that benzine or benzole so prepared will remove grease, resin, &c., from textile fabrics, &c., leaving no mark or permanent odour. Now, I do not know where, or how, Mr. Calvert made these discoveries; but I may be allowed to state where or how he might have achieved them. He might have found them in print, thus.—In the *Quarterly Journal of the Chemical Society* for 1849, vol. i. in a paper written by me, entitled, "Researches in Coal Tar," at pages 257, 264, under the heads "Of the Preparation of Benzole from Coal Naphtha," and "Of a Practical Mode of Preparing Benzole," the first of his discoveries is ready at hand. At page 261 of the same paper, under the head "Of some Useful Properties of Benzole," his second point is indicated. Both these matters were farther exemplified in a pamphlet which was published for me in 1849, by Parker, West Strand, with the title "Benzole; its Nature and Utility." As to the latter of them, Mr. Calvert might have found at page 35 of this little book these words:—"As a solvent for grease of all sorts it (benzole) is unequalled, and its ready volatility may render it, in many instances, of extreme value as a detergent, disappearing as it does entirely after having done its work."

But further, Mr. Calvert might have gleaned from the pages of the *Mechanics' Magazine*, 1848, July 8, p. 43, a scrap of information that might have been useful to him, to the effect that letters patent were granted to me on November 11, 1847, for the manufacture of, amongst other things, this benzole or benzine. He might also have found the whole specification of my patent printed in the "Repertory of Patent Inventions," for July and August, 1848. I did not therein specify, contenting myself with indicating (as at vol. xii. page 29, of said "Repertory"), that particular use which Mr. Calvert claims, of this *factotum* oil or spirit. I abstained from specifying this and other applications of it, on the special advice of my patent agent that I should leave ground open for other persons to use my product; since the greater the number of free uses of it, the greater should be the demand for it. But to have "patented" all the uses of this wonderful substance, would have been to cover everything with my specification. Another person has recently taken out letters patent for another application of benzole,—the use of it in the manufacture of quinine. This was also pointed out by me in some of the passages to which I have above referred.

As Mr. Calvert has given to my property so very high a character, which, indeed, it truly deserves, I ought, perhaps, to feel somewhat obliged to him. I am glad, therefore, for his sake, that "letters patent" are cheaper now than such luxuries were in 1847. He will not have paid so much for his, I fear useless possession, as it might have cost him if he had been earlier in the field. I am sure he will be obliged to me for correcting the errors into which he has fallen.

I should, perhaps, also thank Mr. Calvert for informing me, as he does in the same paragraph from which I have above cited a sentence, that "nitrobenzine," or nitrobenzole, as I used to call it, is "every day becoming more and more employed as a substitute for essence of bitter almonds, and used for flavouring dishes and communicating scents to perfumery, soap, &c." This substance was also one of the subjects of my aforesaid, still valid, patent. Of course I am glad that some one benefits by my labour; but specifying an invention under letters patent used to be rather an expensive mode of communicating informa- to the public.

The old patent-law fell hard upon poor inventors; it swallowed their means, and left them no cash-tools to work their projects, or money-weapons to fight the pirates.

Excuse the length and subject of this letter, and accept my best thanks for your space. Egotism is dirty work, and I am sorry to sully my pen or your pages with it; but justice requires that mistakes should be corrected.

I am, sir,

Yours, &c.,

CHARLES BLACHFORD MANSFIELD.

Weybridge, Dec. 5, 1854.

## ADULTERATION OF FOOD—BREAD.

Sir,—The subject commented on by Mr. Reveley in his letter in the Journal a few weeks since (Adulteration of Food), is so important, that I think it should not be allowed to drop, the more particularly so as there are several points in that letter which are not so accurate as I could wish. That adulteration exists to a very large extent, not only in the various articles of our daily food, but in drugs, and a variety of other matters, has been proved by undoubted facts. It exists, I believe, to a far greater extent than the public generally have any notion of. But if we are to discuss the subject with any hope of ultimate benefit, the discussion must be entered upon with more carefully selected data than those which the letter dwells upon. We must have careful and impartial examination first, and not the idle tales with which some wag has been hoaxing Mr. Reveley, and which injure the cause he advocates. The adulteration of food, &c., is a question the investigation of which, in my opinion, might be usefully taken up by the Society of Arts, and I would respectfully suggest it for the consideration of the Council. It is a grave and important subject, and must be approached in no *dilettante* spirit; but if, after careful investigation, facts be well and clearly established, and the public made thoroughly aware of the impositions they are daily undergoing, and any practical scheme can be suggested for remedying the evil, the Society will have well earned the thanks of the community. I have said thus much to show that though I differ from Mr. Reveley in his data, I am no sceptic as to the evil, and that it may not be supposed that I enter into the question as a partisan adverse to the general objects of his letter. Mr. Reveley starts with the broad assertion that we are behind the rest of the world in the art of bread-making, and proceeds with the general sentiment that the farmer, the miller, and the baker, are, to use the words of the old song, "three thieving rogues together." Now, sweeping assertions of this kind carry no weight; they create a laugh, but engender no serious belief. If we are behindhand in practical bread-making, let us first have the fact shown, then in what direction our deficiencies lie, and after that we shall have some chance of arriving at improvement. That we may be behindhand in the art of bread-making, I am not prepared to deny; indeed, it is very possible that we may be so, but that it arises from the causes which Mr. Reveley states, no one who has taken the ordinary means of ensuring accurate inquiries will be inclined to believe.

It is, no doubt, the interest of the baker, as Mr. Reveley says, to purchase that flour which will make the greatest quantity of bread from a given weight, (with this proviso, which Mr. Reveley omits, that he does not pay a more than proportionately higher price for it.) To this, however, I do not understand that Mr. Reveley objects, provided that nothing beyond sound flour, water, and yeast, are used. But when it is stated that this can be done by using unsound flour, a flour made from heated or unsound corn, the fallacy is obvious to any one who has any practical knowledge or experience in the trade, or who will take the trouble to acquaint himself with facts. Go into any corn market, show your sample of heated or unsound corn to the first miller you meet, and he will soon give you a practical answer in £ s. d., which will be by no means satisfactory if you have been acting on Mr. Reveley's principle. The best flour is made from the best and soundest corn, and the best flour makes the most good bread; and it is alike the interest of the farmer and the miller to deal in the best and soundest corn. The farmer has, of course, from a variety of causes, (cultivation, soil, harvesting, season, storing, &c.,) necessarily, at times, inferior qualities for sale. The miller, too, cannot get all his wheat of the very best quality, and there is no doubt that he purchases a variety of different qualities, and his art consists in using them in such a manner as to produce the best sack of flour he can; but if the inferiority in quality arises from unsoundness, you may be quite sure that he will not use any more of it than he can help—it will not answer his purpose.

Here, let me remark, that inferiority of quality in wheat does not necessarily mean unsoundness. There is, from the causes I have mentioned, a vast variety of qualities in corn. One grain has, for instance, a thicker skin than another, and bushel for bushel produces less flour, but the flour produced may be equally sound and good with that from wheat more productive of flour. The miller, therefore, in purchasing a great variety of qualities, may get in the end an equally good flour, from his variety, though not so much in quantity as if he purchased what are termed the first qualities of corn.

Mr. Reveley is startled at ninety four-pound loaves being produced from a sack of flour, *i.e.*, three hundred and sixty pounds of bread from 280 lbs. of flour, and asserts that this apparently enormous amount of bread is "fraudulently" produced, because he affirms that a sack of flour will hardly produce 320 lbs. of bread, "if the bread be made at home." I can only say, that I use scarcely anything else besides home-made bread in my family. I have made the experiments repeatedly, with careful weighing, both before and after baking, and the result is, that from pure unadulterated Norfolk *seconds* I get from 370lbs. to 380lbs. of bread from 280lbs. of flour—good, well-baked, and wholesome bread, in which nothing whatever is to be found but pure water and yeast, with a little sprinkling of salt. How much more bread would be produced from a superior quality made from fine qualtities of corn, such as that grown on the strong lands of Essex, and other places in the London district, I cannot say; but I have said enough to show that ninety four-pound loaves may be produced from a sack of flour without fraud. I very much fear, that Mr. Reveley's sack of flour, producing only 320 lbs., has been from heated or unsound corn, or that his domestics are behind the rest of the world in the art of bread-making. That alum is used by some bakers is, I believe, an undoubted fact, and more particularly for the purpose of giving to bread made from inferior and damaged flour the appearance of the bread made from the best. It is said, too, that it helps to increase the quantity of bread made, but this, I believe, is doubtful. The quantity, however, is after all very small,—it is said not more than one ounce to the sack,—and I leave it to the doctor to say whether this can have any deleterious effect or not. But whether this be so or not the practice is not to be defended, if the object be to make that apparently of first-rate quality, which in reality is not so. I do not believe, on examination, it would be found in general use among the best bakers, and it would certainly not be required when the best flour was used. When flour is damaged it is generally the gluten which is partially destroyed, and it is difficult to make the bread "rise," as it is termed, without the addition of something. All these, however, are matters which an investigation, carefully conducted, would set right, and the public would then know what they had to guard against. As to anything like a general system of adulteration taking place at the mills, I am satisfied, looking at the character of the parties at the head of such establishments, and the mode in which they are conducted, that, if adulteration be made there, such cases are the exception, not the rule. Even if there were no higher motive than that of self-interest, the latter alone would be quite sufficient, except with a few short-sighted rogues (which there will always be in all trades), to prevent the practice. The story about millers using alum to stop the holes in their millstones, and that thus a quantity is regularly ground with the corn, has been well disposed of by your correspondent H. It is simply an idle tale. That the English millers construct their millstones in the manner described by Mr. Reveley, namely, building them up of brickbats and plaster of Paris, faced with small bits of French burrs, is a pure delusion. If any millwright palmed off such a stone upon the miller, the latter would be sadly wanting in sharpness not to detect the "adulteration." The French burr is found

to present a surface which, from its texture, is peculiarly adapted for grinding wheat. It is imported here in blocks or lumps, of various sizes, and the miller who understands his business will, if he cannot rely on the judgment of his millwright, carefully pick out the various burrs with which he will have his stone built. These are then carefully fitted and cemented together with plaster of Paris, bound round with iron hoops, forming a compact heavy mass, presenting a face the open texture of which is admirably adapted for the purpose intended. How much depends on the quality and texture of the burrs any miller will tell you. I fear the close hard surface of the stones Mr. Reveley refers to would be found not to answer the purpose. He will, however, be doing great service to the trade if he will point out by what means the millers of Italy make a four-foot stone manage to grind well twelve, eighteen, and twenty-four bushels of wheat per hour, with the same or a small increase only in power. I cannot help thinking there must be some error in this, as our millers here are very ready to adopt any improvements in their machinery which they can see are practically valuable. They are fully alive to all that is going on, and the machinery and contrivances in our principal corn mills of the present day, need fear no comparison with any employed in other branches of manufacture.* It is no more a censure, that machinery adapted for the grinding of wheat is incapable of grinding Indian corn, as Mr. Reveley would imply, than that it is incapable of grinding bark for the tanner, drugs for the druggist, or coprolites for manure. I am not prepared to say it is incapable of improvement—that would be absurd. The competition, however, in the trade is so great, that improvements are constantly sought and made, and if Mr. Reveley can show how these Italian methods can be made available for our English millers, he will not only benefit them, but, what is more, confer a vast advantage on the public at large.

I fear, however, I have digressed somewhat too much from my original text—adulteration. To sell an adulterated article, or one of inferior materials from that which it professes to be, appears to me to stand in the same category as that of short weights and measures. We have a machinery by which these are tested. Why cannot a machinery be devised by which the article sold can also be tested. It is plain that the consumer has neither the time nor the knowledge and ability, in the larger number of cases, to make the test for himself. He cannot test the alum in his bread, the chicory in his coffee, the sulphuric acid in his vinegar, &c. I can see no valid reason why visitors of competent abilities should not be duly organized to step into any man's shop, test the articles exposed for sale, report and punish, in like manner as is now done with respect to false weights and measures, all persons selling adulterated goods. Such a system has long been in existence in France, and, I am told, works well and without inconvenience. I shall be told, no doubt, that such a system will do very well in France, and that the genius of the people there is suited for such a system, but that it is wholly contrary to the spirit of the English, and that liberty of which we are ever making so much boast. I am, however, very much inclined to think that that liberty of the subject of which we are ever talking is a sad impediment to the progress of many a social improvement. I believe it to be the duty of society to do that for the individuals composing it, which they cannot undertake themselves. In order to do this, we must, no doubt, surrender to some extent, our individual liberty of action. The extent to which we surrender it should be proportionate to the benefit received in return. So long as this is the case no harm can result. The question to be considered in every instance is, can society by any arrangements carry out effectually the object it seeks, and is not the individual powerless without its aid, and on which side does the balance of benefit or inconvenience preponderate.

I am inclined to believe that careful investigation of this question of adulteration will show evils of a more serious kind than are generally known, and with which the individual is incapable of dealing, but which society can with advantage undertake to counteract.

In concluding, I beg to say, as an apology for my long letter, that although I am neither a farmer, a miller, nor a baker, yet I have had some opportunities of becoming acquainted with their respective trades.

I am, sir, your obedient servant.

NEMO.

* As an example of this, I would point to the very long and important trial which took place last week, Bovill *v.* Rands, in which the claim to an invention of certain improvements in grinding corn, by means of forcing a current of air between the stones, was contested. In this action the merits of six different patents for the purpose were discussed.

## Proceedings of Institutions.

Stockton-on-Tees.—A lecture was delivered in the Assembly-room, Town-hall, in connection with the Mechanics' Institution, on Monday evening, by Mr. S. Phillips, lecturer to the Yorkshire Union of Mechanics' Institutes. "On the Poetry of the Pope Era, from Pope to Burns and Cowper." The lecture comprised a brief sketch of the poets who flourished from the time of Queen Anne to those of George the Third, including Pope, Gay, Thompson, Gray, Collison, Cowper, Burns, &c. Mr. Phillips appears to be thoroughly conversant with the excellencies and defects of that particular epoch, and, moreover, to possess a very independent mind. The attendance was very small, and there was an entire absence of the officials of the society.

Wellingborough.—Mr. H. Vincent delivered two lectures on "The Turkish War, and the duties imposed by this age upon the people of Great Britain," in the Town Hall, to the members of the Society and others. Mr. Vincent is not the mob orator he once was, or was supposed to be, but gave his lectures with a moderation of tone pleasing to all political parties in the town. As an orator, he almost stands unequalled amongst perambulating lecturers, and Societies engaging him, upon his own terms, would not be disappointed.

Wrexham.—A lecture was delivered on the 15th instant, by T. Edgworth, Esq. the treasurer of the Literary and Scientific Institution, "On the Education of the Eye." The lecturer strongly urged the value and importance of acquiring a knowledge of the art of drawing. He adverted to a lecture he had delivered to the Institution twelve or fourteen years ago, on the same subject, and contrasted the means now afforded to young persons to improve and instruct themselves with those existing at the period of his former lecture.

## MEETINGS FOR THE ENSUING WEEK.

Mon. Entomological, 8.
Tues. Pathological, 8.
Wed. Geological, 8. 1. Mr J. W. Dawson, "On a Submerged Forest at Fort Lawrence, Nova Scotia." 2. Professor Owen, "On some new Small Reptilian Remains from Purbeck." 3. Professor Owen, "On a large Fossil Cuttlefish from the Kimmeridge Clay" 4. Mr. W. J. Hamilton, "On the Tertiaries of Cassel and its Vicinity."
Pharmaceutical, 8½.
Thurs. Zoological, 3.
Photographic, 8.
Fri. Botanical, 8.
Sat. Medical, 8.

## PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS,

*Delivered on 21st Dec.*, 1854.

Turnpike Trusts (England and Wales)—General Report.

*Session* 1854.

Par. No.
425. Church Rates (London)—Return.
453. Shipwrecks by Lightning—Papers.

*Delivered on 22nd December*, 1854.

7. Tenement Valuation (Ireland)—Return.
3. Bills—Judgments Execution, &c.
7. Bills—Episcopal and Capitular Estates.
8. Bills—Spirits (Ireland).
Railways (Number of Passengers)—Return.
471. Income Tax (Ireland)—Return.

*Delivered on 23rd December*, 1854.

9. Bills—Public Libraries and Museums.
10. Bills—Common Law Procedure Act Amendment (Ireland).

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Dec. 22nd*, 1854.]

*Dated 9th November*, 1854.

2377. J. Porro, 4, South-street, Finsbury—Reflection of light.

*Dated 21st November*, 1854.

2455. N. Callan, Maynooth-college—Galvanic batteries.

*Dated 23rd November*, 1854.

2473. C. Crickmay, Lozells, Handsworth—Repeating fire-arms.

*Dated 25th November*, 1854.

2491. R. Roberts, Manchester—Preparing cotton to be spun.

*Dated 4th December*, 1854.

2547. W. Thomson, W. J. M. Rankine, and J. Thomson, Glasgow—Electrical conductors.
2549. F. W. Russell, 19, Westbourne-street, Hyde-park-gardens—Looms.
2551. J. Porritt, Stubbin-vale-mill, near Ramsbottom—Carding machines.

*Dated 5th December*, 1854.

2553. T. Cooper, Isle of Wight—Pipes.
2555. C. F. Varley, 1, Charles-street, Somers-town—Dynamic electricity.
2557. G. F. Wilson, and J. C. Craddock, Belmont, Vauxhall—Candles and night lights.

*Dated 6th December*, 1854.

2559. J. Warhurst, Hollingworth—Furnaces.
2561. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Coating and colouring metals and alloys of metals. (A communication.)
2563. J. W. Mackie, Edinburgh—Food.
2565. J. Anderson, Dumbarton—Angle and bar iron for ship-building.

*Dated 7th December*, 1854.

2567. C. Hodgson and J. W. Stead, Salford—Washing machinery.
2569. G. H. Eden, Birmingham—Sharpening razors.
2571. J. E. Mc Connell, Wolverton—Steam-engines.
2573. J. C. Browne, Weston-super-Mare—Wrapper.
2575. N. B. Carney, New York—Circular power loom.
2577. T. Metcalfe, High-street, Camden-town—Bath chair.

*Dated 8th December*, 1854.

2578. E. P. Castelot, Lierre—Decolorizing juices of beetroot, sugar-cane, and raw sugar.
2579. G. Aubury, Queen-street, Edgeware-road, and W. R. Bridges, Gravel-lane—Portable gas apparatus.
2580. F. Jolly, Turton—Mangling machinery for piece goods.
2581. J. E. Mc Connell, Wolverton—Ordnance.
2582. W. Hawthorn, Newcastle-upon-Tyne—Safety valves.
2583. T. Brown, and P. Mac Gregor, Manchester—Machinery for piled fabrics.
2584. E. Acres, Pouldren-mills, Waterford—Drying grain.

*Dated 9th December*, 1854.

2585. J. Thom, Birk-acre, near Chorley—Singeing fabrics.
2586. T. C. Hinde, Birmingham—Ordnance.
2587. J. Cortland, 70, Wellesley-street, Stepney-east—Safety of life at sea or in rivers.
2588. J. Higgins and T. S. Whitworth, Salford—Bayonets.
2589. G. Hale, Tavistock-street, Covent-garden—Motive power.
2590. G. A. Buchholz, Hammersmith—Threshing machinery.
2591. Lieut. R. J. Morrison, R.N., Old Brompton—Propelling ships.
2592. R. Button, Hackney—Locks and keys.
2593. E. Maniere, Bedford-row—Lamps. (A communication.)
2594. N. Johnston, Bordeaux—Buildings for leeches. (A communication.)
2595. J. A. Nicholson, 10, Chapel place, Bermondsey—Table forks.
2596. G. Taylor, Liverpool—Steam-engine governors. (A communication.)
2597. W. Davis, Old Kent-road—Furnaces.
2598. J. I. King and T. Brindley, 2, Leonard-square, Finsbury—Cigar and card cases.

*Dated 11th December*, 1854.

2599. F. Jacquot, Bruxelles—Lining of hats, &c.
2600. W. James, Crosby-hall-chambers—Spikes, bolts, &c.
2601. C. T. Guthrie, New Bond street—T and set squares, &c.
2602. W. J. Harvey, Exeter—Revolving fire-arms.
2603. N. E. Stevens, Tunbridge-wells—Joining blocks of stone.
2604. W. G. Craig, Gorton—Railway axle boxes.
2605. J. Dodds, Sheffield—Slide valves.
2606. E. T. Bellhouse and R. Thomas, Manchester—Cranes.
2607. W. Bemrose, jun., and H. H. Bemrose, Derby—Perforating paper.
2608. F. Puls, Whitechapel-road—Electro-galvanic apparatus.
2609. A. V. Newton, 66, Chancery-lane—Conducting wire for electric telegraphs. (A communication.)
2610. C. H. R. Ebert, and L. J. Levisohn, Old-street, St. Luke's—Rendering cases extensible.

*Dated 12th December*, 1854.

2612. G. H. Bachhoffner, Upper Montague-street—Fire-places for consumption of smoke.
2613. T. White, Landport—Portable houses.
2614. W. Chippindale, and L. R. Sedgwick, Bedale—Steam boilers.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2617. J. Nesmith, Lowell, Massachusetts—Manufacture of wire netting and wire fence by power. 13th Dec., 1854.
2634. W. C. Day, Strand—Portable camp bedstead and bedding. 14th Dec., 1854.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed 22nd December*, 1854.

1419. Peter Armand le Comte de Fontaine Moreau, 4, South-street Finsbury—Improvements in apparatus for producing aerated waters.
1421. James Brunlees, Manchester—Improvements in draw-bridges, applicable to rail and other roadways.
1422. Henry Sutherland Edwards, Cranbourne-street—Improvements in preparing textile fabrics or materials for the purpose of their better retaining colours applied to them.
1429. Thomas Markland, Hyde—Improvements in machinery or apparatus for warping, dressing, and weaving textile materials.
1435. Louisa Monzani, Greyhound-place, Old Kent-road—Improvements in the manufacture of folding chairs, stools, and other articles to sit or recline upon.
1442. Joseph Hulme, Manchester—Improvements in steam-engines and in valves, parts of which improvements are applicable for diminishing friction in other engines.
1443. Thomas Richards Harding, Leeds—Improvements in the manufacture of the pins of hackles, combs, and cylinders used in hackling, combing, and preparing wool, flax, and other fibrous substances, and in the mode of applying them to manufacturing purposes.
1466. George Daniel Bishopp, Inverness-terrace—Improvements in the construction and arrangement of engines to be driven by steam, air, gases, or water.
1475. Thomas Restell, Strand—Apparatus or holder for holding parcels of gloves, and other goods and papers.
1493. William Lacey, The Lozells-lane, Birmingham—Improved method of making copper rollers, cylinders, and tubes.
1525. Luke Cooke, Sowerby-bridge—Improvements in machinery or apparatus for preparing cotton, wool, or other fibrous substances to be spun.
1571. John Livesey, New Lenton—Improvements in lace machinery, and in fabrics manufactured by such machinery.
1603. John Thomas Moss, Arundel-street, Strand—Improvements applicable to apparatus for roasting meat and other edible substances.
1709. Louis Player Miles, Ravensbourne-park, Lewisham—Improvements in the construction of locks.
1748. John Livesey, New Lenton—Improvements in the manufacture of fringes.
2064. William Palmer Surgey, Hackney—Improvements in cigars, cigarettes, and cheroots.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| Date of Registration. | No. in the Register. | Title. | Proprietors' Names. | Address |
|---|---|---|---|---|
| Dec. 23. | 3672 | Steerage Horse Hoe ......................... | John Revell ...................... | Wellington Foundry, Newark. |

Journal of the Society of Arts.

*FRIDAY, JANUARY* 5, 1854.

## THE SMOKE NUISANCE.

During the week commencing January the 15th, and ending January 20th, there will be exhibited in the Society's rooms a collection of models, drawings, and diagrams of apparatus or inventions for suppressing the smoke nuisance. It is hoped that the collection will fairly represent the means by which this desirable end has been or may be attained. In each case a brief description of the invention, method, or plan, as well as of a list of the names of any places where it has been put in operation, has been asked for. Those who are intending to contribute to the collection should bear in mind that the models, drawings, descriptions, &c., should be sent in on or before Tuesday, the 9th of January.

On the evening of Wednesday, the 17th of January, Mr. George Muir, of Glasgow, will read a paper before the Society, "On the Smoke Nuisance; considered Morally, Historically, Scientifically, and Practically," when Mr. W. Fairbairn, F.R.S., will preside.

## FLAX, AND ITS PRODUCTS, IN IRELAND.

Contributed by Wm. Charley, Seymour-Hill, Belfast.

LETTER X.

Before proceeding to discuss the details of flax cultivation in the field, I think it judicious again to refer to the question of *profits*. I wish, in addition to my own experience, and some of my neighbours, to give the testimony of other respectable parties residing in different counties of Ulster, I am anxious to do this because my object is to furnish *bona fide* statements, without either depression or exaggeration.

My calculation is that on my own farm, the cost of an acre of flax is £9 15s. 10d. This sum may be classified thus:—

| | £ | s. | d. |
|---|---|---|---|
| For Horse-work . . . . . | 2 | 9 | 5 |
| ,, Manual do. . . . . . | 2 | 7 | 3 |
| ,, Seed . . . . . . . | 1 | 5 | 0 |
| ,, Scutching fibre . . . . | 1 | 14 | 2 |
| ,, Rent and taxes . . . . | 2 | 0 | 0 |
| Total . . . | £9 | 15 | 10 |

The minute particulars of these were given in my last letter.

This cost will be reduced a little on a larger quantity of flax, as the horse and manual work on such a small field or lot of any crop exceeds in proportion the cost of 5 or 10 acres. We may, therefore, estimate the average cost from £9 to £9 15s. 0d. per statute acre. For the past three years, the average of my produce per acre in fibre, is 29½ to 30 stones, worth about 8s. a stone, and, in addition to this, the flax-bolls are worth from £1 to £3. The difficulty regarding taking off the flax-bolls in the field is this: if rippled off closely, the teeth of the instrument split and injure the tops of the fibres, and the buyers not only object to this, but deduct considerably from the price they offer in consequence. It is, therefore, a matter of calculation, whether it be wiser to take off 30 bushels, worth £1, leaving the *fibre uninjured*, or to take off the entire, say 90 bushels, worth £3, and accept a lower price for the fibre. For a crop of strong, coarse flax I would adopt the latter system, and where a fine and valuable fibre was expected, the former—for in this case the high price likely to be obtained for the fibre, if well-turned out of hand, would more than compensate for the loss of part of the seed.

My statement, already published, shows a profit of £3 0s. 2d.; this I consider only an *ordinary* result, which has been frequently exceeded in good seasons. A middling soil and an unfavourable year have, however, occasionally left me no profit at all, but every crop, as well as flax, is subject to those variations. I now wish to form an average of profit from the three estimates given in my last; 20s. an acre, however, must first be added to Mr. Coates' statement, the rent of his ground close to Belfast being charged much above an *agricultural* rent; in fact a portion of this farm is now let at a very high rate, for building villas on.

The computation of profits will then stand as follows:

| | £ | s. | d. | |
|---|---|---|---|---|
| Mr. Charley . . . | 3 | 0 | 2 | per acre. |
| Mr. Hunter . . . | 5 | 6 | 7 | do. |
| Mr. Coates . . . | 4 | 1 | 8 | do. |
| Divide by 3 . | 12 | 8 | 5 | |
| Average . | £4 | 2 | 9 | per acre |

Now I have recently had an opportunity of seeing, at the office of the Royal Flax Improvement Society, a statement furnished by the secretaries of several farming associations in Ulster on the subject of average flax crops in their respective districts; also a calculation of the profits realised by a large number of farmers about Newry, prepared by an extensive purchaser of fibre in that neighbourhood. These authorities estimate the average profit at £7 the Irish acre, equal to £4 6s. the English or statute acre. The average of my three statements being £4 2s. 9d. is a proof that my calculations are pretty correct, though limited in extent to the crops in the valley of the Lagan. The profit on flax is a fairer way to estimate the crop than by yield in weight or bulk, because a small crop of very fine flax may be as remunerative to the farmer as a large quantity of coarse, low-priced fibre. The average yield in Ulster is, I believe, from 30 to 35 stones of 16lbs. each—the average of my three statements, I find, is 31⅓, again agreeing very closely.

Besides these explanations regarding *ordinary* and *average* crops, it may be interesting to give an account of some *extraordinary* crops, showing a result so satisfactory and astonishing, that, were it possible to gain so high an average, I think every agriculturist in Great Britain and Ireland would plunge at once into the mysteries of flax cultivation.

Mr. William Blakeley, a tenant of the Dean of Dromore, in the townland of Corcelany, near Waringstown, co. Down, grew, some years ago, three statute acres of flax. The produce of the field was purchased for 15s. a stone by Messrs. McMurray and Henning, of Waringstown, the eminent cambric manufacturers, who stated it was equal, if not superior, to any flax they ever saw before, and that they had given 36s. a stone for foreign flax of inferior quality. The entire produce of the three acres was fully 100 stones, which, at 15s, would be £75, or, per acre, £25, leaving a profit, therefore, of from £15 to £16 per statute acre!

John Birney, Esq., of Lisburn, co. Antrim, in a speech made in 1852, stated that he knew a small field belonging to Mr. Lucas Waring, of Lisburn, consisting of three roods, English measure, which grew potatoes one year, corn the next, and flax in 1852. The value of this flax amounted to £14, equal to nearly £19 per statute acre, which, deducting expenses, would leave between £9 and £10 clear profit per acre.

My neighbour, Mr. James Hunter, has this year a very large yield of flax off rather an unpromising soil. He reckons the produce of 6¼ acres in fibre to be 280 stones,* worth 9s. a stone, besides some bolls saved for feeding, worth £1 an acre. These together would give for the

* The stone of flax is 16lbs., or 7 in the cwt. of 112 lbs.

entire value of the crop, £132 10s., or £20 7s. per acre, and deducting expenses, the profit would be from £10 to £11 per acre.

On my own farm the highest profit I have made by flax during the last ten years was between £5 and £6 per acre, but I look forward with hope to be fortunate enough some favourable year, to obtain an extraordinary crop, and to realise a very large profit, like the parties whose pleasing successes I have just described.

Let us now return to the consideration of the soil, the quality of which, as was stated in my last letter, should be a nice loam, or medium weight, with a strong subsoil. With great care, however, a fair crop may be had on other soils not so well adapted for the purpose. The treatment of the soil should depend on its quality; the object to be attained is the production of a *fine, deep, dry, and clean bed* for the flax seed. Any skilful agriculturist would know the best means of gaining these points, but to repeat the plans generally adopted in this country may be of some service. These may be classified for the three kinds of soil; light, medium, and heavy. With respect to the first, namely, light soils, it is considered best to plough the wheat stubble in February, or early in March, so as to get a little of the frost. In April it should be well harrowed and picked clean of any weeds, then sown with flax seed at the rate of a Riga barrel, or three-and-a-half bushels, the Irish acre, that is, fully two bushels per English or statute acre, indeed, two-and-a-half are often used. The ground should be made as even and flat as possible, to ensure uniformity of length in the stems of the plant when at maturity. After the seed is sown, which should be done up and down the rig, not across, a fine seed harrow and a light roller should be passed over the field, to cover the seed and finish the plot; the seed should be about one inch below the surface of the ground. It is considered advisable to sow rather a *full* quantity, except when intended to sow the seed for reproduction; the greater the number of stems, of course the yield of fibre will be increased in proportion. When put in sparingly the seeds produce stronger plants, having great branching tops, loaded with bolls (or seed capsules), but the quality of the fibre is generally deteriorated and always coarser. Depth of tillage in flax cultivation is of more importance than many people imagine. In sustaining so tall a stem, and providing the different peculiar ingredients from the soil so necessary for its well-being and growth, the roots have a laborious office to perform, and they penetrate very deeply, if allowed, in search of the required nourishment; if checked, the prosperity of the plant will be much impaired. Undrained land is quite unsuited to flax, and so are coarse, poor soils. Depth and fineness of quality, freedom from weeds or poverty, dryness and evenness of surface, are the true characteristics of a good flax-producing soil; when any of these are wanting, the whole affair is a speculation of an indifferent kind.

As to soils of a medium class, the same treatment will do on good well-situated fields as I have just described for lighter ones, but if not very well conditioned, it will be judicious to plough the wheat stubble in autumn rather deeply. Should the land be at all damp, or subject to annoyance from surface water, a common case on the heavier kinds of clayey loam, the ridges should be made *high* in the *centre*, and the furrows dug and shovelled up, to carry off the water freely, thus preventing "sourness" from excessive moisture during the winter months;—in the spring cross-ploughing and plenty of harrowing to level and make the soil friable and free from lumps; the rest of the treatment will be the same as that already given for light soils.

The heavy soils are now to be considered. Those moderately so will do very well with the two ploughings, &c., recommended for the heavier kinds of medium loamy soils. In very stiff or clay soils, a second additional ploughing in spring is desirable, but as a general rule, a wise farmer will avoid trying flax on such soils, the chances of success not being in his favour. When the experiment is to be made, however, the subsequent treatment will resemble that given for the heavy medium soils, more frequent harrowings and rolling will likely be required to subdue the clods and bring the ground to the required smoothness and delicacy.

With respect to SEED, the very best and purest should always be procured; it is false economy and miserable management, to run any risk by purchasing *job lots* of seed, and, for the sake of a *present* saving of a *few shillings*, to endanger the eventual loss of as *many pounds*. In some of my previous letters on "The History of Flax and its Products in Ireland," I have shown the prevalence of roguery among flax-seed dealers in former years; it strikes me, however, though the farmers are much to be pitied when deceived in this way, not only for the sake of their own pockets, but from the "heavy blow and great discouragement" given to flax cultivation by the use of bad seed followed by bad crops, they themselves are not free from blame; the excessive hankering after *lowness of price* they too often exhibit creates a class of salesmen to satisfy that demand; the article is produced at low enough rates, but as to good quality, of course, that could not be given; and the poor farmer blames his field, or the season, for a failure that most likely was caused by his own "hard bargain." This remark applies particularly to the class of small farmers, with very limited means. It is not meant to include those clever, clear-headed agriculturists, with good-sized farms and proper capital, joined with a fair amount of education, so many of whom, happily for this country, are now occupying the land, and making "two blades of corn grow where one grew before." Such men are too "wide awake" to fall into this error—they see in the papers the ruling prices for good seed, and they know the importers they can depend on for a genuine supply.

After the flax has been placed carefully in the earth, as directed, it must be attended and watched, to prevent the weeds gaining the mastery, and injuring the crop. In clean, well-conditioned land, few weeds will appear, but all such incumbrances must be removed when the plant is about five or six inches high—if taken too soon a second operation may be required, and if too late the plants will be injured by the weeders, and will not recover their correct position. The weeders should have a cloth or straw mat under their knees, and press always the stems *one way*; if twisted, the plants cannot rise again, and will be lost in consequence.

It is desirable as much as possible, to make the weeders work with their faces *towards the wind*, so that when they pass on, the plant may have the assistance of the breeze in regaining its upright position.

We will now imagine the crop in full growth, rapidly approaching maturity; the field in the distance appears a mass of soft and elegant green, undulating in long waves under the pressure of the passing gale, approach nearer and see every gentle stem in that dense mass crowned with bright blue flowers, of most delicate texture; small, but beautifully formed in every part, and very, very pleasing to the eye. At this stage there is no crop the agriculturist produces that can equal flax for attractive and ornamental aspect; in a few weeks, however, the field becomes changed, and instead of the handsome flowers, rough-cased globules, full of seed, appear.—In this mature condition let us leave the plant for the present.

## Home Correspondence.

### ADULTERATION OF WARES.

SIR,—The inspection of wares by public officers, which "Nemo" wishes to provide, might easily be effected by putting into force the powers of the City companies,—one special object of their incorporation being to create ma-

chinery for suppressing the manufacture and sale of deceitful wares. The perversion of their purposes to the gratification of individuals who are quite unconnected with the trades they affect to govern need be no reason for the gradual decay of these incorporated bodies, when such really healthful duties are required at their hands. The extract below from the statute 3, Henry VIII., cap. 14, similar to the general powers confided to other companies, explains what I have said:—"The Lord Mayor of London, and the masters and wardens of the tallow-chandlers' company have power to search all oils brought to London to be sold, and to oversee that the same be not mixed or altered by oilmen from their right kinds, and what they shall find mixed deceitfully they are to cart away; and punish the offenders by imprisonment or otherwise, at their discretion, according to the laws and customs of the city."

X.

## THE F.S.A. QUESTION.

Sir,—I see, from the "Athenæum," that the Council of the Society of Antiquaries have determined to endeavour to stop the practice of persons using the initials of fellowship with that society without the necessary qualification of being fellows.

I think it a very necessary determination on their part, being aware of several persons using those initials without possessing the requisite qualification, and of several members of the Society of Arts being dubbed "F.S.A." by well-meaning persons, of a flattering disposition, but who, very likely, know no better than that "F.S.A." means *Fellow* of the Society of Arts. If you refer to the list of subscribers to the "Newton Testimonial" you will find many members of the Society of Arts with the appendage "F.S.A." to their names, placed there not by members of the Society of Arts, but by the promoters of that testimonial.

But why members of the Society of Arts should not have an equal standing with those of the Antiquaries, or any other Society, except the Royal, is a matter of surprise to me. The Antiquarian is not by any means to be compared with it in usefulness and numbers, as well as of the eminence of its members in other respects; neither does any other Society surpass it in the power and the will, and the results of its labours, nor has any Society more influence on any important movement.

On these grounds I think the Society of Arts should confer honour on any person who may be elected a member, and, indeed, I think it does so; but, if Fellows of inferior Societies can stickle upon the assumption of initial letters, I do not see that that honour, if any, should be confined to them; but that those of the Society of Arts should also look to their position, and assume "F.A.S." I think they ought to have a position as high as any other society's members, and that they are certainly entitled to "F.S.A.," or "F.A.S." The latter seems more reasonable than the former for the Society of Antiquarians, and the former for the Society of Arts.

As a member I shall be very glad if you insert this in the Journal, so that others may consider the subject, and give expression to their views.

I am, sir, yours very truly,

W. H.

Blackburn, Jan. 1, 1855.

## INDUSTRIAL PATHOLOGY.

### The Flax Dressers' Trade.

Sir,—My attention has been specially directed to an article in No. 48 of *Chambers's Edinburgh Journal*, of 2nd December, entitled "Industrial Pathology," in which I was much gratified to find that the pernicious effects resulting to health from the prosecution of certain trades and professions, had in many instances been counteracted by the adoption of very simple means; it also stated that the body to which you belong, had, with praiseworthy zeal, taken a warm interest in the matter, and was anxious to correspond with working men whose trades or professions were injurious to health, with a view, if possible, to devise some means for removing the cause. I have therefore taken the liberty to address you, sir, as an individual belonging to a class of hardworking men, whose occupation exercises, in many cases, a most baneful influence on their health, and I am afraid on their morals, so much so, that a man when he ought to be at his best, if left to his own exertions, either meets a premature grave, or sinks into the unenviable condition of a pauper. The trade I allude to is Flax dressing; for although hand-labour is in a great measure superseded by machinery, still there are many persons, both here and elsewhere, obtaining a livelihood by it, and will likely continue to do so unless some further improvements take place in the machinery intended to supersede us. With your permission, sir, I will now proceed to give you a short detail of the disadvantages and consequent injury to health we have to contend with in the prosecution of our calling. And, sir, the great evil is dust, or what we call in Scotland, "stour." There are some minor ones, but that is the one great evil, and if we could get rid of that, the trade would be comparatively healthy. The labour we perform is severe; and surrounded by an atmosphere of dense decayed vegetable matter, coming from the flax in the process of dressing, in the shape of dust, which, entering our lungs, produces the distressing results I have described, which results have been mourned over when too late since ever I remember, but no remedy, so far as I know, has ever been sought; in fact it has just been looked upon as a thing that could not be helped. Now, sir, if fortunately you are the means of ameliorating our condition by the discovery of a remedy, you will receive the heartfelt blessings of a class of hard-working men, and you will have the satisfaction of knowing that you have materially advanced the happiness and comfort of a considerable portion of your fellow-creatures; and trusting to hear from you soon, I am,

Yours, &c.,

JOHN SMART.

Dundee, December 26th, 1854.

## MR. P. L. SIMMONDS ON THE BRITISH COLONIAL CONTRIBUTIONS TO THE PARIS INDUSTRIAL EXHIBITION.

Sir,—The Society of Arts having been mainly instrumental in originating and bringing to a successful issue that important Industrial Exhibition of 1851, which has been attended with such beneficial results to the commerce of our country and her foreign possessions, it will, I am sure, be interesting to its members to know what steps are taking to represent the productions and manufactures of our Colonies at the Paris Exhibition to be held in the spring of 1855. As the pebble cast in the water throws out widely-extended concentric circles, so the example set by Great Britain of collecting from all parts various products of industry for examination and reward, has been extensively followed, and every country seems to be imitating the laudable example. To mention but a few, I may instance Dublin, New York, Montreal, Quebec, Toronto, Halifax, Nova Scotia, St. John, New Brunswick, Antigua, Chili, Venezuela, Batavia, and a variety of other places whose exhibitions of produce and manufactures have been held with more or less success, and have certainly contributed to stimulate industry and invention, and to draw forth from obscurity many hitherto unregarded products and materials.

I proceed to summarize, for general information, from my private advices and the Colonial journals, what has already been done, what exertions are making to represent British Colonial industry and the produce of our dependencies in different quarters.

Canada is striving to maintain at Paris that honourable position she acquired for her varied and well-arranged collection of produce and manufactures shown in Hyde-

park. An executive and numerous local committees have been formed, to whom is deputed the task of selecting and arranging the contributions, and rewarding the most deserving exhibitors. Attention is prominently directed to the honorable mention which was made of the Canadian collection by M. Dufresnoy, in the Report of the Jurors, Class I., by Dr. Hooker in the Jurors' Report, Class III., &c. A detailed list of the rewarded exhibitors at London and New York, and in the local Shows, is published, occupying very many columns of the provincial journals, and attention is specially pointed to the class of products requiring illustration, and for which Canada might expect to stand most prominent.

In JAMAICA the Governor has resuscitated the Society of Arts, established at Kingston in 1852 by Sir C. E. Grey, and announced to the members the desire of the government that articles illustrative of the resources of Jamaica should be sent in before the 1st of March for transmission to Paris. Special committees were appointed to collect specimens exemplifying the following branches:

1st.—On the Cultivation, Produce, and Preparation of the Principal Articles of Export from the Island.

2nd.—Timber Trees and Ornamental Woods.

3rd.—Irrigation and Hydraulic Engineering, Aqueducts, Reservoirs, &c.

4th.—The Minerals of Jamaica, and the latest Improvements in Metallurgy.

5th.—The Medicinal Waters, Plants, Gums, Oils, and other Medicinal Productions of Jamaica.

6th. The Manufactures, Handicrafts, and Trades of the inhabitants.

7th.—The Vegetable Productions of the Island, which, not having hitherto been Articles of Export, or of Internal Trade, are supposed to be fitted to become so.

8th.—The Breeding and Rearing of Stock (Large and Small).

His Excellency in his opening speech to the Legislature, thus alluded to commercial products:—

"Much attention has lately been turned at home,—in consequence of the scarcity of the ordinary materials for paper-making, and the anticipated effects of the war with Russia, on the supply of hemp and flax to the fibrous products of the tropics.

"The plantain from the original type of which the Manilla hemp of commerce has long been manufactured —is regarded as peculiarly adapted for each of the objects in view; and as it is grown in our gardens for the sake of its nutritious fruit, this novel use for its now refuse stem promises to be of much importance. Again, various species of the aloe and the pine apple tribes producing fibres admirably suited for textile purposes, are found wild all over the island, and no doubt among the luxuriant vegetation of our plains and mountains, there are plants of other families equally capable of such application.

"Patents for the manufacture of paper and the preparation of fibre have been taken out in Great Britain, and I have every reason to expect that one or more Companies will shortly commence operations among us on an extensive scale.

"It is however to the possible effects of such a movement upon the industry of the innumerable small freeholders scattered throughout the country, often at too great a distance from the remaining sugar or coffee plantations to work for wages,—that I attach the greatest importance; for, if by the aid of a simple hand-machine, already invented, they could prepare hanks of fibre for market from their plantain trees, or set their children, in default of other employment, to extract it from the leaves of the penguin which fences in their grounds, it would prove one of the greatest blessings that could be vouchsafed to this island.

"Our local Society of Arts has not been idle on the point, as it is preparing to avail itself of the opportunity for displaying the varied resources of Jamaica presented by the forthcoming universal Exhibition at Paris.—As this colony has been specially invited to contribute to that exhibition, as you will learn from a Circular Despatch from the Secretary of State to be laid before you, I trust you will be disposed to support so praiseworthy an effort."

Among other contributions to be transmitted, I may refer to a collection of 51 specimens of prepared fibres sent by Mr. Wilson, the curator of the Bath gardens, for exhibition at Paris in 1855. These beautiful fibres were to be exhibited for a limited period at the rooms of the Chamber of Commerce, in Kingston. Many other samples are produced, as also samples of paper made in England from short fibres forwarded from the island.

Mr. E. C. Lewis exhibited specimens of stone found in the parish of St. George, fully equal to the finest stone used in lithography, and for hones; and the Society had authorised him to procure a large slab to be forwarded to the Paris Exhibition.

Mr. Henry Kemble exhibited a sample of oil extracted from the seeds of the marenga, and made an interesting statement in connection therewith. He was requested to prepare a communication to be published in the Transactions of the Society.

The Hon. Mr. Chitty produced a sample of citric acid prepared by Mr. Charles Grant, chemist, of Kingston.

A sample of Texas millet, grown by the Rev. Thomas Wharton, of Bath, was produced by the Secretary, having been forwarded by him for distribution. A paper was read by Mr. Richard Hill, explanatory of the cultivation and produce of this remarkable grain. It is amazingly prolific, and seems well adapted as a mountain corn. Mr. Hill's communication was directed to be published in the transactions of the Society.

I could extend this list over a large portion of your columns, but may notice seven specimens of the hard woods of the island, collected by Mr. Berry from the north side, and which have been planed on one side, and polished. These woods will form a conspicuous portion of the contributions to be sent from this island to the Paris Exhibition. When the collection is complete, it will extend to forty specimens.

Reports from some committees were read, detailing their transactions; and it is now beyond doubt that the Society will send to the Paris Exhibition such a collection of the products of the country as will present no mean appearance; and it is hoped that many articles of commercial importance will thus be brought prominently into notice.

With respect to island manufactures they are few in number, at least of such as would interest or excite the novelty of the Parisians, but from my own local experience of several years residence in Jamaica, I know that a most valuable collection of various woods, of the ordinary staples of commerce, and of the minor products of the soil, might be sent. Jamaica was disgracefully represented in 1851 at Hyde-park, and should make an effort to collect a fair display from her abundance of drugs, gums, oils, fibres, fruits, spices, and other vegetable productions.

There exists in the West Indies a large amount of undeveloped resources besides those to which I recently directed attention in the paper read before the Society of Arts, which would afford remunerative occupation to the industrious poor, resulting in the production of superior articles, not only of a more durable description, but at a lower price than is at present charged on imported articles. Of this fact, well-informed parties in Antigua, Grenada, St. Kitts, St. Vincent, and other islands, have recently become aware. Amongst the articles most in demand, and which would at all times meet with a ready sale, the following may be enumerated:—Cabinet work of all kinds; Tortoise shell work; Rope, Cordage, and all kinds of prepared fibrous substances; Pottery of every description; Leather, dried and salted hides; Saddlery and harness; Boots and shoes; Baskets and wicker work; Plain and ornamental needlework; Hats of Panama and other kinds of straw, and plaited straw; Door, Table, and other mats; Bird Cages; Engineering and working models; Machinery; Brass, Copper, and Tin work; White-

smiths' and Blacksmiths' work; Textile fabrics; Paintings and drawings; Carpenters' and Wheelwrights' and Coopers' work, and all kinds of mechanical work and inventions; Tobacco, Cigars, and Snuff; Stuffed and preserved animals, birds, insects, and fish; Staple products, including sugar, rum, unfermenting molasses, arrowroot, tous-les-mois, potato flour, manioc farina and tapioca, cassareep, ginger, cayenne pepper, curry powder, pickles, all kinds of native succades, cotton, fruits and vegetables of every kind, dried fish, preserved shell fish, honey and bleached wax, oils, animal and vegetable, temper lime, native artificial manures, fossils, cut and polished, and in the natural state, shells, &c., cabinet woods, building materials, &c., &c.

But no description of work exhibiting skill or industry, whether useful or ornamental, ought to be excluded, while a preference should be given to articles of utility, and such as are in daily use.

In the production of the above articles much local industry may be beneficially exercised; besides which many others will suggest themselves to practical minds.

THE FOLLOWING IS A LIST OF THE WOODS AND STONE OF THE BAHAMA ISLANDS INTENDED FOR THE FRENCH INDUSTRIAL EXHIBITION.

| Name. | Principal Islands on which Produced. | Average Size. | General Price. |
|---|---|---|---|
| 1 Native Pine | New Providence | 50 × 12 × 10 | 2d. per foot sup. |
| 2 Yellow Wood | Throughout the Colony | 6 × 5 × 4 | £1 5s. to £2 per ton |
| 3 Madeira Mahogany | Andros Island | 14 × 8 × 8 | £1 14s. to £2 10s. ₩ 100ft. sp. |
| 4 Horseflesh ditto | Do. | 12 × 9 × 8 | 5d. per foot sup. |
| 5 Cedar | Generally | 12 × 9 × 8 | 4½d. do. |
| 6 Young Lignumvitæ | Long Island | 3 × 7 diameter | 50s. per ton |
| 7 Dogwood | G. Bahamas & Andros Island | 3 × 6 do. | 1s. to 1s. 3d. each |
| 8 Prince Wood | Andros Island | 8 × 5 × 4 | £6 5s. per ton |
| 9 Green Ebony | Exuma and Long Island | 6 × 4 diameter | £6 0s. do. |
| 10 Crab wood | Generally | 5 to 6 × do. | £6 5s. do. |
| 11 Stopper | Do. | 8 × 4 do. | 2s. 6d. each |
| 12 Brazilletto | Do. | 5 × 2 do. | £5 5s. per ton |
| 13 Native Stone | Do. | Any Scantling | 30s. per 100 feet cubic |
| 14 Large Lignumvitæ | Long Island | 3 × 8 to 9 diameter | 60s. per ton |

Turning now to the East, I find that in CEYLON, Messrs. Wilson and Co. have prepared various specimens of cocoa-nut oil and soap manufactured from oil which really do credit to Ceylon as a manufacturing country. The finest specimen of the oil is from the plantation cocoa-nut, and is as clear and bright as the purest water. That manufactured from the copperah prepared by the natives contrasts most unfavourably as regards colour and clearness. The specimens of yellow and white soap are excellent, the latter description, scented with almonds, is as white as paper. The toilet soap is very nicely prepared, and will, no doubt, soon become a great favourite with the Parisians. Messrs. Wilson and Co. also forward a very valuable collection of medicinal oils, the strength of which will doubtless surprise the "faculty" at Paris, used as they are to the various herbal preparations of the Pyrenees.

Coffee, cinnamon, and cocoa-nut oil are represented by excellent specimens of each variety. The modes of preparation of coffee and oil are shown by models of a "peeler," and a "checko," with figures of the bullocks at work; while the process of operation in changing the cinnamon plant into the marketable article is illustrated by calotypes.

Specimens of every variety of coir rope and matting, and of the different sorts of fibres used in their manufacture, have been furnished by several exhibitors native and European.

A curious box, containing everything that the cocoa-nut palm produces, from the nut in its husk, husk and nut separated, husk beaten out into coir, from which string, rope, and matting are made, samples of which are also shown; the nut converted by different operations, first into copperah the dried kernel, then into the cocoa-nut oil of commerce, while the refuse or poonac, used for feeding cattle and pigs, and for manuring purposes, is there also. From the juice of the spathe is made arrack, vinegar, jaggery, and sugar; specimens of which are also to be found in the collection, while in other parts the carved shell of the nut is converted into a beautiful ornament, and uncarved with a handle, made of cocoa-nut *wood*, is found the spoon in common use among the natives. There is also a model of the still used in the preparation of arrack.

A great variety of medicinal oils, gums, plants, and seeds is also shown, and a valuable collection of the timber and ornamental woods of the colony is forwarded.

Passing on to the models, which will be found to possess much interest, every variety of native boat in use in Ceylon will be represented, while the models of agricultural implements are perfect; the plough with two buffaloes at work is an excellent specimen of native art. There are many models of religious buildings, from the simple *dagoba*, to the plan of the great Calany Wihare; in one among them the perfect repose always noticeable in the reclining figures of Budhoo is admirably preserved. Next in order are the wax models of the fruits of the island, and on the same table, together with ivory images, bottles, and knife-handles, is a box containing specimens of all the Ceylon precious stones, cut and uncut. There is another and a larger box with all the varieties of common stones, earths, and rocks. Of furniture there is a good but not a large assortment: a pair of richly-carved ebony couches, and a sofa table, and two chairs of tamarind wood being the principal objects of attraction. But the interest attaching to everything else exhibited dwindles into insignificance in comparison with the box of fibres, the manufacture of the Colpetty Industrial School. Fibres the produce of the plantain—of the varieties of aloe, of the pine-apple and other plants are here shown, with several silks. The fibre from the plantain is as long and as fine as Manilla hemp—while that from the pine-apple is as fine as silk. In connection with these products I may append some extracts from the annual report of the inspector, the Rev. J. Thurston, presented to the Island School Commission in November, which are exceedingly instructive and interesting:—

"In 1851 he commenced the growth and preparation of *Arrowroot*. During that year only *fifty-six pounds* of this useful article were made; but so great have been the

demands for it, and the improvements introduced into the preparation of it, that it is now an article of daily sale to the extent of nearly 150 *pounds a month*, a considerable portion of which, it is pleasing to know, is sold to natives in small quantities, thus adding to their scanty comforts in time of sickness. Another point worthy of notice is this, that whereas for the first two years all the arrowroot was grown in the Industrial Garden itself, it is now supplied from the gardens of natives even of distant villages, who have been induced to commence the cultivation of it by the certain return which they perceived it would produce.

"The next object to which the attention of the boys was turned was *tat making;* a few were made at first, by way of experiment, of the central rib of cocoa-nut leaflets strongly tied together, but quite plain, and were used as blinds in the windows of a chapel erected by Mr. Thurston on the mission premises adjoining the Industrial Garden. These attracted the observation of several gentlemen who were present at the opening of the chapel, and the result was a succession of orders for several of the same material. They are now made of split *batalies*, and the string is worked on them in patterns of various kinds. Three or four of very pretty design were shown at the late exhibition of the Agri-Horticultural Society, and were considered deserving of an extra prize. They have also led to an increase in the orders for these useful and ornamental articles to the extent of a thousand square feet. It may be mentioned as a feature connected with the working of this branch of the Institution, that whereas at the first Mr. Thurston had to draw the patterns himself, and even to show the boys how to tie the fibres together, the boys now vie with each other in submitting patterns for selection by Mr. Thurston, and several of them are quite capable of instructing others in the whole process of the manufacture.

"Another very interesting occupation of the boys is *the rearing of silk-worms*, which was commenced last year at the suggestion of the Government agent of this province, who kindly supplied the first stock of eggs, about thirty in number. These have increased almost beyond the limits of calculation, and by crossing the moths with another kind received from Malta, silk of a very rich colour has been produced. Several skeins of this formed an interesting object at the Exhibition above referred to, and gained one of the highest prizes. Several orders for eggs have since been received by Mr. Thurston from gentlemen resident in the country who happen to have their natural food, the mulberry tree, growing on their estates. Any person who attempts to rear them will do well to profit by Mr. Thurston's experience, that it is necessary to protect them from birds and winged insects, as well as from ants, and that damp food produces a fatal disease.

"The preparation of *fibres of various kinds* has for some time been vigorously prosecuted; so that in addition to the coir fibres, which gained a prize at the late Exhibition, there were others prepared from plantain stems, the leaves of the pine-apple, the two common large aloes, *dool* and *inyanda* (an indigenous plant growing in great abundance in many parts of this and other provinces) which also gained a prize. Specimens of these have been sent to England for report, and others are being prepared for the approaching Exhibition in France. Judging from the rope and twine already prepared from these fibres, and from the bark of some trees, it seems not at all improbable that owing to the present scarcity of hemp and flax, Mr. Thurston's efforts may eventually lead to a considerable increase in the exports of the colony.

"Gums and resins of various kinds have been collected, some of which, it is thought, may possibly compete with caoutchouc and gutta percha.

"Sago and Tapioca, apparently of a much better quality than much that is imported, and Cassava flour, have lately been prepared. With reference to tapioca it is interesting to observe, that whereas the natives have hitherto regarded the Manioc as a poisonous shrub, from the fatal effects produced upon their pigs by nightly surfeits on its roots, they will now be able to sell them to considerable advantage, and thus derive benefit from that which, although growing around them in great abundance, has hitherto been rather a source of annoyance than otherwise.

"*Baskets*, similar to those hitherto known as Caltura baskets, have lately been made from the leaves of the date-palm, and it is intended to extend their use to the *manufacture of hats.*

"*Rattan mats* are about to be prepared; some of the boys have prevailed on their relations to cut rattans and bring them for sale.

"Mr. Thurston thinks that many other articles, as for instance, *mustard, castor oil, tobacco, &c.*, may be produced in the island, quite equal to what is imported; and as time and opportunity serve, his attention will be directed to their cultivation."

The best collection made has been shipped home from BOMBAY. Every imaginable species of manufactured goods from every district under the Presidency, we are told, has been collected together in rich and varied abundance. The cabinet black-wood work of Bombay, and its ivory stands and work-boxes are of a particularly chaste and elegant description. The manufacture in Bombay stones is also good, the chief article thus manufactured being, the model of a gun, mounted on a platform, with the limber attached. There are several models of Hindoo temples, the largest, which is in ivory, being a representation of a building at Koltapoor. The collection of articles of wearing apparel is peculiarly rich, the gold embroidered cloths of Ahmedabad taking the lead in this department. A velvet saddle-cloth used by Indian princes for led horses, superbly embroidered in gold, and of the value of £25, has been forwarded as a present for the Empress of the French, by Shekh Ghoclam Russool, merchant of Ahmedabad. The collection of Poona figures is very good, affording the most striking representations of the different descriptions of people to be met with in the Deccan. The ornaments in silver and horn are also perfect, as indeed is every article collected for the Exhibition.

On this, as on the former occasion, the East India Company has taken great pains and gone to considerable expense, in order that the extensive empire and various possessions over which they exercise sway, should be properly represented in its natural and artifical products. Their official minute accompanying valuable documents, drawn by Dr. Royle, and sent out early in the year, are too long to appear in connection with these remarks, but may find a place in the Society's Journal hereafter.

The *Malta Times* thus speaks of the contribution from that island:—

"We are all aware that these possessions can do but little on such an occasion as the forthcoming world's fair, particularly when our productions are placed in juxtaposition with those of the mother country and the Continent; yet in justice to the Maltese, there are some few articles in which our people may be said greatly to excel, and in these we would wish to see our island fully represented. We particularly allude to gold and silver filigree, silk mittens, and lace, and though last not least, ornamental sculpture in our beautiful free stone. On the list before us, we notice with pleasure a proposal to exhibit specimens of *Bombyx Cynthia* silk lace, mittens, &c., articles, which in our opinion will be sure to attract the attention of the curious, and of those who take an interest in the introduction of this novel species of silk from the East Indies into Europe. Upon the advantages derivable from Exhibitions in general, it is superfluous to expatiate. Let us only hope that our island may obtain a fair share of the prizes that will be bestowed at next year's great show, and that its trade may long hereafter reap the benefits which are certain to accrue therefrom."

Besides the articles mentioned above, silk flowers, wax figures, marble mosaic, raw silk, astronomical instruments, and oil paintings, are in the list.

From the *Sydney Herald* we glean some information as to the contributions to be expected from New South Wales. Mr. M'Arthur, of Goorumburra, Warwick, has signified his intention of contributing some specimens of a tree which is extensively used by the aborigines in that colony for stupifying fish. The process consists in placing portions of the wood in a water hole, and allowing it to remain immersed for a period of twelve hours. At the expiration of this time, the water becomes so impregnated with the narcotic properties of the wood, that the fish either die, or merge into such a state of stupefaction, that they can be taken out of the water without the slightest effort at resistance. What is perhaps still more remarkable, the narcotic principle has no deleterious effect on the nutritiousness of the fish for the purpose of human food. The same gentleman has also promised to furnish some native specimens of pine bark, with resin attached, together with a collection of native weapons peculiar to the district, accompanied by an account of the mode of using them. Mr. Calvert, the companion of Dr. Leichardt in the overland expedition to Port Essington, has also presented the Commissioners with a kind of girdle made of aboriginal female hair by the natives in the vicinity of the Gulf of Carpentaria. In addition to this, the same gentleman presents a small quantity of the seed of the nelumbo, or gigantic Egyptian lotus, a native of the same district. Mr. R. J. Want has likewise kindly intimated his intention of contributing a cabinet containing 60 different varieties of New South Wales gold. Mr. Patten, of the marble works, Pitt-street, has promised to contribute a collection of native marbles of great interest and beauty. Mr. R. N. Russell has presented a working model of a steam boiling-down machine, the construction of which has cost him something like £100. It is a very ingenious and useful invention, and is now extensively used in the pastoral and other districts of the colony. As an addition to the ordinary mechanical appliances it reflects the highest credit on Mr. Russell, to whom, we believe, the invention is entirely attributable. Mr. Childe, of East Maitland, we are informed, is preparing a supply of the Cochineal insect, which, with several specimens of the plant favouring the production of the insect, he intends to present to the Commissioners at an early opportunity. Mr. Shoebert, of Wollongong, has also promised to send a block of Albert coal weighing two or three hundred pounds. The sample is from a new seam, and as it belongs to a peculiar coal formation, it will no doubt possess considerable interest. The Rev. Mr. Wilton, of Newcastle, has also promised specimens of coal, accompanied by interesting fossils of the coal formation. Mr. Saul Samuel, of Bathurst, has also engaged to forward some fine samples of roofing slate, copper, iron, lead, and other mineral ores, found on his property, which, as indications of our natural wealth, will no doubt be highly interesting. At a recent meeting of the Board, Mr. Moore, of the Botanic Gardens, presented samples of two most delicious jams, which he had obtained from the native lime and the leaves of the rosella. The Board expressed themselves highly delighted with the specimens, and at once requested Mr. Moore (by resolution) to furnish them with 6 lbs. of the two jams, for the purpose of Exhibition. Among the gold specimens is a very beautiful nugget, weighing 17½ ounces, recently procured from Adelong Creek.

In Victoria, £50 had been placed at the disposal of Dr. Mueller, the government botanist, for vegetable specimens, and a similar sum to Mr. Selwyne, government geologist, for mineral specimens. Both gentlemen were absent from Melbourne, engaged in collecting specimens. The local committee at Ballarat are making a model of that gold-field in plaster. Several handsome nuggets and gold specimens had been purchased by the commissioners for transmission with other things to Paris.

From Van Diemen's Land the following are to be forwarded:—

Gold.—Leaf, gilding, jewellery, &c., in Tasmanian gold.

Furniture and cabinet work which may best display the beauty and adaptation of the ornamental woods of the colony. Inlaid work, ditto. Picture frames, ditto. Turnery, ditto. Models in wood, &c., of public buildings bridges, &c.

Swansdown.—At least two skins, to be pure white, and perfectly freed from fatty matter.

Leather.—Varieties of; grained and enamelled, &c., two hides or skins of each sort.

Printing.

Furs of skins of native animals, thoroughly tanned and dressed; at least two skins. Ditto, made up into cloaks, rugs, &c.

Talbotypes and daguerreotyes, representing public buildings and remarkable scenery, or rare objects in natural history.

Collection of objects in natural history.—Tasmanian minerals, plants, seaweeds, shells, insects, birds, animals.

Ladies' work.

Coal, anthracite, bituminous, 2 cwt. of each; quartz-sand, for glass making, 2 cwt.; Cayenne, 10 lbs.; canary seed, 6 lbs.; caraway seed, 6 lbs.; coriander seed, 6 lbs.; coffee, 12 lbs.; liquorice, 12 lbs.; mustard, 6 lbs.; rye, 2 bushels; groats, 7 lbs.; starch, 28 lbs.; snuff, 3 lbs.; vinegar, 1½ gallons; gum, wattle, 10 lbs.; manna, 10 lbs.; olive oil, 2 lbs.; wattle bark, 1 cwt.; prepared horse hair, 10lbs.; sperm candles, small box; tallow ditto, ditto; tallow, cask; preserved meats, in cannisters, 1 quart each; glue, 7 lbs.; goldbeater's skins, 12; brushes, in sets; combs, ditto; soap, box.

The committee do not pledge themselves to give premiums for even the best articles exhibited, unless they are of superior merit, and they will be prepared to issue extra medals in specially meritorious cases not specified in the first of the two preceding lists.

Three varieties of wheat will be exhibited by R. Dry, Esq., of Quamby. Mr. D. Gibson, of Pleasant Bank, will also exhibit wheat. Mr. Grant, of Tullochgorum, will contribute wools, wheat, and gold, the produce of his estate. Dr. Crooke will send a writing desk made of the fancy woods of the colony. Dr. Milligan was authorised to communicate with the Colonial Secretary, with a view to obtain two of the largest sections of timber (blue gum) which the island can produce. Sub-committees were appointed to procure ornamental articles of furniture, and a model whale-boat of figured Huon pine, fully equipped. Captain Hawkins furnished a sketch of a structure on the principal of the Trophy of Canadian timber, exhibited in London in 1851, calculated to exhibit the valuable house and ship-building timbers of Tasmania to advantage.

The Cape Colony.—For the purpose of maintaining the character and credit of South Africa as an importing country, and as a field for future enterprise, both in a commercial and agricultural point of view, an exhibition of such articles as may best represent the resources of the colony, and the skill and industry of its inhabitants at Paris, was to be held at Cape Town, on the 29th of December. The following is the published official list of articles entitled to a place in the Cape Town Exhibition:

Wool in bales of 100 lbs.; cotton in ditto; Silk, 1 lb.; karosses, prepared skins of wild and domestic animals—seal skins, goat and sheep skins, one dozen of each; hides, dry and salted; ores and minerals of all sorts; specimens of coal, marble, lime stone, granites, clays (for pottery and other purposes), earths, &c.; Ostrich feathers, not less than 1 lb.; wheat, 1 muid; flour, 1 barrel; colonial wines, 6 bottles; colonial spirits, do.; dried fruits of all sorts, in boxes of 25 lbs. each; Cape preserves of all sorts, not less than 5 lbs. each, in glass bottles; fruits in brandy, not less than 2 bottles of each sort; Boschjes sirop (made from the flower of the Proter bush); Caffre corn, 1 muid; melies or maize, 1 muid; oil seeds, 10lbs. of each variety; tobacco in leaf, 20lbs.; ditto, manufactured in cigars or otherwise, 5lbs.; berry wax, 20lbs; coffee, 5lbs.; sugar,

25lbs.; ginger, 10lbs.; turmeric, 5lbs.; bees' wax, 10lbs.; honey, 6 bottles; aloes, 50lbs.; gums, 25lbs. of each sort; samples of Bhoku leaves; snake root, and other medical plants and preparations; samples of Orchilla weed, plants, roots, &c., used for dyeing purposes, accompanied by specimens exhibiting the effect of such materials; argol (white and red), 25lbs.; indigo, 5lbs.; castor oil, six bottles; barks for tanning, 20lbs. of each; barilla or kelp; ganna ashes, or other ashes and alkalies, used in the manufacture of soap, or for other purposes; guano, 25lbs.; collection of colonial woods, in the rough and polished, each specimen of wood not to exceed 50lbs. in weight; fancy woods, manufactured into portable furniture, for use or ornament; sea elephant oil; seal oil; whale oil—one gallon of each in glass bottles; prepared sheep tail fat, 6 bottles; tallow, 100 lbs.; soap, 100lbs.; a pair of sea cow teeth; elephant's tusks, in pairs or single specimens; ox horns, polished, one pair; whalebone, 100lbs.; biltong (dried meat) 5lbs. of each sort; salted beef, one tierce; salted pork, 1 barrel; specimens of Caffre and Bushman's implements and curiosities.

I must now bring these desultory remarks to a close, merely observing that from the notes of preparation and the details I have already given of what has been done, and what is doing, I feel satisfied that India and the British Colonies will be properly and most creditably represented at Paris in 1855.

I have the honour to be, sir,
Your obedient servant,
P. L. SIMMONDS.

5 Barge-yard, City, Dec. 30, 1854.

## THE BANK-NOTE QUESTION.

Sir,—I am induced to trouble you with a few remarks on the important matter of bank-notes, &c.; and as the writers of the papers on this subject which appeared in the *Journal* last week seem to have taken up the question in a somewhat too exclusive—or perhaps I should say professional—manner, arising I imagine from their official connection with public establishments, one or two statements then made call for a word of comment. Great stress was laid upon the identity of water mark, identity of printing, and the importance of uniformity of appearance; it was also stated that no forged note has escaped eventual detection, and that bank-notes are as little, or less liable to be falsified than most other human inventions. Allowing the correctness of these statements, does not the question immediately and naturally arise,—why, then, is the Bank of England about to introduce notes of a new design, which must inevitably lead to the absence of that very uniformity of appearance, the advantages of which were so much insisted on. There will be Old Style and New Style; and the public having, to a great extent, become acquainted with the characteristics of the old notes, are now required to study the peculiarities of the new notes. Will the old notes be called in;—will they cease to be legal tender;—or will both kinds be current at the same time? As a mere matter of economy, notes retaining their present appearance could have been printed from surface, but there was no necessity, I apprehend, to alter the style of printing and the water-mark, if the present notes are not liable to forgeries, and when such occur they never escape eventual detection.

A sort of *sauve qui peut* notion seems to be entertained in many quarters, that if by the unlimited means of manipulation which the Bank of England and similarly situated establishments have at their command, they can effectually protect themselves from fraud,—everything has been done that is necessary. I do not think that the Society of Arts should rest contented with this one aspect of the question, for the following reasons, amongst many others which might be adduced:—

If the case of an individual merchant be taken, it will be found almost universally that the proportion of his transactions managed by means of bank-notes is exceedingly small, and, therefore, the genuineness of his bank-notes is not more important—scarcely of so much consequence—as the genuineness of the other documents by which his business is conducted.

Extend this view to the combined operations of all the merchants and bankers in London, and it will be apparent on the slightest consideration that in each day is included transactions to a vast amount represented by cheques, bills, drafts, warrants, from hundreds of sources, which are entirely unaffected by the security or forgery of a bank-note. If we endeavour to connect with the foregoing the internal and foreign commercial transactions of all England, the isolated question of the genuineness of a bank-note will shrink into comparative insignificance.

Although the plans adopted by the Bank of England are very good in themselves, the special means for the prevention and detection of forgery, which suffice in the peculiarity of its position, can seldom be supplied by other establishments. The Company of the Bank of England may be regarded in three aspects:—as agents for the government keeping the accounts of the national debt, and paying the dividends, for which duty a fixed sum is paid yearly by the government;—as bankers receiving deposits, discounting bills, &c., thus being a competitor with the private and joint-stock banks, and in this department being equally with them interested in the question of security of cheques;—as issuers of the only paper-money which is legal tender in England.

The Bank of England has now secured to itself the issue of nearly all the paper-money current in England, no new banks of issue being allowed, and as the existing ones become extinct they are not replaced, and the number is gradually lessening. The judicious policy of this legislative measure is unquestionable.

The extensive nature of its operations requires for the regularity of their performance adequately huge arrangements for the supply of its documents, and to secure due control, it remunerates one firm so satisfactorily that it is stated the supply of bank-note paper has emanated from the same source for 150 years, and is no doubt regarded as a choice entail or heir-loom. With the exception of the manufacture of the paper, every subsequent operation is conducted on the premises of the Bank.

The immense number of each description of document issued by the Bank of England, and the never-ending variety which go to make up the aggregate of commercial documents, preclude the two from being classed together, and, hence, if anything is to be done for the protection of the latter papers, it must be effected on general principles, applicable, with modifications, to all cases.

The Society would not be rendering an unimportant service to commerce if it were to collect information and specimens of every mode by which documents can be imitated or altered, and test every proffered scheme of protection, ascertaining the precise evil against which the stated security is effective.

Additional importance is given to the subject by the consideration that we are much interested in the public debts, railways, mines, public works, &c., of many foreign countries, and that our securities consist of paper documents.

Moreover, England in this, as in many other respects, is the workshop of the world, inasmuch as Norway, Spain, Greece, Switzerland, the Cape of Good Hope, India, Australia, South America, Canada, and the United States, are more or less provided with bank-notes, cheques, railway and similar documents by this country.

Having thrown out the foregoing hints on the general question, I will append a few notes on some of the curiosities of the subject, which are numerous. The following extracts might be greatly extended with ease.

One bank entirely disregards the advantage of uncut or natural edges, and has its paper prepared in large sheets, with many notes on a sheet; neither have the notes any counterpart.

Another bank pays excessive regard to counterparts, every note being a separate sheet, with counterfoils at each end.

The documents issued by another large foreign establishment have *three* counterparts, but as to save trouble to the officials the documents are severed from all the counterparts before they leave the printer, the security from this source is rather questionable.

In some of the South American States, so great is the issue of paper-money, that the government note is worth less than one-tenth of its theoretical value. It would appear that as the cash value of these paper-moneys decreases the issue is extended, and so, I presume, it will go on until the cost of paper and printing will equal the sum which can be obtained for the finished document, and then a general repudiation of all old notes, and a re-issue will be the only course left.

Instances could be given of an improved style of document tending to raise the shares of the company adopting the improvement.

A few words in an Act of Parliament sometimes causes great changes. After expending a large sum in erecting the beautiful and ingenious machinery devised by the late Mr. Cowper for printing one-pound notes, and working off some millions, the whole was rendered nugatory by the legislature decreeing the non-issue of the notes.

Not very long since a shopkeeper advertised a £5 note and a dress for a few shillings. The bankers issuing the note had failed, and there being no assets, their paper suddenly decreased in value from pounds to pence.

A correspondent of one of the daily papers informed us two or three years ago that the revolutionary party in Italy issued paper-money redeemable in happier times, and that the paper so issued was more readily accepted by the peasantry than the paper of the Italian governments.

Pitt found that money is one of the most important sinews of war; Kossuth the same,—and we are informed that he carried with him his bank-note apparatus until the last moment.

While on this subject I may mention a practice which now strikes one as very curious, but which old colonists of New South Wales will recollect was adopted by the government, to retain dollars in the colony, viz., to stamp a piece out of the centre, thus rendering the coin useless in any other country. The central portion was tender for a quarter-dollar, or 1s. 1d.; and the ring pieces, called ring-dollars, were valued at 3s. 3d., the whole dollar being worth 4s. 4d.

What a change a few years have brought about in this respect!

Hoping some of these scattered fragments may possess a degree of interest, I remain, yours,

WAIMA.

## Proceedings of Institutions.

YARMOUTH.—The Young Man's Institute, by the energy and exertion of its members, has become possessed of the eligible and commodious building situate on Yarmouth Quay, known as the Commercial Club House and Corn Exchange, a building admirably adapted for the purposes of the Institution. The purchase having been completed on the tenth anniversary, the members determined to celebrate that event by a dinner in their newly-acquired hall, which took place on Thursday, the 21st ult., and excited no inconsiderable interest in the town, from the fact that it was to be patronized by the Mayor (Charles John Palmer, Esq.) and other influential gentlemen. The hall presented on entering a very imposing appearance; at the head, or east end, English, French, and Turkish flags and banners were tastefully disposed, forming military and naval trophies; and on either side the emblazoned armorial bearings and trophies of Wellington, Nelson, and others were arranged. Contrasting with these adornments of warfare, at the entrance or lower end of the Hall was an elegant green and gold banner, inscribed with "Prosperity to the Institute," surrounded with handsome paintings, banners, and shields, emblematical of "Science," "Literature," and "Art." The usual loyal and customary toasts were drunk with enthusiasm. The Mayor, in replying to one of the toasts, said, it would have given him very great pleasure to have attended that meeting merely as a member of the society, or simply as an inhabitant; but it gave him far greater pleasure to be present, filling, as he had the honour to do, the high position of chief magistrate of the town, and he was perfectly willing to give the sanction of his presence to their proceedings. He was afraid he could not claim any credit for corporations or town councils in regard to promoting institutions of a similar kind to their own; but he believed better times were coming over them. He congratulated them upon the celebration of their tenth anniversary, and also upon the fact of having a building of their own. In such an institution, it was necessary that a good understanding should be arrived at in reference to their management; for based as it was upon liberality of principle and sentiment, it was impossible to avoid difference of opinion; and therefore, whoever took the management must exercise great discretion. Mr. W. Johnson, in proposing the health of the president, Sir E. H. K. Lacon, Bart., M.P., said, however excellent such an institution might be, it would be of but little avail without a good and influential head, and in the person of the excellent baronet they had a most suitable selection. He very kindly consented to lend a fostering hand, and the Institution, which then numbered from 80 to 100 individuals, had during his presidency increased to 300. In responding, Sir E. Lacon thanked the company for the enthusiastic manner in which his name had been received. He concluded, from the growing number of members, that this Institution would go on prosperously. He trusted that whatever government might be in office they would encourage Institutions of this nature, and he would support any motion brought forward relative to Literary Institutions, or to the circulation amongst them of their proceedings in Parliament. Might they go on successfully, and be spared to celebrate their twentieth anniversary.—Mr. R. Ferrier, jun., proposed "The Vice-Presidents, coupling with it the name of Mr. R. Steward."—In the course of Mr. Steward's reply he passed a high eulogium on the president for his exertion in connection with this Institution. With reference to a free library he hoped to see the day when it would be effectually carried out by voluntary acts.—Mr. Chamberlain gave "The healths of Dr. Smyth and Mr. James Barber, honorary secretaries."—Both gentlemen acknowledged the toast.

## MEETINGS FOR THE ENSUING WEEK.

MON. Actuaries, 7. Mr. E. J. Farren, "On the Improvement of Life Contingency Calculation."
Architects, 8. Mr. W. G. Caldwell, "On the Spire of All Saints' Church, Chesterfield."
Geographical, 8½. 1. "Geographical Notes taken during a Journey in Persia." By Mr. Keith E. Abbott. 2. "Despatch from Dr. Livingston, containing his routes from Lake Ngami through the interior of South Africa to Angola." 3. "Despatch from Colonel Herman, H.M. Consul at Tripoli, stating that the Reports of Dr. Barth's Death still prove Unfounded."

TUES. Syro-Egyptian, 7½. Mr. S. Sharpe, "A further Argument and Explanation of Hieroglyphics."
Civil Engineers, 8. Renewed discussion on Mr. P. W. Barlow's paper, "On some Peculiar Features of the Water-bearing Strata under London."
Med. and Chirurg. 8½.
Zoological, 9.

WED. Literary Fund, 3.
Graphic, 8.
Entomological, 8½.
R. S. of Literature, 8½.

THURS. Antiquaries, 8.
Royal, 8½.

FRI. Astronomical, 8.
Philological, 8.

SAT. Asiatic, 2.
Medical, 8.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Dec.* 29*th*, 1854.]

*Dated* 26*th August*, 1854.

1875. R. A. Brooman, 166, Fleet-street—Motive power. (A communication.)

*Dated* 19*th October*, 1854.

2236. S. Mason and W. Beeby, Northampton—Boots and shoes.

*Dated* 13*th December*, 1854.

2615. Jos. Mayer, Longport, and J. D. Kind, Birmingham—Door knobs and spindles.
2616. C. F. Stansbury, 17, Cornhill—Machine for cutting keys. (A communication.)
2618. A. E. L. Bellford, 16, Castle-street, Holborn—Sewing machines. (A communication.)
2619. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Inkstand. (A communication.)
2620. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Photography. (A communication.)
2621. J. L. Jullion, Tovil—Separating fibres.
2622. Lieut.-Col. W. Grant, Bath—Prevention of smoke in domestic fire-places.
2623. H. Berdan, New York—Compressible life-boat.
2624. S. Fisher, Birmingham—Ordnance.
2625. C. J. Taylor, Handsworth—Underground telegraph wires.
2626. T. F. Evans, Philpot-lane—Candles. (A communication.)
2627. T. Haines, Melbourne, near Derby—Warp machinery.
2628. W. C. Taylor, Greenwich—Bearing parts of shafts and axles.
2629. J. Court, jun., Sheerness—Rockets.

*Dated* 14*th December*, 1854.

2630. J. Redgate, Sneinton, J. Thornton, Nottingham, and E. Ellis, Sneinton—Lace machinery.
2631. R. Ruston, Birmingham—Anchors.
2632. L. W. Evans and J. Mc Bryde, St. Helen's—Sulphuric acid.
2633. W. F. Padwick, Hayling Island, Hants—Projectiles.
2635. W. C. Scott, Warner-road, Camberwell—Paddle-wheels.
2636. P. E. Henderson, 4, Trafalgar-square—Ventilating ships.
2637. L. Cornides, 4, Trafalgar-square—Covering glass with collodion.
2638. J. Rose, Ashford—Fire-boxes of steam-boilers.

*Dated* 15*th December*, 1854.

2639. J. Rowley, Camberwell—Embossing woven or felted fibrous materials.
2640. W. Clark, Islington—Anchors.
2641. U. Scott, Duke-street, Adelphi—Metallic bodies.
2642. A. Lyon, Windmill-street, Finsbury—Mincing machines.
2643. L. Turner, Leicester—Weaving elastic fabrics.
2644. F. Archer, Bishopsgate-street, and W. Papineau, Stratford—Distilling peaty and other matters.
2645. R. Adams, King William-street—Revolvers.
2646. E. Strong, Carstairs, N.B.—Removing and replacing railway wheels and axles.

*Dated* 16*th December*, 1854.

2648. L. J. Livsey and W. Weild, Manchester—Projectiles and ordnance.
2650. J. Hickman and J. Smith, Birmingham—Stop-cock.
2652. Lieut. M. C. Friend, R.N., Greenwich, and W. Browning, 111, Minories—Determining magnetic aberrations occasioned by local attraction.
2654. W. Eassie, Gloucester—Retarding vehicles on railways.
2658. L. Wimmer, Vienna—Baking.

*Dated* 18*th December*, 1854.

2660. C. F. Stansbury, 17, Cornhill—Life-buoy. (A communication.)
2662. W. Hartley, Bury—Safety valves.
2664. E. Whele, Birmingham—Lamps.
2666. L. H. F. Melseus, Brussels—Saponification.
2668. J. H. Johnson, 47, Lincoln's-inn-fields—Extracting tannic acid from leather. (A communication.)

INVENTION WITH COMPLETE SPECIFICATION FILED.

2683. W. Donald and W. Heginbotham, Carlisle—Looms. 20th Dec., 1854.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed* 29*th December*, 1854.

3. Alfred Dawson, 14, Barnes-place, Mile-end-road—Converting small coal or coal dust, or small coal and coke, into solid blocks of fuel.
1431. Edward Joseph Hughes, Manchester—Improvements in sewin machines.
1462. Jean André Cécile Nestor Delpech, Castres—Improved lift and force pump, called 'castraise-pump.'
1464. Joseph Marie Bardet, and François Collette—Improvement in the construction of matches.
1468. Henry Heycock, Manchester—Improvements in hydraulic presses, employed for packing or pressing cotton, silk, flax, wool, or other fibrous materials.
1469. David Bowlas, Reddish—Improvements in machinery or apparatus for knitting or manufacturing healds or harness used in looms for weaving.
1472. Louis Joseph Cheval, Raismes, France—Improvements in beer engines.
1479. Samuel Harvard and Joshua Womersley, Stoke Holy-cross—Heating crushed seed for making cake, for drying seeds, corn, and other grain, and for feeding mill stones or other grinding apparatus.
1526. John Knowelden, 7, Church-road, Battersea—Improvements in steam-boiler and other furnaces.
1620. Edward Francis Hutchins, 263, Whitechapel-road—Constructing the cylinders of engines worked by steam, air, or other fluid body, in a circular form on plan, by which means more power is obtained from a given quantity of the said fluid body in cases where a circular motion is required than by any other known form of cylinder.
1632. Peter Spence, Pendleton—Improvements in obtaining sulphur from iron pyrites and other substances containing sulphur, and in apparatus for effecting the same.
1707. William Gossage, Widnes—Improvements in the manufacture of certain kinds of soap and other detergent compounds.
1762. William Woodcock, Earl's-court Brewery, Brompton—Improvement in the combustion of fuel.
1846. James Lamb Hancock, Milford Haven, Pembrokeshire—Improved pneumatic safety inkstand.
1922. Thomas Craddock, Portway Foundry, Potters-lane, Wednesbury—Improvements in the steam-engine.
1959. Samuel Frearson, Glascote, Warwick—Improvements in the construction and manufacture of buttons, a part or parts of which improvements may also be applied to other similar purposes.
2035. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improvements in sewing machines.
2080. Frederick Clark, King street, Westminster—Improved spindle and bush for door knobs and other similar uses.
2095. John Nelson Gamewell, Camden, South Carolina, U. S.—Improvements in instruments for relieving the wires of the electric telegraph of atmospheric electricity.
2167. Joseph Burdekin Jackson, Etna Works, Sheffield, and William Bowler, Sheffield—Improvements in furnaces or fire-places, and in the prevention of smoke.
2206. William John Bisseker, Birmingham—Improved and durable method of labelling bottles and such like vessels or articles as require or may require labeling.
2258. John Penn, Greenwich—Improvements in the manufacture of the pistons, slide valves, and stuffing boxes of steam engines.
2308. Robert Stirling Newall, Gateshead—Improvements in electric telegraphs.
2323. Alfred Vincent Newton, 66, Chancery lane—Improved method of forging or swaging railroad carriage and other wheels.
2368. William Edward Newton, 66, Chancery-lane—Improved mode of constructing saws.

*Sealed January* 2*nd*, 1855.

1449. Benjamin Walters, Wolverhampton—Improvements in spindles for locks and latches, and in the means of adjusting knobs to the same to suit any thickness of door.
1456. Urbain Chauveau and Charles d'Epinois, Paris—Improved means or apparatus for preventing collisions on railways.
1501. Thomas Waller, Ratcliff—Improvements in the construction of stoves and other fire-places.
1507. Thomas Schofield Whitworth, Salford—Improvements in machinery or apparatus for cutting or shaping wood, parts of which are particularly applicable in the construction of spinning machinery.
1516. Matthias Walker, Horsham—Improved construction of cooking stove.
2021. John Cunningham, Beith, N.B.—Improvements in the preparation or production of printing surfaces.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| Date of Registration. | No. in the Register. | Title. | Proprietors' Names. | Address |
|---|---|---|---|---|
| Dec. 28. | 3673 | Russell's Self-Ventilating Air Tube Coach Roof Lamp | William Russell | 23 & 24, Blackwellgate, Darlington, Durham. |
| 1855. Jan. 1. | 3674 | Empress Boot Leg | J. Westwood Astles | 64, Foregate-street, Worcester. |

Journal of the Society of Arts.

FRIDAY, JANUARY 12, 1854.

## REPORT OF COMMITTEE ON INDUSTRIAL PATHOLOGY ON TRADES WHICH AFFECT THE EYES.

In presenting their Report on Industrial Pathology, the Committee appointed to undertake that subject beg to recall to the memory of the Council that they determined last year to direct their special investigations to the injuries resulting from handicraft work to one organ only, namely, the eye. In the general circular which they recommended to be distributed, this was pointed out, and consequently the greater part of the correspondence which they have received relates, as was intended, to lesions of that part. The report therefore is, for this designed reason, short and partial. But it is also shorter and less pregnant with information than the Committee anticipated. The subject of Industrial Pathology was so new to the public, that much irrelevant matter was introduced into the correspondence, and many classes from whom it was hoped a good deal might be learned, did not undertake to reply to the questions.

One cause, however, for the shortness of the Report may be viewed as a fair subject of congratulation. It appears, from the constant repetitions by different persons of the same lesions, and the very little novel or original information that has been elicited, that the important organ of vision is much less injured directly by handicraft operations than the Committee thought. Many of the affections quoted seem due rather to ignorance or neglect of well-known hygienic laws, than to anything essentially connected with the occupation of the workmen.

Another subject of congratulation also occurs to them, viz., that all the results complained of seem capable of being met by simple, cheap, and universally attainable means: no alterations of modes of manufacture, no interference with the natural liberty of the master to have work done in the cheapest way, is necessary; but merely such precautions as it is monstrous not to adopt when once known.

In returning their best thanks to the correspondents who have assisted them in this work, the Committee beg to explain that the omission of many portions of the replies sent, in some cases the omission of the reply altogether, is due not to their want of appreciation of the value of the information given, or of respect for the contributor, but solely to carry out the rule of avoiding repetition.

Mr. Dixon, surgeon to the Royal London Ophthalmic Hospital, reports:—

In a very large number of those who apply to the Royal London Ophthalmic Hospital on account of what they term "weakness of the sight," the defect is owing to mere *over-use* of the eyes. I mention "over-use" rather than any special *trade*, as the exciting cause, for every day's experience teaches us that needlework, and other occupations requiring close attention to minute objects, may be followed without injury to vision, provided due moderation be observed.

*Tailors* are, perhaps, of all persons, the most liable to exhaustion of visual power from over-use of the eyes. The length of time they work without intermission—often sewing black materials for many hours together—their constrained posture, which obstructs the proper movements of respiration, and so causes congestion about the head and eyes—the want of fresh air in the heated rooms where they are often crowded together—the dram-drinking to which they so habitually resort for dispelling the sense of exhaustion and weariness induced by the want of a due supply of oxygen—all concur in eventually producing an inability to sustain the effort of observing minute objects; while, at the same time, the close and heated atmosphere by which they are surrounded during their hours of labour, makes them additionally susceptible of cold when they go into the open air: hence they are peculiarly liable to attacks of "catarrhal ophthalmia."

*Needlewomen* are placed under conditions so similar to *tailors*, that both classes are liable to very much the same forms of disease, as regards exhaustion of visual power and susceptibility to "catarrhal ophthalmia."

*   *   *   *   *

Among *Dressmakers* the custom almost universally prevails of making up their white and coloured materials during the day, and reserving all black work for the evening. They allege, as a reason for this, that white fabrics are apt to get soiled if exposed to the smoke of gas. It is certain, however, that the strain on the eyes from working on black by artificial light is much more severe than from doing such work by daylight; and it would, therefore, be a great boon to those employed in dressmaking establishments if the proprietors would allow all articles of mourning to be made up during the day, and white materials, and those of such colours as are readily distinguishable by artificial light, to be reserved for the evening.

Improved ventilation (so essential to the health of the workwomen) would doubtless obviate all risk of soiling the more delicate fabrics by smoke or unburnt gas.

In large tailoring and dress-making houses, where a number of persons work in one room, much fatigue of the eyes arises from that *superabundance of light* which gas can so readily be made to afford. In such cases glass shades, or chimneys, tinted with a very faint blue, by intercepting the red rays of the gas flame, would afford great relief.

Those who work at home commonly suffer from an opposite cause,—namely, an *insufficient and unsteady* light; a flickering candle being usually the sole means of illumination within the attainment of the solitary needlewoman.

From the nearness of our hospital to the district of Spitalfields, nearly all the *weavers* who suffer from affections of the eyes come under our notice. These people habitually suffer from long hours of work and want of exercise, Sunday being, to many of them, the only day on which they leave their room. Failure of sight from over-use of the eyes is very common among them, insufficient lighting of their workrooms in the evening being a frequent cause of the overstraining of the organs.

*Boot* and *shoe makers* suffer in the same manner.

Constant attention to minute objects, which, at the same time, are brilliant in themselves, and frequently illuminated by powerful artificial light, exposes *watchmakers* and *engravers* to premature exhaustion of visual power. During the short and dark days of winter they are forced to em

ploy lamplight, and even this they often concentrate by means of a glass bull's-eye.

The ingenious contrivance for intercepting the red rays of the flame, invented by Mr. Rainey, the well-known microscopical observer, would doubtless, very much lessen the injurious effects of their occupation.*

*Copying clerks*, who write for the law-stationers, frequently come under my notice, in consequence of weakness of sight from over-work.

Before quitting the subject of artificial light, I would allude to an inconvenience of which *Compositors* engaged in newspapers-offices have complained to me,—namely, the unsteady light emitted by the jets of gas, in consequence of their being exposed to currents of air without the protection of shades or chimneys. It seems only necessary to draw the attention of the proprietors of our great printing establishments to this inconvenience to enure its being rectified.

*Excess of light* no doubt acts prejudicially upon persons occupied at furnaces, as *Glass-blowers, Smelters, Assayers*—but it seems almost impossible to suggest a remedy, since any kind of tinted spectacles which would modify the glare of light, would, at the same time, prevent the workman from knowing when the glass or metal had arrived at its proper state of fusion, a point mainly to be determined by the intensity of light which the melted substance emits.

Among all the classes of persons I have mentioned as occupied in various ways upon minute objects, instances occur in which the fatigue and distress of the eyes arise not so much from the actual amount of work as from the patients' attempting to execute it, after a certain time of life, without the assistance of glasses suited to correct the gradual change of focus which the eye itself undergoes. Some persons, even in early life—in childhood—who have very acute sight for distant objects, require the aid of slightly convex glasses to enable them to sustain, for any considerable time, the effort of observing minute objects which are near them. This assistance is still more frequently necessary in adults who have passed the age of 50. With convex glasses, accurately adapted to their peculiar focus, such persons are frequently able for many hours to follow their occupation of needlework, &c., when, without such aid, their sight would wholly fail after a few minutes' application. In like manner short-sighted persons suffer from attempting to work without suitable concave glasses.

With respect to *Mechanical injuries* to the eyes, resulting from particular occupations, I may observe that such accidents frequently come under my notice in consequence of the large number of patients who frequent our hospital. In 1850 their number was 9,204; in 1851 it rose to 11,071 (the increase of 1,867 affording a curious illustration of the influx of persons from remote parts of the country into London during the year of the Great Exhibition). In 1852 the number was 10,595; in 1853, 10,058.

During this period the number of foreign bodies, chiefly fragments of metal, which have been removed from the eye, has fluctuated between 500 and 600 every year.

*Metal-burners*, *millstone-dressers*, and *smiths*, are the persons most subject to have minute chips of metal driven into the cornea. *Engineers*, in using the chisel, are liable to much more serious injuries, in consequence of the larger size of the fragments they chip off. I every year see several cases in which eyes have been wholly lost in this manner. *Masons* suffer chiefly from chips of stone projected against the eye, or, still more frequently, from little particles of sand or grit which become lodged between the upper lid and the eyeball, and require surgical aid for their removal. This lodgment of small bodies beneath the eyelid—an accident of comparatively trifling importance, is one to which *Bricklayers* are peculiarly liable. A much more formidable injury which befals these persons, and others occupied in building, is the intrusion of lime into the eye, which frequently causes instantaneous and permanent blindness.

The blows which *Masons* receive on the cornea are often of serious moment, and may lead to severe inflammation of the part. This inflammation is usually destructive in proportion to the feebleness of the patient's constitution, or state of body at the time the blow is received, and the worst cases I meet with occur in *paupers* who are set to break stones in the yards of workhouses. These accidents might be averted if all persons so employed were obliged to use "goggles" of wire gauze, which would effectually defend them from injury, and at the same time enable them to see quite sufficiently for performing such coarse work.

* This apparatus is made by cementing together, by means of Canada balsam, four pieces of glass: the first dark blue, without any tinge of red,—the second very pale blue, with a slight tinge of green,—the third and fourth to be thick plate glass, perfectly colourless.

In this report it may be observed that the only instances given of harm resulting from the irremediable nature of the occupation, are those of smelters, assayers, and workers in metal similarly employed, where the bright light that hurts the eye *must* be seen by the eye to enable the artisan to judge of the progress of his work. Moderate employment in watchmaking, engraving, and other minute work is not stated to be noxious, but only such over-exertion as must be equally objectionable on the score of general health. The wearing of guards not at all likely to impede the work (for it may be remarked that in some parts of Germany they are universally worn), is said to be enough to prevent the frequent injuries to the eyes which stone-breakers experience. Chips of metal might be guarded against in the same way, especially if, when the metal is iron, magnetised wire nets were used. The strain of vision induced by working with the needle on black stuffs by night suggests its own remedy, but would be still further reduced by the use of sewing machines, which have no eyes to lose.

On this subject some suggestions contained in a report by Mr. E. Cousins, of Camden-town, are interesting and valuable.

Mr. Cousins suggests that:—

Needlewomen, embroiderers, and lacemakers should work in rooms hung with green, and having green blinds and curtains to the windows. When in North China, I became convinced of the very great advantage with which this rule has been adopted by the exquisite embroiderers of that part. Their books of patterns are frequently called *Books of the Lady of the Green Window*.

He also says:—

Needlewomen would find great advantage from changing the colour of their work as frequently as possible. The *rationale* of this is found in the law that variation of stimulus is necessary to preserve the tone and health of any organ of sense, and that prolonged application of the same stimulus exhausts it.

With reference to the remote causes of diseases of the eyes, he says:—

The surgeons of Brussels are well aware of the injurious consequences to the eyes resulting from long continuance of work in the sitting posture, as adopted by the lace-workers of that capital. My friend, the late M. Cunier,

referred the congestive diseases of those organs so frequently seen there to the indirect influence of this cause, producing stasis of the circulation in the abdominal organs, and secondary venous congestion of the choroid, &c.

Here, again, the sewing-machine seems to be called for, or, where that is not available, stands or frames to support the work, and enable it to be done by persons in the erect posture for at least a portion of the day.

It may be remarked, in passing, that the sitting posture, especially that doubled-up sitting posture assumed by laceworkers, is otherwise injurious, producing congestion of the abdominal organs, hæmorrhoids, &c.

With respect to the effect of lacemaking and embroidery the Committee beg to refer also to the evidence of Mr. R. D. Grainger, published in the Parliamentary Report of the Children's Employment Commission, in 1841. It is a painful sight in Belgium, as in England, to see children's hands engaged on a lace-cushion almost before their feet can support them in an erect posture.

With respect to Mr. Dixon's inclusion of compositors among those who suffer from flickering light, it is right to say that a great improvement has latterly taken place in this respect. In reporting the conversation which took place in the Society's room after the reading of a paper on "Industrial Pathology," by Dr. Chambers, the editor of the *Medical Times* stated that none of their compositors suffered in this way. The foreman, also, of the printing-office of Mr. Cassell, on Ludgate-hill, remarks, in a letter to the Committee :—

It is very seldom compositors work without a shade. On questioning some of our workmen they reply that the *shades* we use render it much pleasanter to work than the naked flickering gaslight ; still we cannot learn that blindness has been the consequence of the latter. We find the glass funnels economical, even with the shades ; but the compositors dispense with them on account of the heat produced. The open shade is all we use, and we never hear any complaints.

At the printing-office of the *Times* newspaper, shades and chimneys are used, and appear to be entirely successful. Among the 200 men employed, Mr. Harrison, the master printer, reports, and the statistics of the sick fund show, that but one man has been invalided for defective vision, and he is a man of 65, with a cataract.

At Messrs. Clowes's shades made of white paper, by the men themselves, are very general, and the burners are placed at a proper height above the head.

Mr. Moore, surgeon to the Middlesex Hospital, adds to the catalogue of trades injurious to the eyes—

Soda-water bottling, which is a dangerous occupation, from the occasional bursting of the bottles, and escape of the corks.

He says, too,—

Washerwomen suffer a good deal from draughts, and consequent catarrhal ophthalmia.

* * * * * * *

Engineers are sometimes laid up in consequence of encountering a blast of steam.

* * * * * *

Diseases of the eye, and especially *granular lids*, are apt to be particularly severe and intractable in the Irish, certainly more—but by no means only—when they work much in lime.

An annual report on the causes of diseased eyes among the patients at St. Mary's Hospital from Dr. Graily Hewitt, the then surgical registrar, shows that of 88 cases, 9 arose from overwork of the vision in occupations not generally injurious; 5 arose from chips of metal, glass, or other hard substances in the eye; 3 from blows; 2 from exposure to heat; and 69 to constitutional causes, cold, poverty, &c., independent of the occupation. The details of the report, and the nature of the lesions, are irrelative to the present purpose.

T. J. Downing, working bookbinder, reports that—

Formerly the finishing department of the trade was carried on with the use of charcoal fires, which were pernicious to the eyes. These have been superseded by gas-stoves, which are much less so. Finishers are observed often to be near-sighted, occasioned, it is thought, by continually working upon gold-leaf, the glare of which produces this result.

In a communication principally relating to other diseases of the grinders of steel goods, Mr. Wilson, foreman to Messrs. Rodgers, of Sheffield, remarks :—

The grinders are liable to get particles of steel in their eyes. But, as a prevention, some of them wear *very large* spectacles of plain flat glass.

A truly rational and cheap preventive ! Speaking alse of furnacemen, he says :—

I know some whose sight is affected by the heat and light.

J. E. Sinyard, secretary to the working-tailors' society, Ring-o'-Bells, Bradford, attributes the diseases of the eyes which tailors suffer from, to—

Overstraining the organs, exposing them to the glare and heat of gas, bad ventilation, dust, and intemperate habits,—including snuff-taking. Although addicted to it myself, yet I think it causes the eyes to be strained by the frequent blowing of the nose.

He says, too :—

Fine work in thick cloth, velvet, &c., causes the eyes to be inflamed, watery, and the vision confused. Spectacles are considered to be beneficial by daylight, but positively injurious by gaslight, the glass being heated by the necessary close proximity to the light.

* * * * *

I have long thought that much good might be done by placing a reflector over each burner, having a small tube reaching from the top of the reflector to the outside of the building. I think the reflector would cast down the light from the eyes upon the work on the knees, and the tube carry off the heated air, like a flue.

Mr. George Wilson, of Price's Candle Manufactory, Belmont, Vauxhall, writes :—

The only suggestion I can make as to trades affecting the eyes, relates to glass-blowing. We require a good deal of this work for the purposes of our manufacture, and had

a number of our boys taught to work the blow-pipe. The oil-lamp used for heating made a bad unwholesome smell —we substituted gas, and then found that the eyes even of those who had been at the work but a short time became red and sore. We gave them dark-blue spectacles, which, so far as our experience goes, is an effectual remedy.

The smell of oil is no doubt unpleasant, but it may be questioned whether Mr. Wilson is right in calling it "unwholesome," an epithet more pertinent to the residuary gases escaping from the usual semi-combustion of coal gas. The effect of gas light on the eyes is worth more inquiry than it has yet received. Many who have had gas laid on in their servants' apartments, find that their female domestics suffer from affections of the eyes, which are sometimes catarrhal, sometimes amaurotic. The reason that females complain more than males, is probably, the nature of their evening occupations. The Committee have no written evidence on this point, but they have heard that at some schools, where gas is used for lighting the rooms, the boys are observed to become short-sighted. An explanation of the difference between gaslight and other light is given in another communication. (See Mr. W. W. Cooper's Report, page 124.)

Dr. Caplin, of Manchester, says that :—

If we take the trouble to investigate the effect of light on the eyes, we shall find that it is not so injurious as is generally thought. An organ, whatsoever it may be, is not injured so long as it can perform its functions with facility. The stress on the eyes results from *want of light*; and whenever the light falls on the object we want to see, not on the eyes themselves, it does not prove hurtful.

* * * * *

I have known many persons accustomed all their lives to the most minute work, such as engraving, whose eyes were neither affected nor impaired. This fact is in accordance with the law of physiology, by which the strength of an organ is in proportion to its activity.

* * * * *

Oblique and bad light are the cause of affection. But it may be remedied by altering the window, or changing the place or position of the worker. The foregoing remarks are not intended to exhaust the subject, but are mentioned merely for the purpose of pointing out the necessity for directing our investigations to the discovery of primary causes, instead of forming our diagnostic on secondary effects.

The question whether the eye, or any of the other organs of sense, is capable of improvement in proportion to its use, or whether, like a human mechanical contrivance, it wears out by employment, is a very serious one. A great deal of our conduct in daily life depends on the way we answer it to ourselves. It is probable that the "wearing out" contrasted in the popular saying with "rusting out" is often falsely attributed to the human body, and that perfectly healthy organs are made more efficient by use—provided that such use does not diminish the nutrition of the system; but, at the same time, local injury is certainly experienced in many parts of the body, especially the eye, by working too long hours. The explanation appears to be this, viz., that after the body has been long employed, sufficient vigour does not remain in each separate organ to enable it to do its duty—it cannot be called healthy after the general strength has been exhausted. "Overwork" means working with the eye in an unnatural condition.

To answer more completely this and other questions concerning lesions arising from occupations, it would be desirable to collect a list, not only of such trades as injure particular organs, but of such as benefit them. In a communication from James Cowell, a shipwright at Newcastle, an opinion is expressed that his employment is peculiarly beneficial to the sight. It is said :—

It is a rare thing to find a shipwright weak-sighted, or shortsighted, who is not naturally so. I understand also that shipwrights are much quicker sighted than sailors, and that in consequence they are preferred to them for steering vessels at sea.

As a proof, however, that such statements concerning their own trades are to be received with caution, the Committee hear, on inquiry from Mr. Wigram, of Blackwall, the extent of whose experience puts doubt out of the question, that shipwrights are never employed at sea as steersmen, or in any way out of their own line, and that he has never heard of their occupation improving the sight. Mr. John White, of Cowes, also thinks this must be a "popular error," perhaps originating in shipwrights being noted for having a quick eye in detecting an unfairness in their work. It may be remarked that some medical men attribute to mere *superabundance* of light, however natural, some injuries of the eyes. Thus, Mr. France, lecturer on Ophthalmic Surgery at Guy's Hospital, in his answer to the circular, mentions as suffering from "excessive illumination"—

*Sailors*, especially in tropical stations, blacksmiths, cooks, and others tending large fires, metal-polishers, and engineers, jewellers, harvesters.

Mr. France further says :—

If the Society of Arts would exert its influence with the public to abolish the present custom of decorating shop fronts with broad plates of brass, they would effect an important oculo-sanitary improvement. These brazen mirrors, when in summer-weather the sunshine is perfectly reflected from them, are in truth a very serious evil to the vision of passers-by.

He also suggests that arrangements should be made to enable persons engaged much in minute work,—

such as sempstresses, to execute as large a portion of their task as possible by daylight, and, for that end, to adopt very early instead of late hours of employment. The less artificial light is used the better. That which is used should be above the level of the face, so as to allow, as in nature, the brow, and lashes, and iris, to shelter the pupil, and thereby the expansion of the optic nerve from the *direct* rays. Neglect of this precaution is injurious in two ways;—first, the influx of such rays continued for a considerable period tends to exhaust the normal susceptibility of the retina;—and, secondly, by eclipsing the brilliancy of the rays reflected from the work, so that the workman is induced to increase the light to a degree otherwise quite superfluous, dazzling, and pernicious.

The Committee take the liberty of suggesting that in the investigations concerning artificial lighting, the effects of temperature, as well as of glare, upon the eye-ball, should be taken into consideration more carefully than is usually done, and perhaps also the influence of the gaseous products of combustion upon the conjunctiva.

As respects the effect of heat on the eyes, reference may be made to the possible injury resulting from the heat and irritating smoke of tobacco pipes, when, for the convenience of holding in the teeth while the hands are employed, they are made short. The bad eyes of cobblers are attributed to this cause in a long communication on the health of that class, written by one of themselves.

J. Dacres Devlin says :—

A shoemaker, a voracious smoker, having been compelled to apply, through the failure of his sight, to the celebrated oculist, Dr. Alexander, this gentlemen, immediately he held the head of the wretched sufferer before his observation, exclaimed, "Why, you have brought this all upon yourself! You are your own eye-destroyer! That short pipe which you stick in your lips is doing it all. Throw that bad and filthy thing aside! There can be no remedy for you until you drop this vile propensity. Why, man, you are burning your very eyeballs out of their sockets." So he told him, and then and afterwards he did what he could for his patient; but all unavailingly as regarded a complete restoration of sight; and now, in his visual benightedness, he is compelled to sell matches in the streets of London.

Another such case has come to my knowledge of a workman who had his tuition under one of the best hands (as a *smoker*) in the west end of London (and that is saying a good deal), but his eyesight failing some twelve or fifteen years ago, he had to leave that, the palace part of London, and get employment at coarser work in the Borough. Latterly, however, even this has been denied him, and he is compelled into the shuddering necessity of plying the varying occupations of a patterer in the New-cut.

I had a closely similar account of a shoemaker the other day—even since the circular of the Society of Arts came into my possession. This person is well known among proficients of the smoking art, so that he has received the nickname of "Bellows Dan."

* * * * * *

He can now follow his shoemaking no longer—his eyes are so damaged; while he has been distinctly told by the Dispensary doctor, to whom he has been forced to turn for help, that he has "burnt all the nerves out of his head." For in this way the story has been repeated to me—meaning, doubtlessly, by the word *head*, the *eyes*, just as Dr. Alexander stated the first-mentioned case to be.

* * * * * *

As the habit is indulged in during the long working hours of week after week, the bowl of the pipe closely sideling up against the leather-like cuticle of the right or left cheek, as it may be, the fine nervous system of the eye, as has already been mentioned, must even be more offended and damaged, and eventually, perhaps, completely destroyed.

The Committee would not wish to assign to the habit, which this writer so energetically denounces, the whole of the effects produced in the above-quoted cases. As far as they can ascertain by inquiry, the local injury done by tobacco-smoking would be more likely to be exhibited in the lids than in the eye-balls or nerves of vision; but the constitutional influence of the drug on the nervous system must not be entirely passed over.

As respects the employment of artificial light by the shoemaker, the same writer remarks that a great improvement has taken place of late years by the introduction of what is called the "Scotch lamp," suspended from the ceiling, instead of the "flats" formerly employed, and that gas also is becoming usual even among those who work at home.

The sameness of colour on which fine work is done, is stated to be especially trying to females employed in ladies' shoe-binding; and the very long hours at which they work is also viewed as a frequent cause of weak sight. As regards a remedy—

The writer does not think it possible by sewing-machines, or any other kind of mindless agency, to be able to command such an amount of variable expertness as that which the fingers, following the direction of the mind, are required to perform.

It appears that the work now in general demand, is, however, less trying to the eyes than the fine stitching required for the high-heeled shoes of our forefathers; for the same communication continues :—

Nor is the maker of the now full dress boot for the gentleman obliged to do, as formerly, in respect of the showiness of the awl-work, which was required in the fine parts, (this technical term meaning the stitching and finishing off of those stiches, as the same are seen displayed on what is called the *welt*), and, as every reader will be able to apprehend, who is old enough to remember the appearance of the gentleman's boot in the sole part 20 years ago, the blacking brush even being made to respect those beautiful proofs of the work-man's skill in stitch-setting and "jigering." Less fortunate, however, than the *woman's man*, and *man's man*, has the *boot-closer* been in regard to his branch of the general trade, on comparing the last 15 or 20 years with the immediately preceding period; and which disadvantage is mainly, if not solely, to be attributed to the introduction of that kind of leather called "patent." A material so beautiful to the eye has necessarily excited to the finest mode of stitching, and

* * * * *

the substance so stitched upon having a shiny jet-black surface, thereby causing the sight of this special artizan to be greatly tried.

It is scarcely necessary for the Committee to remark, after what has been before said, that they cannot agree with the opinion that fine work is in itself an evil to the trade. It wears out the shoes faster, as our correspondent afterwards remarks, and therefore gives him more work, and that highly skilled instead of mechanical work. The danger to the eyes may doubtless be obviated by moderation in their exercise.

Though doubting the possibility of using sewing-machines, the writer mentions some mechanical contrivances which have aided much the shoemaker and spared his eyes of late years. Among others the "pinkers" used for "stabbing."

These pinkers being a series of nicely-cut teeth formed upon the thin edge o fa flat steel bar. * *

Another contrivance is the "wheel-pinker." This is to run along the edged places which require to be stabbed.

This pinked surface is rubbed over with chalk, by the bright colour of which the holes are clearly indicated, and so the eyes saved.

In shoemakers the sight of the eye is sometimes completely destroyed by a particular sort of liability, that of the unexpected breaking of an awl. * * * Those who habituate themselves to press the head down very closely over the knees when at work, or are so compelled from shortness of sight, being in the greatest danger from such accidents.

J. D. Devlin thinks that the great remedy for evils arising from handicraft employments lies in the diffusion of knowledge concerning them, and this end he thinks is most likely to be attained by the publication of cheap writings addressed to special trades—not to artisans in general, but to particular sorts of artizans, which he says will be valued and read.

No broad cure is to be arrived at but through the agency of the easily-to-be-purchased "*class-journal;*" each of the more prominent sections into which industrial exertion has been thrown, must have its own distinct medium of individual inter-communication; * * * for only through such class-publications can worker with worker freely commune.

A series of papers of this character, each having its own distinct purpose, printed under the auspices of the Society of Arts, and sold at the lowest possible paying price, could not, as I feel, but confer a very extensive range of benefit; while, on the other hand, these very different matters, when ultimately brought together in a volume or volumes, and so addressed to the social philosopher in their wholeness, must come to him with the deepest claims on attention.

This last suggestion bears so pointedly on the interests of the working classes in general that the Committee commend it strongly to the attention of the Council and the Society at large, but will not add any remarks of their own to the heartfelt energy of their correspondent.

The observations in the subjoined communication from Dr. Gibb, of Guildford-street, have much originality. It may be remarked that the injuries attributed to the action of potash in a trade not here indigenous arise also in chimney-sweeps in England from the ammonia, a still more stimulating alkali, in soot, getting into the eyes:—

The occupation of "ashes boys," one not known, I believe, in this country, but very common throughout the towns and cities in Lower Canada, is exceedingly injurious to the eyes.

The ashes remaining from the various kinds of wood used as fuel are saved and sold to those boys, whose eyes become diseased from the light powdery dust finding its way on to the surface of the eye, and between the lids. The particular composition of these ashes is the source of the inflammation (which may be said to be chronic from the commencement); they contain the salts of potash in large quantity, which acts as a direct caustic. It is very common to see these boys without any eyelashes, and the lower and upper lids thickened and very red, with constant dribbling of tears.

The occupation, although not known here, is of sufficient interest to mention, in its connection with other sources of injury.

I am quite certain that many—in fact, a large number—of artisans, who are exposed to the influence of dust, grit, chips, splinters, &c., from the nature of their occupation, suffer more in proportion from the absence of beards and whiskers than those who possess these appendages. This is a fact which is becoming established every day. I have followed this observation out to some extent in practice, in the treatment of diseased eyes from dust, &c., with shaven faces, where there appeared to be at the same time a weakness in the organ of vision from the latter cause. On the growth of the beard, when the affection of the eyes was cured, the weakness disappeared, and many whose eyes were before diseased through the nature of their occupation, after obtaining beard and whiskers, were to a great extent exempt from a return of their eye affections.

This may be attributable to two causes:—the *first*, the protection afforded to the face by the hair, the strengthening and tonic influence imparted in consequence to the nerves of the face and eyes, and the general improvement of the health from the comfort experieneed in wearing the beard;—the *second*, the arrest of the particles of dust and grit by the hair of the beard and whiskers, and thus relieving the eyes.

Without at all going into the question as to the propriety of wearing the beard and whiskers, I mention these facts as likely to prove useful in reply to some of the questions in the special memorandum, but I will observe, in conclusion, that there is a great deal of sympathy between the beard and the eyes, and an abundance of evidence could be brought forward to prove it.

Mr. White Cooper, Surgeon to St. Mary's Hospital, reports:—

Chips of Metal, causing injuries to *Turners in Metal, Fitters, Hammermen, Cutlers.*

The injuries inflicted on the eyes by chips of metal are highly serious—1st. From the force with which they strike the eye causing (*a*) extinction of sight from concussion; (*b*) severe penetrating wounds, the fragments often burying themselves in the eyeball. 2nd. From the chips being more or less heated, sometimes red-hot.

Sparks, causing injury to *Foundry-men, Blacksmiths.*

A very common accident with these men is an ignited spark becoming fixed in the cornea, from whence it has to be picked out: a stain is often left, and I have seen instances in which the sight has been impaired by frequent repetition of this accident.

Chips of Stone, causing injury to *Stone-cutters* and *Carvers, Masons, Breakers of Stones on the Highways, Quarrymen.*

In working sandstone or the other softer stones, comparatively little force is required, and if the eyes are struck by chips the injuries are slight; not so in breaking granite or flints; the sharp fragments of flint will penetrate the eye like chips of metal, as I have repeatedly seen, and, from the force required, severe injuries are often received in working granite.

Grit.—Since the introduction of railways, instances are constantly occurring in which sharp angular particles of coke strike the eyes, and often become impacted in the cornea. Whether there or under the lid, they cause excessive irritation, and sometimes violent inflammation. Besides the *Guards, Travellers in open cars* (used on some lines) are especially liable to this injury.

Lime.—Very formidable injuries are inflicted on the eyes by lime, of which I have seen examples in *Masons, Bricklayers, Hodmen,* and *Limeburners.*

Gunpowder.—*Miners, Firework-makers, Rock-blasters,* and *Quarrymen,* are liable to injury of the eyes from the explosion of gunpowder. Besides the burn, grains of powder are often driven into the eye, and unless every particle is carefully picked out, an indelible stain remains.

Dust and Flue.—*Millers, Chimney-sweeps, Mortar-mixers, Dustmen, Drug-grinders,* are exposed to the per-

nicious influence of dust, *Grinders of steel* to metallic dust, *Workers in cotton** and *Wool* and *Feather Cleaners* to flue.

The most common effect of dust is chronic inflammation of the outer covering of the eye and the lining membrane of the eyelids, not unfrequently attended with disease of the margins of the lids, causing loss or misdirection of the eyelashes. The dust of cantharides will sometimes excite violent inflammations of the eyes.

Deficiency of Light.—The classes of persons who, according to my experience, suffer from this in the greatest degree, are tailors, sempstresses, glove makers, and workers with the needle generally, who follow their occupation in ill-lighted and ill-ventilated rooms. The strain upon their eyes is great under ordinary circumstances, but is especially so when they have to work on black materials. For instance, I have invariably found that a general mourning increased the number of applicants for relief at the Ophthalmic Institutions to which I am attached.

Overstraining the Eyes.—This leads me to state that the number of persons who suffer from overwork of the eyes in this metropolis is very great. On referring to my records I find that *thirteen hundred and twenty* such cases came under my notice in nine years, the large majority being tailors, shoemakers, and female workers with the needle. It is not the mere employment *per se* which appears to be productive of so much harm, but the circumstances under which it is conducted and the excess to which it is carried. I have been repeatedly told by milliners that twelve, fourteen, or sixteen hours a day was the ordinary duration of their labours, and this often in foul and badly-ventilated apartments. Milliners and tailors are especially liable to suffer from extraordinary demands upon their powers of endurance; a large amount of work has to be completed in a limited time; this involves the loss of sleep and close confinement in an atmosphere loaded with impurities and heated to an exhausting extent. To recruit their powers stimulants are taken freely by the men, and thus a combination of evils exists which are equally pernicious to the organs of vision and the general health.

Excess of Light.—1st. Degree, *Glass blowers*, *Metal smelters*. 2nd Degree, *Retort men*, *Bakers*, (*oven work*,) *Cooks*.

The intense excitement of the retina, produced by the glare and heat proceeding from the liquid glass and metal, frequently terminates in amaurosis.

The same injurious effect may arise from the occupations placed in the 2nd degree; but chronic inflammations of the outer coverings of the eye are a more common result.

There is a large number of persons engaged in occupations of various sorts, whose eyes are seriously injured from their working by gaslights, which lights are placed before them casting the full heat and glare upon their faces.

The following sugestions have reference to the prevention of injury to the eyes from artificial light.

A. Colour of Light.—To fully understand the object to be attained, it is necessary to bear in mind that daylight is composed of the three primary colours in the following proportions:—yellow 3, red 5, blue 8.

The red and the yellow rays are the most exciting to the eyes, and in direct proportion as artificial light possesses them in excess, is it fatiguing and injurious to those organs.

The bad effects, however, may be obviated, 1st. by surrounding the flame with a chimney tinged pale blue; 2nd. By surrounding the light with a shade coloured azure blue on the inner side; 3rd. By transmitting the light through fluid tinged blue with ammoniuret of copper.

In all these contrivances the colour of the light is improved by the addition of the deficient blue rays.

B. Position of Light.—A frequent cause of the injurious effects of artificial light is the direct and concentrated manner in which it is permitted to fall upon the eyes. No light should be placed in front of the eyes, but should either be above the head, or rather behind, and on one side, so that the object can be well illuminated, whilst the eyes are fully protected from the heat and glare.

C. Unsteadiness of the Flame.—The steadier the flame the better for the eyes; lights should, therefore, have glass chimneys, to assist combustion and prevent flickering.

D. Heat and Dryness.—This cannot be avoided in rooms heated with hot air, nor where there are many lights; but it may be obviated by placing, in some convenient situation, a flat dish containing water; and those engaged in work requiring a strong light should place a large wet sponge near them, to cool and moisten the air by its evaporation.

E. Eye Shades.—When circumstances compel artisans or others to work with lights before them, the eyes may be advantageously protected by shades worn on the face. The ordinary shades have had the objection of heating the forehead and eyes, by not allowing of the escape of the vapour from them. An optician, has, at my suggestion, made a shade working on hinges, which does away with the objection by allowing of ventilation, and it can also be adjusted at any angle most convenient to the wearer.

The simplest and least expensive contrivance for protecting the eyes from chip or grit is a cup, of fine wire, made to completely surround the eye, connected to its fellow and retained in place by elastic bands. These are commonly used by railway guards, and are especially adapted for stone-breakers.

Dust or Flue.—The eyes may be protected from dust or flue by cups of papier maché, having a piece of glass fixed in front.

Steel Dust.—Grinders and polishers of steel, whose eyes are liable to be injured by fine metallic dust, might use with advantage an apparatus similar in form to the above, but having magnetised wire in place of the glass. This would be cooler, and would arrest the particles of dust before they reached the eyes.

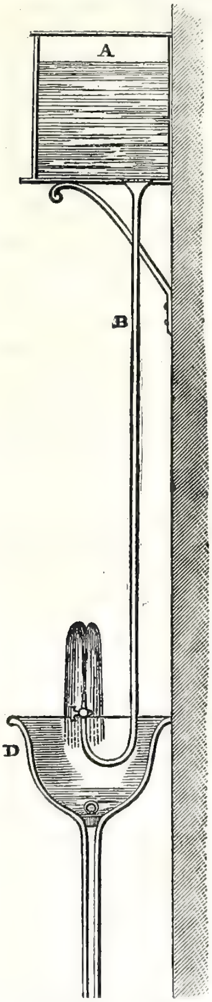
Excess of Light.—Glass-blowers and smelters would find advantage from the use of eye-pieces covered with double gauze or crape, and retained in place by elastic bands; or even a spectacle-frame, with large circular eye-pieces covered with the above materials, would be a considerable protection. Neutral-tinted glass and metallic gauze would be objectionable on account of their speedily acquiring and retaining heat.

It may here be remarked that *full blue* and *green* glasses, which are often worn by persons having weak eyes, are highly objectionable, being of definite colours, and exciting complementary colours. Neutral-tinted glasses being, as the name implies, of no definite hue, screen the eyes from all colours alike, and produce an effect most grateful to irritable eyes.

Dust and Flue.—A simple and efficacious mode of cleansing the eyes would be by having suspended, in cotton and other manufactories, douches for the use of the work-people. In the accompanying sketch (page 126) A is a cistern, capable of holding three or four gallons of water, and fastened to the wall; it is open at the top, to admit of its being filled, and closed by a well-fitted lid, to exclude impurities; a funnel-shaped zinc tube, furnished with a fine strainer, is attached to the bottom. From this extends a pipe (B) of quarter-inch bore; the end is curved, and furnished with a stop-cock, and a rose is attached; D is a

* According to the census for Ireland, 1851, 18 blind persons had been smiths, 100 engaged in spinning, and 73 weavers or weavers' assistants.

zinc basin, furnished with an ordinary plug and waste-pipe, into which the water falls.




By simply holding the face on the rose, and turning the cock more or less, a regulated jet of water can be thrown upon the eyelids, which would effectually remove all impurities and afford the eyes a most refreshing bath.

Mr. Wilde, of Dublin, was the first to recommend this description of douche for hospitals.

Use of Glasses.—Artisans are much in the habit of resorting to magnifying glasses, or "clearers" as they are called, for the purpose of assisting their sight. By enlarging the object they certainly make it more visible, but such glasses improperly used, are often exceedingly injurious to the eyes, increasing congestion and exciting a sensation of straining in them and over the brows. As a general rule, glasses ought never to be resorted to without the sanction of a person acquainted with diseases of the eyes.

Magnifiers. — Watchmakers and other artists who work with a magnifier should never acquire the habit of using one eye only; the glass should be applied to the eyes alternately; by so doing, rest, and an opportunity of recovering from the fatigue produced by the exertion of looking through the magnifier, would be afforded to each.

In conclusion, I shall offer a few general remarks.

The Reports of Eye Infirmaries show that a considerable number of persons present themselves with injuries to the eyes, mechanical and chemical. For example, in the ten years inclusive from 1839 to 1848, of 65,353 patients treated at the Royal Ophthalmic Hospital, Moorfields, 2303 were for wounds of the eyes: of 11,052 applicants at the North London Eye Infirmary, also in ten years, 342 suffered from the same cause; and of 11,233 cases which presented themselves at St. Mark's Hospital, Dublin, 463 were examples of injuries of the eyes and their appendages.

Nevertheless, injuries bear but a small proportion to the enormous number of cases of overwork of the eyes, varying in degree from slight derangement of sight to absolute blindness; but all interfering more or less with the due use of the organs of vision. For example, in the slightest case, the patients are recommended, as an essential part of the treatment, to pause from time to time when working, and give their eyes rest: in the more aggravated cases, the patients find prolonged repose indispensable. Now this very resting of the eyes is an interruption to their work, and as that has generally to be completed in a limited time, the number of hours devoted to it are necessarily increased at the expense of sleep and exercise.

I have no hesitation in expressing my conviction that the general use of sewing-machines would be of incalculable benefit as regards the sight of artisans; they would do away with one of the most fertile sources of ocular disease, and would tend to diminish materially the number of persons who from a comparatively early age are sufferers from imperfect vision.

It has been already stated that insufficient light and bad ventilation are fertile sources of mischief. These will doubtless decrease as improvements in the dwellings of the poor become more general, for the sufferers are mostly the inhabitants of miserable dark rooms, the windows of which are often purposely fastened up, and the apologies for panes of glass so begrimed with filth that light can scarcely enter. It must, however, be borne in mind that the evil of bad ventilation applies equally to the great rooms in which large numbers of workpeople are congregated together. It is in the power of the proprietors of establishments of this description to prevent serious mischief to the eyes of those in their employment by making due provision for ventilation, and by carrying out such suggestions as those contained in this report as to the character and position of the lights in the rooms. It would be easy and inexpensive to arrange them in such a manner that the illumination would be good, and the workpeople not distressed by heat and glare. The vigour and energy with which work would be carried on in cool, well-lighted, well-ventilated apartments, would satisfactorily prove that attention to such points would be as conducive to the interests of the employer as to the health and comfort of the employed.

None of those who have sent communications to the Committee, have noticed the effect of ground glass. They have, however, reason to believe, that harm is often done by the use of this medium for the transmission of light. The intention is to diminish the ill effects of glare on the eye, and to a certain extent that purpose is effected; and if it were necessary to look at the source of light at all—if it were desirable that the direct rays from the illuminating power should fall on the eye—then ground glass would be useful. But as it is, the effect is to diminish the supply of light to the work as well as to the eye, and at the same time to diffuse it about the apartment, instead of directing it aright. So that in reality this glass causes the workman to experience a deficiency of light, unless he increases it to its former intensity.

As a *resume* of the foregoing information it may be stated,

1. That the following classes of artizans are exposed to injury of the eyes from chips, splinters, dust, grit, or fluff, viz., engineers, masons, stonecutters, stonebreakers, bricklayers, soda water bottlers, turners, fitters, hammermen and smiths, cutlers, railway guards, rock blasters and quarrymen, millers, chimney-sweeps, workers in cotton, flax dressers, feather cleaners, drug grinders, (especially in grinding blistering flies) shoemakers (from breaking of the awl); and that the following appliances have been found useful in preventing the ill consequences of such exposure, viz., for those liable to blows from large portions of hard substances, such as stonebreakers, &c., coarse metal netting as eye guards, and for those exposed to the finer dust, crape spectacles, while at the same time free ventilation of the apartments they work in would relieve much of the inconvenience.

2. That the following suffer from the chemical

nature of the substances which, in the shape of solid particles get under the eyelids, viz., bricklayers, workers in lime, workers in potash.

No special preventive seems to be here pointed out beyond the placing within reach of the workmen the ready means of immediately cleansing the parts with pure water. Some such apparatus as that described in Mr. White Cooper's communication might be placed in the workshop or superintendent's office.

(The action of chemical fumes, strictly so-called, has not been reported to cause injury.)

3. That the following suffer from excess of light or glare proceeding from the material used, viz., furnace men, gilders, bookbinders.

No practical remedy for this inconvenience has been suggested, as spectacles which intercept the light would diminish the efficiency of the workman.

It may be observed that there is a great difference between excessive illumination of the work, and excess of light on the eye. The latter is the most common, and is considered under a separate head.

4. That the following suffer from deficiency of light, viz., dressmakers, tailors, sempstresses, cobblers, and, in fact all who, having to direct the needle to a definite spot, are unable to command the requisite amount of direct illumination.

5. That the ill effects of deficiency of light are much aggravated by working long on the same material or colour. The remedies for this and the foregoing evil are, increase of light and variety of work.

6. That flickering of light is a great evil, which is felt much by compositors and all who work at minute objects by gas illumination.

The simple remedy for this is the employment of glass chimneys.

7. It seems improper that an equal quantity of artificial light should fall on the work and on the eyes of the workman. If that is the case the latter become overstrained.

This evil, when it occurs, is easily obviated by shades to the light, which defend the eye, and throw the illumination on the required object. The shades should be made of white or light coloured material, so as to reflect as much light as possible. Ground glass between the light and the worker is injurious, by intercepting and diffusing the illumination instead of directing it on to the object.

8. It seems doubtful whether heat and cold have much ill influences over the healthy eye; but when it is in a weak irritated condition, there is no doubt but that they are injurious.

9. Bad ventilation, constrained postures, over-indulgence in spirituous liquors, the fumes of tobacco, and all other violations of healthy habits, are injurious to the eyes at the same time as to the rest of the body, and aggravate the bad effects of the above-named industrial occupations.

10. The employment of the eye when the body is in an exhausted state from want of food, prolonged working hours, mental distress, &c., even in handicrafts not of themselves pernicious, is very detrimental to the organ. So that the later periods of work are those which are found most materially to weaken the sight and injure the eye.

The shortening of working hours would probably be a saving in the end to both master and artisan; for the faulty execution of that which is completed with an imperfect organ must be a loss to the former, while the latter is ill remunerated by slightly increased wages for the risk of illness which he runs.

11. The diffusion of knowledge bearing on the health of artizans by means of *Class Journals*, is worthy of the serious consideration of the philanthropist.

The Committee beg to report, that they have prepared a list of "Desiderata" in the department of Industrial Pathology, for the Exhibition of the Society, that is, of inventions required to protect the lives and health of working persons in various occupations; which list they recommend to be published and circulated.

They beg also to recommend, for special inquiry during the current year, as the basis of a report to be prepared by the ensuing January, either

The accidents which occur from the faulty construction of machinery, scaffolding, shipping, and other mechanical contrivances; or

The injury to health arising from the inhalation of dust, grit, fluff, and similar foreign matters; or

The effects of the exposure to damp and cold, rendered necessary by some employments.

T. K. CHAMBERS, M.D., *Reporter.*
JOHN SIMON, F.R.S
T. TWINING, Jun.

## SHIPWRECKS BY LIGHTNING.

The following is extracted from an interesting paper which has just been presented to Parliament:

An historical record of well-authenticated instances in which ships and vessels of the Royal Navy have been exposed under various circumstances to the destructive agency of lightning, cannot but prove of great nautical and philosophical interest, beside that it is really of much importance to a maritime country such as Britain to know the probable amount of damage its fleets may sustain at any given instant, through the irresistible operation of one of those mysterious and unsparing natural agencies to which they are so frequently exposed. On the other hand, it is a main object of physical research to discover how and in what way a subtle elementary force in nature such as electricity displays itself, what is the amount of its mechanical or chemical action, and the meteorological and other changes by which it is attended.

Some idea may be formed of the ruinous effects of lightning in the public service by an analysis of 280 instances in which ships of the Royal Navy have been damaged by the unsparing action of the electrical discharge. In order that no doubt or obscurity may arise as to the facts, the names of the ships, dates, and circumstances, as taken from the official log-books and other records, are given in an Appendix. It is not possible to ascertain every case which has occurred, or, could we treat such in detail, that would be, in fact, to write a painful history of the most unparalleled and afflicting calamity. The *Thisbe* frigate was struck by lightning off Scilly, in January, 1786. It is not a solitary instance—the *Lowestoffe*, a sister ship, was set on fire and dismasted in a similar way in March, 1796.

The cases quoted may be taken, with slight exceptions, as having happened between the years 1790 and 1840, comprising a period of about fifty years. They include 106 ships-of-the-line, 70 frigates, 80 sloops and brigs, 2 schooners, 7 cutters, 5 sheer hulks, 5 ships in ordinary, 5 steamers (2 built of iron); no kind or class of vessel therefore has escaped. The following are the results of a careful analysis of these cases :—

There were damaged or destroyed at least 185 lower masts, of which 135, or nearly three-fourths, were lower masts of line-of-battle ships and frigates; full 100 were completely ruined as masts;* of topmasts, 180 were ruined or damaged; more than two-thirds were the topmasts of ships-of-the line and frigates; nearly all were either destroyed or ruined as spars; of topgallantmasts about 150 were destroyed, the greater part of which also belonged to large ships. In addition to this we find a serious amount of rigging and sails, and other stores, either ruined or completely destroyed, or what is called expended.

In about one-eighth of the cases the ships were set on fire in some parts of the masts, sails, or rigging, and in great peril, and in some instances severely damaged in the hull.

The total loss to the country in material alone could not have been far short of £150,000 upon these cases only. Taking into the account every contingency and the number of ships at sea, the public expenditure, on account of damage done to its navy by lightning, would, upon a moderate estimate, be from £7,000 to £10,000 a year upon twenty-three years of the war, between the years 1792 and 1815 and from £1,000 to £3,000 a year upon twenty-three years of the subsequent peace.

Besides this great destruction of material, we find in these cases a serious loss of life or injury to our seamen. Nearly 100 seamen were killed, 250 and upwards dangerously hurt, and full 200 struck down on the decks; in some cases 20 to 40 at one time. The Repulse, 74, No. 162, lost seven men killed on the spot, and ten more were so disabled as to be of little use to the service after. The Sultan, 74, No. 203, had seven men killed at once; and in the Thunderer, 74, No. 219, all the watch in the maintop were paralysed, and had to be lowered down by ropes.

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The recorded instances of the effects of lightning in the merchant navy are quite appalling.

At least 18 merchant ships, varying from 300 to 800 tons each, are known to have been totally destroyed by this terrible agency within the last 20 years.

* * * * * *

The vast amount of destruction by lightning to ships would certainly have never occurred had any efficient method of electrical conductors been invented, applicable to all the variable and complicated conditions under which the general structure of a ship in all its casualties might become placed. Ships in former times, and to a great extent even in the present, were either unprovided with any means of parrying the electrical shock, or if provided with them, the conductors in use were of such small capacity, so partially and ill-applied, and so dependent on the prejudices of sailors for due care and attention to them, that very little advantage seems to have arisen out of this means of preservation in lightning storms.

CAPACIOUS AND PERMANENTLY FIXED CONDUCTORS.

In 1820, Mr. Snow Harris, having devoted himself to the investigation of the question of the defence of the Royal Navy from lightning, and the nature and effects of the electrical discharge, proposed to the Board of Admiralty a new method of capacious electrical conductors, to be permanently fixed and systematically applied upon demonstrable scientific principles, along the masts and generally throughout the hull of a ship, so as to make the vessel itself integrally secure from lightning at all times, and under all circumstances, without the officers and crew of the ship incurring any responsibility whatever for due attention to the conductors, or care in handling, placing, or replacing them, as in the case of the ordinary chains applied as rigging.

Upon the faith of original physical researches, printed in the Transactions of the Royal Society, and in other philosophical works, the inventor was led to discard the prevailing notions relative to the nature and operation of the electrical discharge, as exhibited under the form of lightning; without stopping to inquire whether electrical phenomena were dependent on an invisible fluid or fluids, attractable or attractive of certain kinds of matter, or of matter generally, he came at once to the immediate elementary result, deducible from an immense induction of facts, as recorded in the official log-books of the British navy, and in other authentic records, viz., that what we commonly call lightning is an explosive form of action of some unknown natural agency, when forcing a path, as it were, through matter, the constitution of which is such as to resist its progress, such bodies, for example, as atmospheric air, glass, pitch, wood, &c., &c., whilst in falling upon other kinds of matter, such as the metals, the constitution of which is such as to oppose but a small resistance to its progress, this explosive form of action we term lightning is no longer apparent, but is converted as it were into a sort of comparatively quiescent current, the expansive force of which is always in some direct ratio of the resistance opposed to it. That the dominant law which determines the course of a stroke of lightning and its usually attendant destructive effects, is altogether dependant on this great truth. So far as the unknown agency we term electricity is concerned, Cavendish has shown that all kinds of matter are, in respect of any peculiar specific attraction, alike indifferent to it; that an equal division of an electrical charge always obtains between bodies, without regard to the kind of matter of which they consist; the French philosopher, Coulombe, arrived at a similar result. That, in the progress of a stroke of lightning, the electrical agency, whatever it be, seeks to pursue the least resisting course between certain surfaces of action, represented in nature by the clouds, land, or sea. If metallic bodies be present, and they happen to be in a position favourable to the progress of the electrical agency, then they become subject to the force of the discharge; but if not in such a position, then the discharge assails other bodies. The whole, therefore, of the path of the electrical discharge is resolvable into a question of resistance and distance.

Admitting the truth of this great general principle, Mr. Harris came to the conclusion that if a ship were non-resisting in all its parts in respect of the electrical discharge, no damage would arise to it when assailed by lightning, since, at the instant of the explosion falling upon any point, the explosive form of action would vanish, and would become converted into what may be considered

* A 74-gun ship's mainmast, of Riga spars, has cost in the war £1,008, and £848 since the peace; a maintopmast £140 nearly; when made of other spars, the cost has been less, but it has been occasionally still very considerable. The cost of the mainmast of a three-deck ship reached during the last war £1,400.

as comparatively quiescent currents of electricity, having unlimited expansion in all directions upon the surface of the sea, that is, upon one of the surfaces to which, by a law of nature, the discharge tends. To arrive, therefore, at very perfect security from lightning on shipboard, he concluded that we should endeavour to bring the general fabric into that passive or non-resisting state it would have, supposing the whole structure were a mass of metal. The proposal then was, upon the faith of these principles, to fix capacious conductors in the masts, and to unite these with the metallic masses in the hull and with the sea, so as to give the electrical discharge unlimited room of expansion in all directions, by which the explosive form of action we call lightning would vanish. Although a method of applying lightning conductors in ships under a fixed form had been long called for, yet was this proposal received at first with much apprehension, as being calculated to draw down lightning upon the vessel. Many naval officers thought it impossible to contrive a conductor in the way proposed, such as would stand the strain and flexure of the spars under sail; so that it was not until further, and repeated, and distressing damage to the navy by lightning had occurred, that the Board of Admiralty determined, after ten years had elapsed, to give Mr. Harris's system a trial, contrary to the opinion of many prejudiced persons, who predicted the destruction of the ships in which the new conductors had been placed.

It may be here observed that, in consequence of Sir Snow Harris's scientific inquiries, the results of which have been published in the transactions of learned societies, as also on many occasions in a separate form, a vast amount of prejudice on the subject of lightning has been dispelled, and the progress of useful knowledge greatly advanced in the Royal Navy. When this plan was first proposed, viz., in 1820, now more than thirty years since, very unsound views and very singular prejudices prevailed, especially amongst sailors, relative to the agency of lightning. Every piece of metal was considered as an attractor, and hence a source of destruction. It was customary to put wet swabs into the pumps and over the doors of the magazines, with a view to keep out the lightning. Vulgar prejudices of this kind certainly retarded a complete and effectual preservation of the navy from lightning for a period of at least twenty years.

The system as now applied in the ships of her Britannic Majesty's navy is as follows:—Lines of metal are incorporated with the several masts throughout their entire length, from the truck aloft to the heel of the lower masts; the lines of metal consist of copper plates, in series of lengths of about four feet, varying from one and a half to four inches in width, and 1-16th to 1-8th of an inch in thickness. These plates are carefully cut by a circular saw so as to be everywhere parallel, and are otherwise prepared for fixing; they are conjoined in two layers, of 1-8th and 1-16th of an inch thick, an upper and under layer, and are so placed as to cause the butts or joints of the one to fall under or over the continuous portions of the other. In this way we obtain a continuous line of metal, in a series of shut joints, calculated to yield to any flexure of the spars under a press of sail, without disturbing the line of conduction. The plates are secured in shallow grooves, ploughed out of the aft sides of the several spars, by means of appropriate planes or other tools; they, the plates, are turned round the several mast-heads, so as to unite with the metallic lines on the next mast, through the caps in which they are supported; the plates are finally turned round the heel of the lower mast, and rest upon similar plates which surround and envelope the step; these again unite with other similar lines of metal, connecting all the keelson bolts driven through the keel to the copper sheathing outside the ship. Similar lines of metal pass transversely under the beams from the points of the deck in which the masts are placed to the sides of the ship, and there unite with the iron knees and bolts driven through the planking and framework to the copper expanded on the bottom; these transverse lines of metal unite with the lines of metal on the masts, as they pass into the ship. There are other similar lines of metal passing from the foremast to the stem, and from the mizenmast to the stern-post; and thus we see that the whole fabric, from the truck to the sea, may be considered, in an electrical sense, as one uniformly conducting mass; so that when lightning strikes upon any point, the explosive form of action vanishes, the electrical discharge has unlimited room of expansion in all directions, and no damage can arise to the ship, as experience of the preservation of the Royal Navy of this country fully shows.

Moreover, this system fulfils all the conditions essential to a practical application of lightning conductors in ships; it had been the great defect of the temporary chains hitherto used that the conductor was partially, not generally, applied, being of small calibre, and liable to all the damage incidental to a ship's rigging, seldom in place when required, always a source of trouble and anxiety to the officers and crew of the vessel, who were held responsible for its repair and due application, and who were always exposed to danger whilst handling it in thunder storms.

Now, in the case of a permanently fixed system, such as that just described, forming an integral part of the ship itself, all these difficulties vanish, *e.g.*, the conductors by which the safety of the general structure is insured are quite independent of the crew of the ship, are always in place, always ready to meet the most unexpected danger; and whilst clear of the standing and running rigging, they admit of every possible motion of the spars, one on the other; or of any portion of the mast being removed, either by accident or design, without interfering in the least degree with the required security; being independent of the crew, the sailors are not required to meddle in any way with the conductors, to their great peril and annoyance. Finally, a discharge of lightning falling upon any given point cannot enter upon any course of which the fixed lines of conduction do not form a part; so that this system fulfils strictly all the conditions essential to perfect security.

Sir Snow Harris has shown, in his various papers on this subject, that this system is in accordance with all the general laws of electrical discharge; that in whatever position the sliding or moveable portions of the mast be placed, or however circumstanced, the existing conducting lines present a course to the sea, having less resistance than any other which can be assigned, and that hence the mere position, or fracture, or removal of any portion of the mast, is a matter of indifference.

It will be immediately perceived, on a very slight review of these elementary principles, that the method of electrical conductors to ships proposed by Sir Snow Harris resolves itself into a great general system, by which a ship is effectually secured against lightning in all its parts as a whole, upon demonstrable scientific principles; it hence differs essentially from the common methods of application of a small wire or metallic chain applied as rigging, and which has been not unfrequently applied, in a very hypothetical way, for good or evil, as a sort of nostrum, calculated to draw down lightning upon itself and thereby protect other parts of the vessel; charming as it were to rest the otherwise unruly spirit of the storm. This at once marks the difference between the new method of lightning conductors for ships and that of the ordinary methods after the lightning rods of Franklin, a question not unfrequently asked by naval men. The large amount of experience of the new system in the Royal Navy for more than a quarter of a century, embracing, as it does, the application of lightning conductors in the most general and unreserved way, has amply resolved all those long-controverted questions relative to lightning rods which engaged the attention of so many eminent philosophers of the last century; *e. g.*, whether metallic conductors are an effectual security against lightning? Whether such substances attract lightning? Whether

they prevent explosions of lightning? At what distance does their protecting power extend? All such questions are now no longer problematical.

It may not be unsatisfactory, in the way of evidence, to advert briefly to a few of the most remarkable of these instances of the preservation of her Majesty's ships by lightning, as recorded in official letters and other public documents.

Her Majesty's sloop *Scylla* was struck by lightning at sea, in the West Indies, on 6th August, 1843, at 7 a.m. The ship had just shortened sail to a squall, with a dense black cloud overspreading the sea. This cloud poured forth its terrific lightnings, on the mainmast with an explosion which, to use the captain's expression, "shook the ship to the keelson;" but no damage ensued; the electrical discharge was rapidly transmitted by the conductors through the ship into the sea. The captain of the *Scylla* enclosed a copy of the log to his commander-in-chief, Admiral Sir C. Adam, with this remark, "I cannot omit this opportunity of recording my high opinion of the lightning conductors on Harris's plan, and with which the *Scylla* is fitted; if we had not had them, the mainmast must have been shivered, and perhaps a more serious disaster would have befallen us." She had, according to the log, shortened sailed at 7.50 a.m.; at 8.20 a.m., that is, within about half an hour, sail was made again, and the ordinary duties of the ship went on as if nothing had happened. If this result be compared with such cases as quoted, with that of the Thisbe, for example, then, as must be allowed, it is a vast gain for our navy.*

The case of the *Fisgard*, struck by lightning in the Oregon territory, at 7·45 p.m., 26th of September, 1846, is another important case. Captain Duntz says in his official letter, "Mr. Rodd, the senior lieutenant, is of opinion, from the severity of the shock, that but for the efficiency of the conductors, the mainmast must have been totally destroyed, and much serious damage have occurred, in which opinion I fully coincide." Mr. Rodd was standing on deck, within three yards of the mainmast, when the lightning struck the mast. The vane spindle aloft was melted, and everyone in the ship was under a momentary panic.

Captain Sir Baldwin Walker, in his report of the *Constance*, struck by lightning on the coast of Mexico, on the night of the 19th July, 1847, says, "I cannot speak too highly of the conductors of this ship, which are fitted on Mr. Snow Harris's principle. The thunderstorm was so violent that, had it not been for the perfect way in which they are fitted, our top-gallant masts being housed at the time, this ship would probably have lost her masts, besides being otherwise disabled, which on this coast, during the present bad season, might have been attended with serious consequences."

The official report from Captain Sir Everard Home, of the *Calliope*, struck by a heavy shock of lightning on the 16th July, 1851, on her passage from Hobart Town to Sydney, is another most satisfactory acknowledgment of the value of the conductors. "Captain Home was made aware of what had taken place by seeing a mass of fire as it appeared in the fore part of the cabin, and an explosion as loud as if the gun nearest the door had been fired. The lightning passed out of the ship upon each side. The mast is uninjured." †

The saving to the public exchequer upon the few cases recorded could not have been less than from £20,000 to £30,000, on a moderate computation.

* * * * * *

Now, it is to be observed that within the short space of 16 months, viz., between March, 1846, and July, 1847, no less than ten ships, including four large frigates, were preserved from the usual destructive action of lightning on foreign stations, by which at least £10,000 must have been saved to her Majesty's Treasury.

* The case of the Sappho, 18, Appendix 1, presents a most remarkable coincidence in the attendant circumstances; here, however, the spars were knocked in pieces, and ten of the crew either killed or hurt.

Former Boards of Admiralty, fully aware of the great practical value of Sir Snow Harris's method of guarding ships against lightning, have required in their contracts for mail boats that his conductors should be provided, and have furnished private builders with plans and instructions for their guidance in fitting them. Private companies, and the owners of many fine merchant ships, have begun to adopt the same method. The ships of foreign powers building in this country are nearly all fitted with the conductors, as in the public service, so that, in fact, the general shipping interest, the merchant and shipowner, the private builder, and powerful private companies are all being benefited by Sir Snow Harris's long and anxious labours.

* * * * * *

Upon a review of this mass of evidence relative to Sir Snow Harris's method of lightning conductors for ships, we arrive necessarily at this most important deduction, viz., the complete security at all times, and under all circumstances, of the Royal Navy from the destructive element of lightning, a proved source of shipwreck in every form; an element which, in former periods of its history, constantly deprived the country of the efficient services of its ships and fleets, wasted the public treasure to a serious amount, and destroyed or crippled its sailors; and this stands proved by the testimony of some of the greatest naval and scientific authorities in the world, by the experience of nearly a quarter of a century, by numerous public documents, including official letters and reports, and by the united opinion and approbation of nearly every naval officer in her Majesty's service.

## Home Correspondence.

### THE F.S.A. QUESTION.

SIR,—The initials, F.S.A. and F.A.S. would appear indiscriminately to have appertained to, and signified, Fellowship with the Society of Antiquaries from time immemorial. Your correspondent W. H., however, suggests that as unscrupulous use appears already to have been made of the same by, or on behalf of, some members of the Society of Arts, that such a course should be continued by its members in order to raise their position as a Society as high as any others. Now, sir, I have yet to learn that the members of this or any other Society will raise their position by any such conduct. The well-known initials of the Society of Arts, viz., M.S.A., are surely in themselves sufficiently honourable, without our descending to the meanness of strutting in the borrowed plumes of any other Society than our own. And even if the term *membership*, as distinguished from *fellowship*, seems less aristocratic—surely, as we have in the same category with ourselves the Geographical Society, the Royal Society of Literature, the Royal Asiatic Society, and other of the leading Societies which I could name, enjoying the peculiarity of conferring *memberships* and not *fellowships*, we have no great cause for grumbling; rather let us (and with good cause) be proud that the Society of Arts has of late years taken so prominent a position among Societies—by no dissembling of initial titles, be it remembered—but by sheer talent and enterprise. May it always be so distinguished. is the wish of,

Sir, your obedient servant,

F.S.A. *et* M.S.A.

London, Jan. 6, 1855.

SIR,—The advertisement put forth by the Society of Antiquaries, to which your correspondent from Blackburn has alluded, held out the threat that the names of all persons using the above letters as an addition, without

being members of that Society, would be *published.* I do not suppose, sir, that any man but an adventurer would, wittingly, use either a title or an addition to which he had no right. Members of the Society of Arts have had letters *addressed* to them with the addition of F.S.A.; but this they could not prevent. They are certainly entitled to *some* addition, as much as the Society of Antiquaries. The letters M.S.A. would be most in accordance with the words of their diploma, and I trust that the Council of our Society will favour them with instructions upon the subject.

Faithfully yours,

M. S. A.

Cheltenham, January 6th, 1855.

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Sir,—Your correspondent, "W. H.," in discussing the late determination of the Council of the Society of Antiquaries, asks "why *members* of the Society of Arts should not have an equal standing with those of the Antiquaries, &c.," and be entitled to the initials F.S.A. or F.A.S. The truth is that in all societies wherein the election is almost *nominal*, and requiring no qualification or examination, and open to an unlimited number, the addition of its initials after a member's name confers little or indeed no distinction. The question, however, should not rest here, but deserves consideration as to the possibility of making the initials of the Society a real distinction—an object of ambition and a means of getting good service from its members. It ought to be ascertained if the Society has, or should obtain, power to elect from its body a certain number of *Fellows*, men who have really distinguished themselves in its service, either by their communications, their work on its committees, or their world-acknowledged talent devoted to aid their efforts. I feel little doubt that able men would be attached to the Society by these means and work out its intentions more zealously, *if*,—and this is a serious if,—the distinction were only won by real merit, and the award not made merely by the Council, but by men competent to judge of that merit. The highest medals of the Society would have increased value if such a distinction were added to them, and services which could no otherwise be paid would be rewarded by such an election, if it were limited in number and just in its award.

I am Sir, yours truly,

R. A.

Kensington, Jan. 8th, 1855.

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Sir,—Your correspondent, "W. H.," in the last number, opens a question which, I humbly think, ought definitively to be settled by the Society of Arts. The question is, have the constituents of the Society a right to call themselves Fellows, or merely Members. On reference it will be found that the charter speaks only of Members, no allusion being made to Fellows. But then it must be remembered that the word Member is generic in signification, and, as the charter expressly permits of bye-laws being made not beyond its scope, so it would appear permissable to designate some of the constituents, who would necessarily be members, "Fellows," as in like manner some are called Vice-Presidents, &c. But until such a bye-law is made it appears to me we are only members, and that we may violate that noted Act against the assumption of illegal titles in dubbing ourselves Fellows. I cannot help thinking, however, that it is highly expedient that the members of the Society of Arts should be placed on a level with the members of other societies in the use of the conventional symbol, or ornamental appendage, denoting membership. Many societies which offer this coveted honour are of recent origin—most of them had not been called from the vasty deep when our Society was 50 years old. And now we have astronomers, geographers, geologists, zoologists, Linnæists, statists, numismatists, horticulturists, florists—and they are all Fellows; and pray, sir, why should not we be Fellows, *good* Fellows, and so say all of *us*. Are we less numerous than the —— less respectable than any of them; are our members less distinguished than those of the ——? If they elect by ballot, so do we; if ours is a mixed body so is even the Royal Society, taking away the representatives of *physical* science, the doctors. But not to indulge "in oderus caparisons," as Mrs. Malaprop has it, not one of these societies has for its President a Royal Prince (and so great a Prince), as we have. Membership in certain cases seems to be considered a high honour, as, for instance, Member of Parliament, the highest honour, it is said, that can be conferred on a commoner; Member of the Privy Council, &c. The term, however, when used in connexion with scientific societies, seems to convey an idea of inferiority to that of Fellow, and, therefore, I think it expedient that we should be placed on a level with the societies I have alluded to; or I would venture to suggest the propriety of conferring Fellowship after seven years' probation. I say seven years, because this is the magic term which seems to give so much virtue to barristers in the eyes of our legislators, a barrister of seven years' standing being fit for any of the thousand and one places which Government and the House of Commons are continually creating for them. Sir, permit me to say, in conclusion, that I hope this question will be ventilated in the columns of our Journal, and finally and satisfactorily adjudicated on by the Council.

I am, sir,

Your obedient servant,

C. B.

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## PRODUCTS FROM COAL—BENZINE.

Sir,—In reply to Mr. Mansfield's letter, which appeared in your valuable Journal, 29th of December, I beg to state that I have no time for newspaper polemics, the more so when it is to prove the priority of an invention. I believe that the best place to discuss such subjects is a Court of Law.

I remain, sir,

Your obedient servant,

F. CRACE CALVERT, F.C.S.

Manchester, Royal Institution, 9th January, 1855.

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## Proceedings of Institutions.

Waterford.—Professor Shaw, of Queen's College, Cork, commenced a course of nine lectures "On Heat and the Steam Engine," at the Mechanics' Scientific Institute last Thursday week. The lectures are to be delivered, generally, on alternate evenings. One of the course is "On the pressure and motive power of liquids, gases and vapours."

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## MEETINGS FOR THE ENSUING WEEK.

Mon. Chemical, 8.
Statistical, 8. Mr. Alfred Waddilove, D.C.L., "On the effect of the Recent Orders in Council in respect to our own Commerce and that of Neutrals."
Royal Instit., 3. Prof. Tyndall, "On Magnetism."

Tues. Civil Engineers, 8. Mr. Rennie, "Description of the Aqueduct of Roque-favour, near Marseilles."
Linnæan, 8.
Pathological, 8.

Wed. London Inst., 7.
Society of Arts, 8. Mr. George Muir, "On the Smoke Nuisance, considered historically, morally, scientifically, and practically."
Geological, 8. 1. Mr. E. Hopkins, "On the Cleavage Structure of Primary Rocks." 2. Mr. Odernheimer, "On the Geology of the Peel River district, Australia."

Thurs. Royal Inst., 3. Mr. W. B. Donne, "On English Literature."
Antiquaries, 8.
Royal, 8½.

Fri. Royal Inst., 8½. Prof. Faraday, "On some Points of Magnetic Philosophy."

Sat. Royal Inst., 3. Dr. J. — Gladstone, "On the Principles of Chemistry."
Medical, 8.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Jan. 5th*, 1854.]

*Dated 6th October*, 1854.

2149. A. Smith, Princes-street—Safety cage for miners.

*Dated 16th December*, 1854.

2647. D. C. Hewitt, Richmond—Pianofortes.
2649. J. Sykes, Huddersfield—Piecing machines.
2651. T. Forshaw, Manchester—Beetling woven fabrics.
2653. J. Fenton, Low-moor Iron Works—Axles, piston rods, shafts, &c.
2655. R. L. Chance, Birmingham—Glass.
2657. J. Martin, Soho-square—Apparatus for cleaning windows.

*Dated 18th December*, 1854.

2659. M. Morrison, Chelsea—Preserving paintings on glass.
2663. R. Von Seckendorff, St. Helen's—Sulphuric acid.
2665. T. Hart, 255, George-street, Glasgow—Jacquard apparatus for weaving.
2667. J. Cunningham, West Arthurlie—Starching textile fabrics.
2669. J. Pritchard, Portsea—Screw propellers.

*Dated 19th December*, 1854.

2670. A. F. J. Favrel, Paris—Machine for beating precious metals.
2672. J. B. Falguière, Marseilles—Propelling vessels.
2673. J. Avery, 32, Essex-street, Strand—Machinery for cutting metallic bars. (A communication.)
2674. F. R. A. Glover, Bury-street, St. James—Carriages.
2675. J. G. Briggs, Kingsland—Fuel.
2676. J. and R. Langridge, Bristol—Corsets.
2677. J. Tucker, Bristol—Ships.
2678. J. Quick, Sumner-street, Southwark—Furnaces.

*Sealed 20th December*, 1854.

2679. W. Bittleston, sen., 26, Mary-street—Ploughs.
2680. R. B. Huygens, Holland—Ordnance and fire-arms and projectiles.
2681. J. Paul, Manchester—Paper staining.
2682. J. Higgins, Oldham—Steam boilers.
2684. W. Milner, Liverpool—Safes and locks.
2685. A. Cochrane, Kirkton Bleach Works—Starching textile fabrics.
2686. R. Whytoch, and T. Preston, Edinburgh—Twist lace machinery to fabrics.
2687. G. T. Bousfield, Sussex-place, Loughborough-road—Splitting leather. (A communication.)
2688. R. Walker, Glasgow—Telegraphing.

*Dated 21st December*, 1854.

2689. T. and S. Baker, Liverpool—Lifting and lowering heavy weights.
2690. J. Venables and A. Mann, Burslem—Printing and fixing colours in earthenware and other substances.
2691. G. Bell, 21, Cannon-street West, and G. C. Grimes, Wandsworth—Lucifer matches.
2692. W. Bertram, Woolwich—Iron ships, &c.
2693. W. Greener, Birmingham—Repeating fire-arms and cartridges.
2694. H. Render, Liverpool—Night lights.
2696. G. J. Sculfort, Mauberge, France—Screw plates.
2697. J. Smith, Bedford—Buckle.
2698. J. H. Johnson, 47, Lincoln's-inn-fields—Railway wheels. (A communication.)
2699. J. H. Johnson, 47, Lincoln's-inn-fields—Application of the electrotype or galvano-plastic processes. (A communication.)

*Dated 22nd December* 1854.

2700. L. J. F. Margueritte, Paris—Sulphuric acid.
2702. J. Hunt, Birmingham—Illumination.
2704. R. Ashworth, and S. Stott, Rochdale—Spinning machinery.
2706. E. Loysel, Paris—Cooking apparatus.
2708. J. H. Johnson, 47, Lincoln's-inn-fields—Electro-magnetic engines. (A communication.)
2710. F. M. Baudouin, Paris—Isolating telegraph wires.

*Dated 23rd December*, 1854.

2712. B. M. Giroux, Liege—Locks.
2714. J. F. Porter, Besborough-street—Bricks and tiles.
2716. J. KcKelvey, Belfast—Spinning, &c.
2718. A. Henfrey, Turin—Railways for steep gradients and in working same.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2764. S. S. Shipley, Stoke Newington—Fittings for dressing cases—30th December, 1854.
1. E. Frascara, 12, Alfred-place, Bedford-square—Voltaic pile, and the application of its electric fluid either to the decomposition of water, or to enable the gas to replace the steam-power actually in use.—1st January, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed January 5th*, 1855.

1499. Joseph Ellisdon, Liverpool—Improvements applicable to reading, lounging, and other chairs.
1521. William Houghton and Robert Hoyle, Bury—Improvements in machinery for spinning and doubling cotton and other fibrous substances.
1591. Richard Roberts, Manchester—Improvements in machinery for preparing to be spun cotton and other fibres.
1631. Alfred Vincent Newton, 66, Chancery-lane—Improvement in the process of converting wood into paper.
1841. William Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture of carding apparatus for the preparation of fibrous materials.
1917. George Lewis, High Cross street, Leicester—Improvements in the construction of locks.
2227. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in preventing collisions on railways.
2327. Charles Hargrove, Birmingham—Improvements in annealing cast-iron, or in rendering cast-iron malleable.
2357. Thomas Metcalfe, High-street, Camden-town—Improvements in the construction of portable carriages, chairs, and other articles for sitting or reclining upon.
2383. Frederick Smith, York-street, Lambeth—Improved construction of smoke-consuming furnace.

*Sealed January 8th*, 1855.

1502. William Robinson and Robert Crighton, Manchester—Improvements in machinery or apparatus for rolling metals into suitable shapes or forms.
1506. Felix Lieven Bauwens, Pimlico—Improvements in the manufacture of soap.

*Sealed January 9th*, 1855.

1517. Thomas Richards Harding, Leeds—Improved mode of doffing fibrous materials from hackle cylinders and gill or porcupine or preparing rollers.
1536. Arthur James Lane, Surbiton—Improvements in breech-loading fire-arms.
1538. John Greenwood, Irwell Springs, near Bacup, and Robert Smith, Bacup—Improvements in sizeing, stiffening, and finishing textile materials or fabrics.
1540. Edwin Travis, Oldham—Improvements in machinery or apparatus for indicating and registering the height of water, and also the pressure of steam in steam boilers or generators.
1546. William Bishop, Boston—Improvements in machinery or apparatus for ticketing or labeling spools, parcels of the same, or other similar parcels.
1552. Astley Paston Price, Margate—Improvements in the distillation of wood and of other vegetable substances.
1622. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the preparation of silk. (A communication.)
1654. François Desiré Molvé and Pierre Martin, Paris—Improvements in heating water for feeding boilers of locomotives and marine steam engines.
1720. John Cunningham, Beith, Ayr—Improvements in the preparation or production of printing surfaces.
1730. Samuel Lucas, Dronfield Foundry, near Sheffield—Improved mode of manufacturing steel.
1746. Jean Baptiste Ambroise Marcelin Jobard, Brussels—New system of pump.
1978. John Norton, Cork—Improvements in the manufacture of ropes, bands, and cordage.
2370. Edme Augustin Chameroy, Paris—Improvements in the junction of sheet metal pipes and apparatus employed therewith.
2384. George Ross, Falcon-square—Improvements applicable to the manufacture of articles of caoutchouc or of compositions of which caoutchouc forms a component part.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| Date of Registration. | No. in the Register. | Title. | Proprietors' Name. | Address |
|---|---|---|---|---|
| Jan. 3. | 3675 | Cigar and Tobacco Magazine and Rack... | George Dowler........ | Birmingham. |
| ,, 9. | 3676 | Certain Parts of Folding or Camp Bedsteads ........ | John Thompson ........ | 19 Clarendon-villas, Notting-hill. |

Journal of the Society of Arts.

*FRIDAY, JANUARY* 19, 1854.

## ARTIZANS' VISITS TO PARIS.

The Committee met on Saturday, the 6th instant, T. Winkworth, Esq., in the chair. The Committee has learnt that cheap trips, on an extensive scale, to and from Paris, during the period of the ensuing Exhibition, at low fares, have already been organized.

The Committee is actively engaged in promoting the completion of arrangements for boarding and lodging the excursionists in Paris during their stay there, with interpreter guides, &c., on reasonable terms. As soon as the Committee is in possession of the actual terms on which the service will be performed, no time will be lost in making them known to the Institutions, with full information as to the means and expense by and at which individuals may avail themselves of the advantages offered.

## INTERNATIONAL COMMERCIAL LAW.

A requisition having been made to the Council by several members of the Society, to the effect that it is necessary that another step should be taken by the Society to give practical vitality to the recent resolutions of the Council upon the improvement of International Commercial Law, the Council has appointed the evening of Friday, the 2nd of February, for the purpose of taking into consideration this important subject. At this meeting a short paper will be read, as introductory to a discussion.

The Council cordially concurs in the opinion expressed by one of the requisitionists, "that our Society, whose object is the Encouragement of Arts, Manufactures, and Commerce, ought to be at the head of this movement; for what would so certainly encourage, and tend to extend the arts, manufactures, and trade of all countries, one with the other, as a Code of Commercial Law by which the rights of traders as partners, as debtors, and as creditors—as shipowners—as insurers—as shareholders in national enterprises—as well as the rights of authors and artists, should be alike, and governed by the same forms of procedure in all."

The Council has received replies from the Chambers of Commerce in Belfast, Bradford, Bristol, Hanley, Liverpool, and Newcastle, approving of the suggestion that a congress should be held in Paris during the occurrence of the Universal Exposition this year; and the latter body remarks, that they conceive that it is one of the best means of bringing this question to a favourable issue. The replies from the Blackburn Chamber of Commerce and the Manchester Commercial Association do not express a distinct opinion, either for or against the proposed congress.

The following practical illustrations explain the objects contemplated by the proposed European Congress in Paris for the promotion of International Commercial Law:—

A most excellent opportunity presents itself in the forthcoming "Exposition Universelle" in Paris, in 1855, for advancing the assimilation of the Mercantile Laws of Nations. The Edinburgh Society for the Promotion of an International Commercial Code, presided over by Professor More, have transmitted an address on the subject to his Majesty the Emperor of the French, and by his instructions the same has been remitted to the Legislative Section of the Council of State, to report thereon to the Emperor.

During the preliminary arrangements for the holding of the Conference in London in 1852 on the assimilation of the commercial laws of England, Ireland, and Scotland, we had seriously in view the great importance of promoting a Commercial Code for the British empire, including the Colonies and Dependencies; and also that it should be so framed, stripped of all useless technicality, that, like the Justinean Code, it might be adopted by almost every other nation. Nevertheless, much difficulty was apprehended in the attempt to assimilate the mercantile laws beyond the three United Kingdoms. As to the Colonies, it was found that many of them are still governed by foreign laws—such as Canada and the Mauritius, by the French law; British Guiana, the Cape of Good Hope, and Ceylon, by the Roman Dutch Law; Trinidad by the Spanish law, &c. And as to foreign countries it was deemed desirable to endeavour, in the first instance, to assimilate the laws at home; and, in doing so, to examine, in a candid spirit, the institutions of foreign states, with a view to the introduction into this country of any principle which might be considered beneficial. The issuing of a Royal Commission for such an object has so far crowned our labours with success; nor can we omit to notice, as the fruit of the Conference of 1852, the several bills introduced into parliament, some of which have already become statutes, for the assimilation of the law and procedure between England and Scotland.

It is, however, important to expand our views on the subject. The increased means of communication, and above all a greater concurrence by France and other states in the principles of Free Trade, have caused a considerable extension of commercial intercourse between all civilized countries. The industries and resources of all countries are now open to the competition of the whole world; capital circulates freely, and is invested in mining and other enterprises of all descriptions. It is but natural to suppose that in proportion as these international transactions extend, so the sources of disputes between individuals of different countries may become more frequent. *The bankruptcy of a merchant in one country may affect a large number of creditors in other states;* suits for the non-delivery of produce or claims for inferior qualities, will necessarily be more numerous. *Bills of exchange* have a wider circulation. Such, in fact, is the connection between all mercantile affairs, and the essentially international character of commerce, that these relations mingle themselves in a thousand ways, and often affect individuals in modes as distant as they are unforeseen. It is the business of mercantile law to *establish rules for the settlement of commercial disputes, and to afford remedies for the enforcement of rights.* That it may do so successfully between merchants of different states, it is necessary that it should act similarly in all countries; that the geographical boundaries of a state shall not interfere with the purposes of commercial justice, and that a full knowledge of the re-

quisites of the mercantile law of nations may enable the merchants, the shipowners, and even the captains of merchant vessels to appreciate the nature of their duties and the extent of their rights. These considerations will at once explain the importance of removing the differences which now exist between the mercantile law of the States of Europe and America. These differences may be comprised under the following heads:—

First, in the usages and institutions which they sanction; secondly, in the modes in which they are applied; and thirdly, in the courts and procedure by which they are enforced.

As to the first, we find differences in the rights granted to foreign merchants in different countries; in the ages of majority; in the obligations of merchants to enter particulars into a general registry, and to enrol themselves into some guild. *The law of partnership differs materially in the subject of commandite, &c.* In bills of exchange in some countries *blank endorsements* are valid, in others they are void. *The days of grace differ* in many towns; and, by a strange anomaly, whilst all the world has accepted the Gregorian Calendar, Russia still preserves the Julian, hence the difference of the old and new styles still in operation.

Secondly, as to the modes in which mercantile laws and usages are applied. In most countries in Europe they are reduced *into the form of a code*, which, though of necessity too limited to meet the numberless emergencies of commerce, is sufficiently comprehensive to afford to the merchant a good outline of the law; *in many others they are included in the general law.*

Lastly, with regard to the courts and procedure by which the mercantile laws are enforced. Most European countries possess *tribunals of commerce*, or *district courts*, of a mercantile character, for the speedy and economical settlement of commercial disputes. It may be admitted that the development of mercantile legislation is dependent on the commercial importance of each country, and that certain institutions may be adapted to the peculiar condition of one which would not be adapted to that of another. Nevertheless it is often found that the institutions of the smallest state possess intrinsic value which render them fit for general adoption. The development of moral science, which is greatly included in a commercial code, is the result of juridical and philosophical investigations, and is often the production of a single master mind. Witness, for instance, what Lord Mansfield or Lord Howell did for the commercial law of this country, what Valen, Emerigon, Troplong, Pardessus, or Pothier, did for France, and what Mr. Justice Story or Chancellor Kent did for the United States of America. How important, therefore, is it for the interests of commerce, and for the advancement of judicial ethics, to bring periodically into one focus the experience of the merchant and the researches of the learned. It is to accomplish this that the idea has been suggested to assemble at Paris *a great Congress of Deputies from all Chambers and Tribunals of Commerce, and other Commercial and Legal bodies of different countries*, to discuss the subject of commercial law. The excellent working of such congresses has been exemplified in those lately held at Brussels, in reference to Meteorology and Statistics, both of which have been productive of invaluable benefit to the respective sciences.

At the Statistical Congress held at Brussels in 1853, a resolution was passed expressing a wish and trust that the great differences now existing in the mercantile legislation of different countries may be diminished, if not altogether removed. The Great Exhibition in Paris in 1855, is destined, it may be hoped, to promote in a large degree an intimate connection between all nations; and, in many respects, France, being the heart of the Continent of Europe, possesses facilities, both by her genius, learning, and language, to give a great stimulus to the fusion of interests and to the unity of society. At the head of that great nation, there is one whose qualities are essentially suited to advance these great objects, and whose name is associated with those Codes which have effected a most complete reform in European jurisprudence. Let us seize the great occasion of the forthcoming Exhibition for advancing the interests of commerce. British merchants, whose connections extend over all the world, are deeply interested in everything which can administer ease and security in mercantile transactions. It is above all of the utmost importance to strengthen our commercial relations with France. *We are now receiving from France* 20 *per cent.* of all her exports (£10,216,832 of £49,330,500 in 1852), and are *sending them only* $3\frac{1}{2}$ *per cent.* of our exports (£2,736,286 of £78,976,854, in 1852). We stand FIRST in her export list, and France stands EIGHTH in our export list. By an extension of free trade on the part of both countries; by the removal of useless restrictions; by the promotion of international treaties; and by assimilating the mercantile laws of both countries, the commercial interests which at present exist between France and Great Britain may be multiplied tenfold, at the same time that a friendly spirit and a firm political alliance may enable both France and Great Britain to be the champions as well as the guardians of the liberties of Europe, and the pioneers of civilization throughout the world.

## SEVENTH ORDINARY MEETING.

### Wednesday, January 17, 1855.

The Seventh Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 17th instant, William Fairbairn, Esq., F.R.S., in the chair.

The following Candidates were balloted for, and duly elected ordinary members:—

Hicks, Elgar. | Hobbs, Alfred Charles.
Whitehead, James Heywood.

The following Institutions have been taken into Union since the last announcement:—

382. Stanhope, Literary Society.
383. Stratton (near Swindon, Wilts,) St. Margaret Library and Reading Society.

The Secretary called the attention of the meeting to a Portable Stove for heating and cooking, constructed by Price's Candle Company, and proposed by them as suitable for the use of the army in the Crimea. It is simple and compact in its arrangement. The fuel used is cocoa-nut stearine, in cakes, burnt by means of six wicks introduced into each cake. No smoke is produced, and the stove is capable of boiling, baking, and broiling, and the whole is comprised in a cube of about sixteen inches. The cost of fuel burnt is at the rate of one penny per hour, a cake lasting eight hours. One of the stoves was placed on the table, and remained in action during the meeting.

The paper read was

## ON THE SMOKE NUISANCE, CONSIDERED MORALLY, HISTORICALLY, SCIENTIFICALLY, AND PRACTICALLY.

By George Walker Muir.

In entering upon the consideration of the important subject of Smoke Nuisance, permit me to tell you, first, what you are not to expect, and, secondly, what you may expect.

First, then, you are not to expect a learned, original exposition of what smoke is, its chemical constituents, or manner of formation; neither need you look for an ac-

count of some new method of constructing apparatus for its prevention or consumption,—for consumed it may be.

I do not suppose that this preliminary announcement will disappoint you much; you may, on the contrary, probably feel a little relieved from your apprehension of a dry paper, full of chemical analyses or mechanical details; but if you are not to have either an account of what smoke is, or of some newly-discovered plan for its consumption, what, then, are you to have? what are you to expect?

What I propose to offer you this evening is the result of my inquiries and observations, stated in a plain, practical way. These inquiries have extended over a period of several years, and were directed to the ascertaining of the truth, and not to the discovery of some hitherto unknown mode of smoke burning or prevention which I could call my own.

In common with, I believe, ninety-nine out of every hundred persons who have paid even a moderate degree of attention to the subject, the smoke nuisance was, some time ago, a puzzle to me. Time after time, paragraphs announcing the discovery and complete success of some before unknown smoke-burner, appeared in the newspapers, and the assertion was confidently made, that the public might *now* look for the complete disappearance of the nuisance "so long and so justly complained of," and that the authorities might with complete immunity from fear of an unjust interference with vested interests, proceed to enforce the penalties by law imposed. But with all these discoveries of modes of smoke-burning, and with all the threatened terrors of the law, the nuisance did not cease, old chimnies retained their acquired characters as inveterate smokers, and every new one appeared emulous to earn a similar name. Glasgow, Manchester, and other towns where an agitation against smoke has been carried on for years, are by some supposed *now* to be in the enjoyment of pure air, but having resided in Manchester for the greater part of last year, and knowing as much of Glasgow smoke as most men alive, I have little hesitation in saying, that if either of these cities is to be held up as a pattern to others, these others must indeed be in a very horrid state.

When the continuance of the smoke nuisance is considered along with the invariable assertion that by each discovery a saving of at least "twenty per cent. in fuel" might be secured, the surprise is increased to astonishment that manufacturers, generally so quicksighted, should be so blind to their own interests, or so stubbornly determined to annoy the public.

But the mystery so far is unveiled when the reported discoveries are found not to be new things, but old plans revived, and that upon an extended trial they have fallen far short of the success at first attributed to them. Possibly, after a time, we learn that the paragraphs in the newspapers had been penned by the proprietor of the patent, or by some gentleman of the press, who had attended experiments without a knowledge of what had been and could be done, and therefore reported as altogether novel what was new to himself; and that the testimonials had been given by willing employers, on the word of an engineer or stoker, too ready to report favourably when he saw that his master would rather have that than the truth, or, perhaps, with a heart softened towards the patentee by the judicious exhibition of *palm oil*.

I propose to treat this subject under the heads of its moral, historical, scientific, and practical aspects.

Morally, I will consider first, how the matter stands between the offending manufacturer, and the offended public; secondly, how the legislature should treat the question.

Historically, I will consider first, how the question has hitherto been dealt with by the Legislature; and secondly, explain what I conceive to be the mistake all along made.

Scientifically, I will very shortly show how smoke is formed, and explain the principles by which all attempts to prevent its formation or consume it, when formed, should be regulated; and

Practically, I will explain the best modes known to me by which the object may be accomplished.

What, then, are the relative positions of the manufacturers and the public? The latter may be called the plantiff, and the former the defendants. The charge is that they annoy the public and injure the public health, by the discharge of smoke from their manufactories, in consequence of their furnaces being improperly constructed or negligently managed. This statutory offence, when proved, subjects the manufacturer to penalties just as if he had committed an offence against morality and good order. Is this then a proper mode of treating the manufacturer? Is it just to subject him to penalties as if he had been guilty of a breach of the peace or Decalogue? No breach of the peace or Decalogue can be a benefit to society, (neither can the discharge of smoke,) but it is not necessary for any person to break the moral law, while the manufacturer must carry on his operations, and may not be able to do so without the discharge of smoke, which operations do benefit society; thus the discharge of smoke is not necesarily an offence against society, for that cannot be an offence which confers a benefit. There can be no doubt, that manufacturers do benefit the public, and if the discharge of smoke was inseparable from the carrying on of manufactures, then the public is not entitled to interfere with the manufacturer. The private right of each individual, or a number injuriously affected, to protect himself from annoyance and his property from injury, by the operations of a neighbour is another affair. with which I am not called upon to deal at present. I feel very safe in saying that if the suppression of the smoke nuisance involved the stoppage of the sugar refineries of Whitechapel, the breweries of London, or Burton-on-Trent, the cotton factories of Lancashire, the flax mills of Dundee, or the steamers on the Thames and Clyde, the vast majority of the inhabitants would poll in favour of its continuance. This, then, being the relative moral positions of the parties in this cause, it now becomes me to show in what way the public may justly call upon the manufacturer to conduct his operations in such a manner as to give the public all the benefit of his skill and enterprise, without the infliction of annoyance. That the great majority of manufacturing operations may be carried on without the discharge of smoke is undeniable. Do not imagine that I am an out and out defender of manufacturers; all that I say in their favour is this, that since their operations confer a public benefit, the public should, before subjecting any individual to a prosecution, be prepared to show that individual how his operations may be carried on without annoyance to person or injury to property. The manufacturer is not necessarily acquainted with the best mode of constructing or managing furnaces. His conscience will tell him unerringly when he has broken the moral law, and he has no difficulty in distinguishing between right and wrong in such matters; but, though his furnace be constructed on the worst possible plan, though his stoker may negligently manage, and the densest volumes be discharged from it, he may be quite aware of the wrong, but cannot ascertain the right. In dealing with this subject, then, it becomes the legislator, when making laws to compel the consumption of smoke, to provide for the manufacturer such information as will enable him to carry on his trade without being liable to penalties. In examining the acts passed at various periods I will show that what I propose is not a new thing in itself, but only in the time at which the information should be communicated. I will endeavour to show the mistake made in not affording to manufacturers proper information at the time it would be most acceptable, viz., when he is erecting or altering his furnaces, but in placing him under a statutory obligation to construct and to manage them in the most approved mode, without defining what is that mode, or by whom it has been approved, until he is arraigned before a police court, side by side with the drunk and disorderly, the thief and the murderer. He will then, if he knows what he is en-

titled to, demand to know the most approved construction and mode of management, for it is manifestly impossible to show that a furnace is improperly constructed, or has been negligently managed, without showing that a better construction and management might have been adopted, and describing that better construction, and if it could be adapted to the furnace in question.

Historically, this subject may best be considered by a review of the parliamentary and legal proceedings regarding it; for, to trace the rise, progress, and present position of the nuisance itself, would simply be an account of the rise, progress, and present position of the manufacturing interests of these United Kingdoms.

An examination of the proceedings of Committees of Parliament of the bills introduced, and the acts passed to suppress the smoke nuisance, brings out two prominent features First, that the legislature had no idea of treating the question other than as involving an offence, which, when proved, should be punished; and, secondly, that an idea prevailed that the object could be accomplished by the adoption of apparatus *per se*, which, having apparently suited in some cases, would suit equally well in all; and that the manufacturer, having been told that means existed by which the purpose could be accomplished, was bound to examine these means and select that best suited for his own case.

It is impossible to remember that for nearly forty years Parliament has from time to time been agitated by the discussion of this question, and that many clauses have been inserted in Acts of Parliament without producing the intended effect, and not to suspect that some latent errors have lurked in the proceedings. These errors consisted in treating the nuisance as one that was to be suppressed in the same way as offences generally, by the fear of punishment; and, when acts have been passed, the leaving their execution in the hands of those subject to their operation, which inevitably led to the very gentle application of the law. But the offence of smoking is one which never will be suppressed by the mere fear of punishment. It is recorded that at an early period a citizen of London was actually put to death, like a robber or a murderer, for the so-called crime of using sea-coal, and thereby making smoke. Certainly the law was then about as stringent as it could be made; much more, indeed, than Lord Palmerston's Act—and yet smoking was not put down.

I am not acquainted with any modern Parliamentary proceedings of an earlier date than the appointment of a Committee of the House of Commons in the year 1819, under the presidency of Mr. M. A. Taylor. That Committee, having examined a few witnesses, reported, July 12, 1819, "that from the advanced period of the session at which the appointment of your Committee took place, it was not to be expected that they could form any ultimate decision as to the precise object of their inquiry; but as far as they have hitherto proceeded, they confidently hope that the nuisance so universally and so justly complained of, may at least be considerably diminished, if not altogether removed."

This report was accompanied by the evidence taken by the Committee, and a considerable number of very well executed plans, with descriptions of the inventions laid before them by Messrs. Gregson, Losh, Steel, Wakefield, Coombs, Brunton, and Walker.

Respecting the inventions of these parties, it is not requisite to remark further than that they exhibit samples of the then general modes by which smoke might be consumed or prevented, viz., a mechanical or constant supply of fuel; the admission of air to the furnace by the bridge or elsewhere; and the plan of alternate firing, or making the flame of one of two or more fires consume the smoke of the other or others. These are the identical means by which it is now proposed to effect the object, while it is nearly forty years since this Committee reported to Parliament.

In the following session a Committee was again appointed; and on the 5th July, 1820, reported "that the revival of your Committee has afforded a full opportunity of ascertaining how far the reduction of smoke in furnaces of different descriptions can be practically accomplished; and the evidence detailed in the appendix will show that the object the House had in view has been satisfactorily and effectually obtained."

This opinion appears to have been based upon the evidence of Mr. Josiah Parkes, Mr. W. Brunton, and Mr. John Wakefield. These were the only professional witnesses examined; the others were gentlemen who had been witnesses to the successful application of the plans invented by those I have named.

I do not think that either Mr. Parkes or Mr. Wakefield was entitled to the credit of being the first inventor of the plans they produced. As I understand their descriptions, in both cases they employed a split bridge, or other opening, for the admission of air, which had been published long before (in 1796) by a Mr. Thomson, of London.

No action appears to have followed upon the presentation of this report, further than the introduction of a bill (28th May, 1821, passed into an act the 1. Geo. IV. cap. 41), by which the judge before whom any party was tried under an indictment at common law for smoke nuisance might, in addition to an order for an abatement of the nuisance, give an order for payment of the costs. Some years afterwards a clause was inserted in an act obtained for the government of the town of Derby. This clause appears to have served as the pattern for all legislative attempts at smoke-burning from that time (1825) until the appointment of a Committee of the House of Commons in 1843, on the motion of Mr. M'Kinnon.

On the 17th of August, 1843, that Committee reported that "it appeared to be the unanimous opinion of the witnesses conversant with the subject, that imperfect combustion arises from a deficiency of atmospheric air to mix with and act upon the inflammable matter at a proper temperature, and under circumstances which must ensure effective operation: that this admission of air, properly regulated, is the great, if not the only, principle of preventing smoke which is generally applicable; and that all inventions for the consumption of smoke (except when the smoke has been separated mechanically by an artificial shower of water produced in a flue constructed for the purpose) are only various applications, in different forms, of this general principle."

The Committee further recommended that "a bill should be brought into Parliament, at an early period of the next session, to prohibit the production of smoke from furnaces and steam-engines."

I do not know whether in 1844 either the Government or Mr. M'Kinnon introduced a bill according to the recommendation of the Committee, but in the year 1845 another Committee was appointed, which reported, on the 9th of May in that year, "that opaque smoke issuing from steam-engine chimnies may be so abated as no longer to be a public nuisance."

"That a variety of means are found to exist for the accomplishment of this object, simple in construction, moderate in expense, and applicable to existing furnaces and flues of stationary steam-engines, as well as to those hereafter to be erected.

"That a sufficient body of evidence has been adduced, founded upon the experience of practical men, to induce the Committee to be of opinion that a law, making it imperative upon the owners of stationary steam-engines to abate the issue of opaque smoke, is desirable for the benefit of the community.

"That in the present state of knowledge and experience upon the subject, it is not desirable to extend the provisions of an Act beyond the furnaces used for the generation of steam for the working of stationary steam-engines.

"That in the provisions of an Act for this purpose, the offence will be best described as being 'the issue of opaque smoke.'"

And also that a penalty should attach to the occupier of the property, or to the person employed in the care of the furnace. And that public functionaries should be appointed to take cognizance of the nuisance, and to bring the offender before the constituted local authorities.

A bill founded upon this and previous reports appears to have been introduced and to have met with great opposition, for the Committee was revived for the purpose of inquiring whether any and what exemptions there should be from its operation.

On the 11th of July, 1845, they reported that "furnaces connected with the manufacture of iron, copper, and coal works, and with distilleries should be exempted."

This bill was not passed, and another of a similar nature, and for the same purpose, introduced into the House of Lords by Lord Redesdale, in the year 1850, and passed, was afterwards lost in the House of Commons.

No further important step appears to have been taken on the part of the legislature, until the passing of the act for London, of which I shall hereafter have occasion to speak.

In the following year, Sir H. De la Beche and Dr. Lyon Playfair, were appointed by Government to proceed to various towns and to inquire into the causes of the nuisance and into the working of the then existing local acts.

Those gentlemen, on the 3rd of March, 1845, (ordered by the House of Commons to be printed, 6th of April, 1846) made a most excellent report.

I could not possibly state the causes of smoke nuisance more clearly than was done by these gentlemen when they class them under these heads :—

1. The want of proper construction and adjustment between the fire-places, and the boiler, and the disproportionate size of the latter to the amount of work which they are expected to perform.

2. The deficiency of draught, and imperfect construction of the flues leading to a chimney of inadequate height or capacity.

3. The carelessness of stoking and management by those entrusted with the charge of the fire-places and boilers.

I beg you to observe that here there is no mention made of any of the then known *inventions* for either preventing or burning smoke, but the causes are said to be *improper construction, adjustment, and management.* The suppression of the smoke nuisance truly is a matter not of *inventions*, but of *dimensions* and *management*. How different the opinions of these gentlemen from that of the House of Commons' Committee, who reported "that the admission of air was the great if not the *only* principle upon which smoke could be prevented," an opinion based upon the then popular theory of Mr. C. W. Williams.

From an examination of the Parliamentary proceedings it is easily seen that the agitation headed by Mr. M. A. Taylor, was based chiefly on the plans of Mr. Parkes, Mr. Brunton, and Mr. Wakefield, while the later efforts of Mr. M'Kinnon were supported by the supposed discoveries of Mr. C. W. Williams.

Scattered throughout the evidence produced before the Committees, the true causes and proper means either to prevent or consume smoke, may be found mentioned, but to suppose that a manufacturer, about to set up a factory, could, by an examination of that evidence, decide for himself which plan was most suitable for his circumstances, is as reasonable as to imagine that the perusal of a standard authority on law, or medicine, would enable a man to convey his own property, conduct his own causes, or cure the ills that ail him.

I have given this history of Parliamentary proceedings in a great measure with a view to direct the attention of parties in search of information on this subject to the reports of the committees, for, though not fitted to be the guides of the owners of factories in general, yet one having the experience necessary to prevent the reception of error (sometimes published under very high authority), may acquire a very considerable amount of knowledge of the subject by their perusal.

The Derby smoke clause, requires that all furnaces for purposes of trade or manufacture, "shall be constructed in the best manner known and practised, so as to prevent or consume their own smoke." It is not requisite to notice the other provisions of this clause regarding notice in writing, &c., &c. The leading principle, and a sound one it is, is that parties are to use the best known means for the prevention of nuisance, (the idea of prevention did not originate with Williams). I am acquainted with but one local act in which the smoke clause wants the proviso as to the "best means." That act relates to Halifax, in Yorkshire, and, as I read it, makes the prevention of smoke imperative, *whether* it be *practicable* or not.

It is unnecessary to quote the clauses in the acts relating to other towns, for though there are differences, still in their main provisions they are the same as the Derby clause, but there are two cities to which clauses apply where the provisions are in one case so different from all others, and in the other of so recent enactment, as to make them worthy of special notice. I refer to the acts relating to the cities of Glasgow and London. I need hardly tell you that when an act provides that parties are liable to punishment for the non-performance of a statutory obligation, the failure to perform must be proved before punishment can be inflicted; now the statutory obligation is to construct and manage furnaces so as to prevent or consume their own smoke. It is not the discharge of smoke that is the offence; it is the failure to construct and manage. Now to prove this offence, it appears to me that the complainant must prove, not that other persons' furnaces are constructed and managed so as to consume their own smoke, and, therefore, that those in question may also be otherwise constructed and managed, but that those in question are neither properly constructed or managed. Now that proof cannot consist in an inference that because their smoke is not consumed, therefore their furnaces must be improperly constructed or managed, but the complainant must describe the construction of the smoky furnaces, and the better construction that might be adopted, and show the difference between the two.

Now, the peculiarity in the Glasgow Act is that the question as to whether a furnace is, or is not, properly constructed shall be referred to *three engineers or other persons of skill in such matters*, who shall examine the furnaces, and report to the Court the alterations, if any, they would recommend to be made; and there is a provision which does the greatest credit to the framer of the act (whoever that was), and it is this—that persons of skill are to examine *the relative dimensions of the furnace, boiler, chimney, and cylinder of the engine, if any.* In the hands of an honest corporation, this act would long ago have sufficed to free Glasgow from furnace smoke. As an Act of Parliament it is based on the soundest principles of any on the Statute Book referring to the smoke nuisance. The great defect in the Glasgow Act is, that there is no provision made for the owners of furnaces having the advice of engineers or other persons of skill until they have been indicted. They are left to find out for themselves, and if they fail, down comes (or should come) the law upon their head.

I will now take a glance at the last effort in the way of legislation, the Act 16 and 17 Vic., cap. 128, the short title of which is "Smoke Nuisance Abatement Act, Metropolis."

It is said that a coach and six may be driven through almost any Act of Parliament; this London Act might be pierced by a hand-cart. There is first the old gap, "the best practical means," a gap that leads to the question, "what is the best way of burning or preventing smoke?" Thus this act restricts the answering of this question, declared by Mr. Fairbairn and Dr. Playfair to be among the most difficult to deal with, to the constables of the Metropolitan police force, who alone are authorised, with or without assistance, to enter upon premises, to

inspect the furnaces, and to inquire into the manner of carrying on the business therein. There is another pretty wide opening in the shape of a proviso, that *all the smoke need not be burned*, leading to the question how much will satisfy the inspecting constable or the neighbourhood, for the discharge must be great enough to annoy the neighbourhood. It is very clear *that* gap will be a great deal wider in Whitechapel than in Belgravia. It is very possible a great deal of evidence has been produced in the cases under this act which has not been reported, but so far as I can understand the cases as they are reported, the parties indicted have not generally made any strenuous resistance, and thus no decision of an authoritative character has been obtained. The right to institute proceedings being in the hands of the Government, is somewhat of a guarantee that the law will be enforced, but it may not be so, and possibly ere long the excitement will pass away, and the grasp of the law will be relaxed. Possibly also the administration of the smoke department may pass into other hands than Lord Palmerston's.

When we attempt to acquire a knowledge of the combustion of fuel and the prevention of smoke, we are bewildered by the variety of opinions advanced on various branches of the subject. We see it asserted by one authority, with a great array of chemical knowledge, that smoke is incombustible, and if once formed cannot be consumed. One party insists upon the air being heated before its admission into the furnace—another prefers to have it cold. The bridge of the furnace is said by one to be the proper place to admit it, whether cold or hot; while another insists upon admitting it at the door. Some contend for a constant, others for a graduated quantity. Much learning has been thrown away in attempting to define what smoke is, but it has always appeared to me that, so far as the public are concerned, the inquiry need not be pushed very far in that direction. Smoke, as it appears to the eye when issuing from a factory chimney, is a compound of soot, dust, steam, and gas, of the same description as is produced and distributed by the gas companies. If the first or sooty portion be removed, I imagine the public should rest satisfied. When that is accomplished what remains to be done is more a question of economy for the factory proprietor than for the public. But there are some things connected with this part of the question which should be noticed before entering upon an examination of the practical.

I am not one of those who assert that smoke is *directly* prejudicial to health. Indirectly it will, by obscuring the light of the sun and by making the ventilation of our houses a question of two evils—a close or a sooty atmosphere—injure the health of those exposed to its influence; therefore, though it may not directly injure the health, yet, as it does indirectly and undeniably lessen our enjoyments of life, it is a nuisance, and when possible, should be abated. It is sometimes gravely asserted that if smoke be consumed, the gases produced by the process are more detrimental to health than the smoke itself, an assertion very easily disposed of.

As the burning of smoke is the consumption of the carburetted hydrogen gas evolved by the fuel, it follows that the product of that combustion will mainly be the same as that from the consumption of gas in our houses. That product is water, and I am not aware of any very hurtful consequences attending its discharge into the atmosphere. The proportion of carbon consumed at the same time will not add greatly to the quantity of carbonic acid gas, which is the principal product, and is not considered so detrimental as to warrant great expenditure for its removal. On the point of economy I may here say a word. I believe that the constituent parts of the Newcastle coal, which is chiefly used in this city, are about 85 parts of carbon, 5 of hydrogen, 7 of azote and oxygen, the remainder of the 100 being ashes or incombustible matter. The smoke, then, which affects the public, is mainly composed of the hydrogen and such portions of carbon as are thrown off with it; and, as the proportion of hydrogen is only five per cent. of the whole, it is evident that no room exists for effecting a saving in fuel to the extent of from seventy-five down to ten per cent. I never yet have been able to get evidence to satisfy me that the direct saving from the burning or prevention of smoke was over five per cent. I have known cases when no difference resulted in the quantity of fuel consumed, whether smoke was consumed or not.

The conditions requisite for combustion are, that the subjects of combustion—by which I mean the fuel and the oxygen—be brought into contact, and subjected to a heat sufficient to unite them, and the manner by which these conditions may be attained I shall consider as the practical part of the subject. When these conditions do not exist, the formation of visible smoke will be the result of the imperfect combustion consequent upon their absence. But the smoke discharged from furnaces is generally the result of imperfect combustion consequent upon the stoppage of the process after it has been begun. This stoppage in many cases is caused by deficient draught; from want of air the heat necessary for combustion is not maintained. But a common cause of dense volumes of black smoke is not so much the want of draught, as the stoppage of combustion by the products of the fuel nearest to the grate bars being passed through a layer of fresh coal laid upon the incandescent fuel. By far the greatest quantity of smoke is caused by the passing of the heated gases through this layer of cool fresh fuel, and the better the draught, the blacker and more abundant will be the smoke. Smoke, then, is caused by imperfect combustion, either from want of air, or from the cooling of the products of one part of the fuel by their passage through another part.

The means, then, by which the formation of smoke is to be prevented, or consumed when formed, are draught, adequate dimensions of boiler, and good management.

Adequate dimensions of the flue and chimney are primarily necessary to prevent or consume smoke. Adequate dimensions of the boiler are not requisite to consume smoke, but to consume it *economically* and consistently with the performance of the work to be done. Draught is the first requisite, for without it smoke can neither be prevented from forming nor consumed after formation; but as boiler power is frequently said to be *necessary* for the prevention or consumption of smoke, I will now show that it is necessary only so far as the economy of the process is concerned, and also as regards the capability of the boiler to raise the requisite quantity of steam for the work to be done *in a certain time.* Draught is necessary to produce the heat, and boiler space is required to absorb it when produced.

To many it appears to be a very extraordinary thing, that when smoke is burned, less steam is raised in a given time. It seems sound reasoning to say, smoke is fuel, and since steam is raised by the burning of fuel, the burning of smoke should raise steam. This is so far correct; but I have observed, that in many cases where smoke is consumed by the admission of air above and not through the fuel, there is not so much coal consumed; and since coal is also fuel, it is evident that the burning of smoke may, by decreasing the consumption of coal, lessen the heat of the furnace, and thereby reduce the quantity of water evaporated *in a given time.* This I will endeavour to prove by reference to the diagrams on the wall: but as there may be some here who are not acquainted with the construction of furnaces, I will give a very familiar example by refering to the operation of blowing up a domestic fire by putting a cover in front of the grate and forcing all the air to enter by the bars through the fuel. When this is done the fire burns with greater intensity, and a much greater heat is produced, because a greater quantity of fuel is consumed in a given time, consequently more steam would be raised in that time, if the heat be applied to that purpose, than if the fire were allowed to burn slowly.

The process of combustion in the furnace of a steam-

boiler is identical with that in the domestic grate, except in so far as the mode by which the air is supplied. In the steam-boiler furnace, as in the open air, if the air be admitted above the fuel, then it is consumed less quickly and the rate of evaporation is slower, and as the most active part of the boiler is that right over the fire and for a short distance beyond the bridge, it is evident that any reduction of the heat of that fire will have to be balanced by increased heat in the flues, and whether that will or will not be the case when smoke is burned, will depend upon the relative constituent parts of the fuel, the setting of the boiler, and the power of the draught. Nothing can be more preplexing and unsatisfactory than the comparative results of experiments made in different places, when the construction and setting of the boiler, with the dimensions of the several parts, not only of the boiler, but of the flues and chimney, are not also given.

Boiler power, then, is not in itself necessary for the prevention of smoke by the admission of air, but solely as regards the raising of a certain quantity of steam in a given time. If air be admitted above the fuel, the intensity of the fire is lessened, because less air will pass through the bars, and as the fire on the bars is, compared with the flame in the flues, the more powerful evaporator, it follows that the admission of air above the fuel lessens the rate of evaporation. If you will look at diagram No. 1., you will see represented the incandescent fuel on the bars, and the fresh fuel above the incandescent; now the reason why the admission of air into the furnace above the fuel, has the effect of lessening the rapidity of combustion, is this: The size of the flues and chimney, and the heat therein, regulates the quantity of air which the fire will draw. If air be admitted above the fuel, or into the flame bed at the bridge, the quantity passing through the bars will be lessened in proportion to the quantity admitted elsewhere. The fresh fuel being placed over the incandescent, it is apparent that the fresh will be consumed quickly or slowly in proportion to the degree of heat which passes through it from that on which it is placed. If a quantity of air be admitted above the fuel, that which passes through the bars will be lessened, and as the rate of combustion depends on the supply of air, that rate will be lowered when the supply is reduced. It will thus take longer to ignite the fresh fuel, and consequently the time during which the furnace will be cooled down by the fresh charge will be lengthened.

The diagram No. 1, shows how smoke is formed. You will observe that the fresh fuel is laid upon the red-hot coal. That part of the fuel which is in contact with the incandescent portion is immediately ignited, and the products pass upward, but as the mass above is cool, the products are cooled in their way upward, and smoke is formed. That is the whole affair; there is no mystery about it; and any parlour fire which is supplied with fresh fuel will furnish an example of it.

Now, I am sorry to differ with Mr. C. W. Williams, when he says it is impossible to consume smoke if it be once formed. It can be consumed; by that I mean that the gas, vapours, smoke, or whatever else it may be called, which, whenever formed, and permitted to pass through the flues and chimney into the air the constables of the metropolitan police would call smoke, can be consumed, and that is all the public care about.

Observe diagram No. 2. There is the smoke formed from the fresh fuel; it passes to the bridge, when it meets with a supply of air; and if the furnace be hot enough to supply the initial heat, it—that is, the smoke—will ignite, and be consumed to all practical intents and purposes. I have seen smoke consumed a thousand times, and I consider it mere trifling to assert the contrary; and to rush into the bosom of high chemical authorities for proof. Dr. Reid, in his evidence before Mr. M'Kinnon's Committee, very justly remarked how inconsistent it was for parties to assert that smoke could not be burned, when their own diagrams showed it formed in one part of the furnace and consumed at another.

I have said that the smoke will ignite when it meets the air admitted at the bridge, provided there be heat enough to set it on fire. This brings me again to the question of draught, which I have already touched upon.

Draught is necessary to consume smoke, because otherwise the heat of the furnace would not be high enough to ignite it. If you will observe diagram No. 2, you will see that the smoke passes over the red coal at the bridge, and at this part the air is generally admitted. If the draught be not keen enough to cause the red coal to burn briskly, the heat will be insufficient to ignite the smoke and air, and the desired effect will not be attained. Draught (that is a sharp draught) is not required but at this time, so that slow combustion is quite consistent with the occasional use of a quick draught, for it is a very easy matter to lower the damper and to slacken the draught when it is no longer required. I have not prepared any tables of draughts calculated from given dimensions and degrees of heat in the chimney. When I see a furnace in operation, I can tell at a glance whether or not the draught be sharp enough to effect the consumption of the smoke. A good draught in a furnace is a main element in its economy. I have known a ton of coal saved in a week by adding to the height of the chimney; the sharper the draught the greater is the heat, and the greater the heat the more perfect is the combustion, and the more perfect the combustion the greater is the economy, and, with good management, the less the smoke,—thus draught s the prime requisite both for economy and for the consumption of smoke.

The most usual mode of burning the smoke of furnaces is by admitting air above the fuel; there are others of which we may hereafter take notice. I will now consider (1) the admission of air with respect to its temperature; (2) whether it is better intermittent or constant; (3) whether admitted by one opening or many; (4) whether at the bridge-door, or sides of the furnace.

1. About twelve years since a warm controversy was carried on between the advocates of hot or cold air, and it has been renewed among the patentees of the new plans. On this subject I have an opinion that it does not matter very much whether the air be or be not heated before admission into the furnace, *first*, because though it is heated, the degree is not very high, and *secondly*, because it is generally heated by the furnace itself, and in that case, heating the air is like robbing Peter to pay Paul. When the air is heated, a larger aperture is required for the admission of the required quantity.

Certainly, when the aperture is of the requisite size, it is so much gained, if, before entering, the air receives heat which would otherwise be wasted.

2. The advantages of a constant or intermittent supply will depend (1) upon the quantity of hydrogen in the fuel; and (2) upon the depth of fuel on the bars. When the furnace is newly supplied with fuel, and is required to mix with the hydrogen when the fuel is incandescent, and the coal laying so thick on the bars as to produce carbonic oxide, then air is required to mix with that gas; but when the draught and depth of fuel are properly adjusted the air should be shut off, when the fire is clear, as, when the product of combustion is carbonic acid gas, the addition of a further quantity of air is prejudicial, by damping the draught through the bars, without compensating by the production of flame in the flues.

3. The two leading assertions of Mr. C. W. Williams are—that smoke once formed cannot be consumed in the same furnace; and that for its prevention the air must be admitted in thin films, or in slender jets. Smoke may be consumed, and its prevention is not to be effected by the admission of air above the fuel, whether in one volume or in many small ones.

Diagrams Nos. 3 and 4, show Mr. Williams's plan as practically applied; and having seen and thoroughly examined a number of furnaces fitted with his patent, I have found that, in point of economy and smoke prevention, the effect is much the same. No doubt the more completely

we can mix the air and gases the more complete will be the combustion, but there are practical difficulties in the way of admitting air by many perforations, and the mixture can be effected very well indeed by having the after wall of the split bridge a few inches lower than the front, and having a flame-bed so large that the gases and air will circle about on their way under the boiler, and thereby be mingled. I do not expect that my opinion will be considered of so much value as that of Mr. Williams, I therefore deem it necessary to fortify my position by the following quotation from the evidence of H. Houldsworth, Esq., before Mr, M'Kinnon's Committee, in 1843, and this I do the more readily, that Mr. Houldsworth is a gentleman upon whose experiments and opinions Mr. Williams himself sets a great value.

Q. 1056. *Mr. Brotherton.*—What is your opinion with regard to admitting the air by means of one large aperture or by many small ones; does that make any difference? —I think it does in favour of the small apertures; *but in our case certainly not to an extent to justify any increased outlay in consequence.*

Q. 1057. *Chairman.*—Is it your opinion that if the air comes in in a body, it will have the same effect in mixing with the hydrogen as if it came through small holes?—I think it essential that the air should mix with the gases, but that in some furnaces at all events there are eddies or certain drafts which produce the effect of mixing the air and the gases instantly, *even though the air is admitted in a large body.*

Q. 1058. Still, from your evidence, it appears there could be no harm by introducing it through small apertures? I should prefer that theoretically. I am persuaded that is the right principle.

Q. 1059. *Mr. Beckett.*—You have not tried the admission of air through small holes in various places, supposing the bricks perforated, and the air coming in gradually at the sides. You have not formed an opinion upon that?—I feel quite justified in saying that *it is quite immaterial where the air is admitted*, provided a judicious quantity is admitted, and it be into or about the furnace. I admit it in four different ways, and they are, as near as I can find, *equally effective.*

It is unnecessary for me to add one word to show the small practical importance to be attached to the admission of air in finely-divided streams *above the fuel.* It may not be out of place here to direct the attention of those who wish to pursue this subject further, to the evidence of Mr. Muntz, M.P., Dr. D. B. Reid, Mr. Houldsworth, and Mr. Fairbairn, as the most valuable part of the mass taken by the Committee in 1843.

4. In practice, I have known the air to be admitted at various parts of the furnace; the places most usually selected are first, the furnace door, secondly the arch over the dead plate, when the setting of the boiler will admit of that being done, thirdly the bridge, if through the dead plate. I do not think it matters much, if anything, which of those plans is chosen, but if I were driven to make a selection, I would choose either the bridge or the dead plate. The bridge has been objected to because, if not provided for, the intensity of the heat consequent upon the inflammation of the gases is so great as to injure the boiler. That may have happened in some instances, but I have known boilers used for a considerable time without showing any injury arising from that cause.

I believe the best place to admit the air is through the bars. That mode fulfils Mr. C. W. Williams's theory exactly, for the passage of air through the spaces between the bars is truly in thin films. I have observed of late thin bars coming into use as something new; they are particularly referred to in the evidence of Mr. Molesworth, the Vicar of Rochdale, before Mr. M'Kinnon's Committee.

But let air be admitted over the coals at any part of the furnace, the smoke will not be consumed unless the furnace be at the same time well managed. By this, I mean that the coal be supplied regularly, and not in too great quantities, and not be laid over the whole mass of red coal. It will not matter one whit whether air be admitted in one volume or in finely-divided streams or jets, if the fresh coal be laid all over the red, as is shown in diagram No. 1. If the layer of fresh coal be very thick, say four to six inches, the smoke will be very black, and last a considerable time. If it be thin, say not more than two inches, the fire will pass through in a short time, the gases will be ignited as they arise from the fuel, and little smoke will be seen. Stokers are generally averse to fire thin, as thin firing involves frequent firing, and that involves trouble. It is usual, when giving instructions to stokers, to recommend that the fresh fuel be placed on the front, and the red shoved to the back, as in diagram No. 2.

I lately saw at the silk mills of Messrs. Walker, in Salford, a mode invented by their manager, Mr. Bury, which is better. It is to draw the red coal to the front and throw the fresh to the back. When this is done, the flame from the front plays over the fresh fuel and ignites the upper portion, thus burning it downwards. The fire is also carried forward by the draught, and the whole mass is soon ignited. An immense quantity is thrown on at once, the furnace being supplied but thrice per day. My attention was directed to this mode by Messrs. Holcroft and Hoyle, of Manchester, and I have great pleasure in making it widely known. It is shown in diagram No. 5.

When smoke must be burned, the fire must be well managed, and I attribute the saving frequently ascribed to the adoption of smoke burning, more to the *management* than to the *patent.* Hitherto, I have referred to smoke combustion by the admission of air over the bars or at the bridge beyond; but there are other modes by which the object may and has been accomplished. The alternate firing and gradually feeding two or more furnaces united in a mixing chamber, and firing them not simultaneously, but alternately, is, of all the modes of smoke burning, the most effective; but it requires a good though not a keen draught, and ample boiler power.

This principle of firing two or more furnaces alternately, appears to have been first patented by Losh, in 1815, just 40 years ago, (another proof that there is nothing new in smoke burning). The patentee encumbered it with dampers, to throw the smoke back on the clear fire, a quite unnecessary addition. It was again patented by Thomas Hall, in 1839, and this identical plan was revived in 1851 at Glasgow, and once more made the subject of a patent. It may have been patented in other instances with which I am not acquainted, but it is somewhat remarkable that the mode most in favour at the present day among engineers, should have been discovered so long ago as 40 years, and have remained so little known. It shows very clearly that knowledge is not to be communicated by the collection of information and its publication in blue books or pamphlets. Mr. Losh was a witness before Mr. Taylor's committee in 1819, and plans showing his method are given in the appendix to the Committee's report. They are repeated in Mr. West's pamphlet, published at Leeds in 1843, along with those of Mr. Thomas Hall, and I was very much struck some weeks ago, when conversing with Mr. Houldsworth, to hear that gentleman say that the next boilers he had made would be on the alternate firing principle, but with a furnace at each end of the boiler instead of at one, this being nearly identical with Mr. Losh's plan.

There remains but the principle of gradually supplying the fuel by means of machinery, as has been done by Brunton, Stanley, Juckes, Godson, and Hazeldine. There are others, but I have named these because they are the best that I have seen of the class. It is unnecessary for me to explain or describe them. I have seen them all in successful operation, but have had something to do with Juckes's at Glasgow, where, I am sorry to say, a gentleman adopted it on my recommendation, and after spending £500 was forced to abandon it, on account of the extra consumption of fuel, not less than 45 per cent. This

arose from the fuel not being suitable, but it would take too long to explain how. I am satisfied that all these very elaborate and expensive appliances are altogether unnecessary when the boilers, furnaces, flues, and chimney are of dimensions adequate to perform what is expected of them. To expect that smoke will be burned by the simple application of inventions, is altogether futile.

I may now do what I should have done at first, apologise for my presumption in appearing before you on a subject which authorities so high as our Chairman and Dr. Lyon Playfair, have acknowledged to be among the most difficult they have ever tried to deal with. After having seen hundreds of furnaces, in all parts of the kingdom, and examined the plans and descriptions contained in many reports and pamphlets, I am of opinion that our knowledge of the subject is not much, if at all, superior to what it was twenty years ago, and that the success of the most modern invention is not greater than those of that time. We are told in the testimonials of that time, that the smoke was reduced to not more than is seen from any kitchen chimney, and with a saving of 20 per cent. at least. I challenge the proprietor of the latest patent, or of any taken out during the past 12 months, to produce better results. This stationary position of affairs is to be attributed to the nuisance having been dealt with by the legislature as one to be included in the category of moral offences, and to the all but universal idea that it was to be got rid of by the adoption of some peculiar invention or apparatus, and the consequent neglect of sound principles in the construction of furnaces. I consider Mr. Fairbairn's paper, read at the meeting of the British Association in 1842, to be a very valuable guide in estimating the proper proportions of the furnaces and boilers, but I was much disappointed to find that Mr. Fairbairn had not furnished data from which the area of the flues and chimney, as well as the height of the latter, might be ascertained.

It is the duty of the Government of this country to ascertain the proper construction, and to make the best relative dimensions known, and only to prosecute when parties obstinately refuse to accept advice, and who yet continue to have smoke discharged from their factories. When Dr. Neil Arnott was asked by Mr. Beckett (a member of Mr. Mc Kinnon's committee) what course he would recommend the legislature to adopt, he suggested that the Board of Health should institute experiments, and said that it would be wrong to insist upon persons doing what they were not told how to have done. It has always appeared to me as humiliating to the Government of this great country to be the prosecutors of parties whose furnaces are no worse constructed than those of many departments of the Government itself, and to see their counsel, Mr. Bodkin, able only to say, "Smoke can be consumed, and you must do it *somehow*."

I shall be surprised if the present crusade against smoke is successful. Prosecution and fines have been inflicted elsewhere, and yet the nuisance remains undiminished. Mr. Buchanan, the United States Minister, is reported to have said, at a civic feast in this city, that his Government had instructed him to watch Lord Palmerston's proceedings for the suppression of the smoke nuisance. It looks like stepping from the sublime to the ridiculous to think that the minister will have to report to his Government that Lord Palmerston proceeds against smoking just as he would against drinking or thieving. It is possible to live without getting drunk, or committing theft; therefore, drunkenness and theft should be punished. It is likewise possible to consume coal in furnaces without allowing smoke to be discharged into the atmosphere; therefore, those whose furnaces discharge smoke into the atmosphere should be punished;—such is the reasoning, but the cases are not parallel. I submit that the parties properly liable to punishment are not the owners of the furnaces, but the engineers who made them. Smoke may be consumed in furnaces properly constructed; therefore, those who improperly construct furnaces ought to be punished, is a sounder argument.

Let the Government remit this subject to three persons —say Mr. Fairbairn, Dr. Neil Arnott, and Dr. Lyon Playfair—and there will be good hope of their being rightly informed. The course at present pursued is not creditable to the Government of a country pre-eminent for scientific knowledge and a love of fair play; but is another instance of how far we are behind other nations in the organisation of adequate means to secure an end.

How is an attack on the smoke nuisance usually begun and carried on by us? It is thus: some member of a Town Council, or Local Board of Health, happens to meet with, or is waited on by, some person who has at last found out a way for furnaces to burn their smoke. With a laudable desire to benefit the public, the member moves that a committee be appointed on smoke nuisance; —he waits on some patriotic smoker, and introduces his friend the inventor, and an arrangement is made for the alteration of a furnace on the new plan. When completed, the committee are invited to call at the factory, and see for themselves; they attend at the appointed time. Ten to one but the new plan is on the admission-of-air principle; accordingly, the valve is opened, and shut; dense volumes of smoke are allowed to gush forth, and at the word of command are arrested; the committee are delighted; perhaps they partake of cake and wine, but whether or not, they leave fully assured of the fact that smoke may be burned, and resolutely determined to vote for the immediate adoption of stringent measures for the suppression of the "nuisance so long and so justly complained of." Probably the gentlemen of the press are also present, if so, paragraphs appear testifying to the certain success of the invention, and trusting that the authorities will not fail to now enforce the law which for so long has been suffered to remain a dead letter. But ere long the Committee learn that the apparatus has been burned out, or that the steam can not be kept up, or, more likely, they delay proceeding further until a greatly superior plan, invented by a person of experience, is fully matured and tested. By the time this is done, some other inventor, attracted from a distance by the stir which he learns is being made, comes down, and ere long the Committee become bewildered among the many plans, each having its advocate and all their enemies, and at length they get disgusted, and the proceedings die off. After the lapse of a few years, some other members get into the same circle, and do the same round of supposed discovery, confident hope, and eventual disappointment. This arises from want of organisation for the careful collection of information by persons appointed for the purpose. Suppose Dr. Arnott's suggestions had been recommended by the Committee in 1843, and adopted by the Government, long ere this there would have been towns free from smoke, provided the people in them desired that consummation. Suppose the Town Council or the Local Board of Health resolved to move in the matter, they would apply to the persons appointed to supply information and assistance. An officer would be appointed to survey the manufactories, and to state what means, if any, could be adapted. He would first make himself acquainted with the qualities of fuel used for manufacturing purposes. He would visit and inspect each manufactory, and examine into the manner in which the furnaces, &c., are constructed and managed. This done, he would be able to specify what were the best means, if any, for each particular case, according to the circumstances; and if his recommendations were voluntarily adopted or enforced by the law, the town would get rid of the smoke, and the manufacturers would, after a time, find that a benefit had been conferred upon them. If the money spent upon patents for smoke consumption had been spent in the organisation of such a system of procedure, we should at this date, instead of being little, if any, better than we were in 1843, in either theory or practice, have had the satisfaction of knowing how much we could attain, and have had a ten years' ac-

quired experience in the practical application of sound principles.

To secure the benefit of such a system it is not necessary that the Government should interfere. The local municipal authorities of any town may adopt it for themselves.

If, instead of appointing an inspector to watch chimney-tops and push patents, they appointed an engineer to inspect furnaces, they would take the first step in a right direction. It is amusing, to one who knows that no particular plan will do in all circumstances, to be asked, when the smoke nuisance is the subject of conversation, and he has said it may be abated, "What is your plan?" As well ask an engineer what plan he would adopt to supply a town with water. There may be a variety of places from which a supply may be drawn, but the principle of gravitation is the best. So with furnaces; there are many forms of boilers, but of whatever form a boiler is constructed, the dimensions must be sufficient. Once more I have to repeat, that the smoke nuisance involves the consideration of *dimensions*, not *inventions*, and the sooner this truth is recognised and acted upon, the sooner will our cities be freed from the nuisance of smoke, and our Government freed from the reproach of attempting to do by sheer force what could have more speedily and economically been done by instruction.

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## DISCUSSION.

The CHAIRMAN said that having heard the very interesting paper laid before them by Mr. Muir, he was sure there were a great number of gentlemen present who would wish to express their sentiments on the subject, but as their time was very limited, each gentleman would express himself as briefly as possible on the best mode of suppressing the nuisance, the consideration of which had been so ably brought before them.

Dr. NEIL ARNOTT, F.R.S., having been called upon, stated that his attention had been more particularly directed to the means of getting rid of smoke from the domestic fire-place than from the furnaces of large manufactories, and he felt that it would be more interesting to hear the opinions of those who had devoted their attention to that portion of the subject, than for him to occupy the attention of the meeting.

Mr. LEE STEVENS would offer a few observations on the paper which, he was sure, all must have felt gratified in hearing, it having been laid before them with so much gusto and humour, and so divested of technicalities and dry details, as to make it a pleasure to listen to it. He was a member of a class of society who, as inventors, had directed their attention to the subject of the consumption of smoke. He did not, however, profess to occupy the entire field, because he believed there were very many inventions on the same subject of great merit, and that manufacturers should be left to determine for themselves which of them were best adapted to their particular works. He agreed with Mr. Muir that, with sufficient dimensions and with a sufficient draught, the smoke might be consumed without the aid of mechanical inventions, but without those requisites, it could not be consumed excepting by the aid of the inventor. He noticed one observation in the paper, that, although these inventions went to the reduction of the smoke carried off with the gas, there was no saving effected in the consumption of fuel, nor a greater quantity of water evaporated. [Mr. MUIR—In a given time.] Now, from some experiments made with his (Mr. Stevens's) apparatus by Mr. Robert Galloway, the engineer of the London and Westminster Steam Boat Company, in which the time occupied was as nearly as possible the same, it appeared that with 1lb. of coal, 1·48, or nearly 1½ lb. more water was evaporated by the use of the apparatus than without it—the quantities standing respectively 7·38 and 5·9 lbs. of water to the lb. of coal. He did not think it at all necessary for him to refer to Mr. Muir's opinions with regard to different inventions alluded to, as all the inventors had to do was to bring forward their inventions, and leave it to manufacturers to determine for themselves which would best suit their particular wants. He had been invited by the Society to attend that meeting, and to furnish them with his plans and models, and he had done so, being perfectly ready to leave it to gentlemen to form their own opinion upon their value. He might, however, be allowed to say that he had supplied the Society with a list of more than one hundred establishments in which his inventions had been applied, amongst which were the *Times* newspaper, Messrs. Charrington, Head and Co., the brewers, Messrs. Miller, Ravenhill, and Co., the engineers, and various other firms of equal standing. He might therefore be allowed, on the part of the inventors, to enter his caveat against the assertion that they were doing nothing to abate the nuisance. He was pleased to hear Mr. Muir refer to the plan of feeding furnaces alternately, as adopted by Messrs. Bell, of Newcastle; but was that gentleman aware that the firm alluded to were making a series of experiments with a view of having each furnace dependent onlypon itself, and abandoning the system alluded to. He would not detain them with details of his own invention, as those who wished for further explanations could see him at his own office, where he would be happy to show them his drawings, and give them every possible explanation. There it was he transacted his business, and not in the hall of a Society like that which he then had the honour of addressing.

Mr. G. F. WILSON might speak to the care and trouble with which Mr. Muir acquired part of his valuable information, but he would rather confine himself to a few words upon Hazeldine's furnace, which he considered the best, because it was the cheapest and simplest, of the moveable-bar smoke-consuming furnaces. He might premise, however, that no member of Price's Candle Company ever had any interest in any smoke consumer. He would now give the results of an ordinary twelve hours work in a Hazeldine of twenty-four feet fire space, and would leave engineers present to form their own conclusions.—The coal used was common London "small," taken from a heap where it had become wet from exposure to the weather. London small coal was at least 6s. a ton cheaper than common steam coal, Hartley's, for instance. In 12 hours the coal consumed was 28 cwt., and the number of pounds of water evaporated was 21,600; therefore 6·88 pounds of water were evaporated by one pound of wet coal. The cost of a 24 feet Hazeldine was £90; that of a common fire-bar furnace, was, he believed, £25. The extra cost of the smoke consumer was thus £65. He considered that with a furnace working night and day this amount was saved twice in the first year.

Mr. HENRY MAUDSLAY was sure all would feel that their best thanks were due to Mr. Muir for his very valuable paper. It was true that smoke could be prevented if all their apparatus were of sufficient dimensions for their business; but without the aid of mechanical inventions it would be impossible to prevent smoke if they attempted to make a ten-horse power boiler do the work of a twenty-horse one. In most establishments the business had gradually grown upon them, and many manufacturers found that they had only to increase the quantity of coals used to do any amount of work they required. In doing so a great amount of smoke was made, and it was shown to be a false economy to employ an old boiler to do the work inefficiently, as they had no real return for the larger quantity of coals consumed excepting up the chimney. As to smoke consuming apparatus it was evident that there were different forms of boilers to be considered, and that any one apparatus could not be applicable to all kinds. The furnace for a steam-engine would be different to that for a glass-works, a pottery, a soap-manufacturer, or the many other trades of which he could go on with an almost innumerable list. He might be permitted to say however that the admission of air in small quantities might be beneficial. If a

pipe was passed through the fire for the purpose of heating the air, they would find that all the economy obtained by the use of heated air would be regulated by the quantity of fuel employed in heating it. There were some furnaces to which mechanical inventions could not be employed for destroying the smoke, such as furnaces for working the ironmasters' hammers, &c., therefore it was impossible to apply one mode of effecting their object to every case. That kind of furnace was most economical which depended upon the exertions of the stoker, as the effect produced was obtained out of the outlay for his wages, instead of being debited against extra expenditure for mechanical improvements. He had lately seen a furnace of the description he had mentioned, with which he was much pleased, as it fully answered the purpose of getting the saving out of the wages of the fireman. In the first lighting of the fire, as the coal was thrown on it was well known that it came into a state of semi-coke, and whilst properly igniting threw off large quantities of smoke. The furnace to which he alluded was under an old patent. He had no interest in it himself, it being the property of a poor man named Ford. On each side of the furnace, above the fire bars, were lines with slides, by which they were worked under the fire, and the furnace was continually supplied with new coal without the door being opened at all, and there was no medium for the sudden or undue admission of air. The lines having been worked across the fire-bars, the latter were lowered by a rack, and the stoker could readily clear away the clinkers and put on 6 or 8 inches of coal. They were then brought up under the top as before, the lines withdrawn, and it became one fire with the live fuel at the top. The coals gradually became ignited from those above them, and the gases escaping through the fire, there was no smoke produced.

The Chairman—There was, in fact, a double set of fire-bars.

Mr. Maudslay—Precisely so. He had seen a number of inventions, but none, in his opinion, came up to the one he had described for efficiency. With regard to the fining manufacturers for not consuming the smoke from their furnaces, he agreed with the principle, as he was convinced that they would not take the necessary means for doing so until they were fined.

Mr. Fraser regretted that the able paper which had been read that evening, contained such sweeping condemnation of inventors and inventions; this, he thought, was unnecessary, even in a warm advocate of "large dimensions of boilers" and "slow combustion;" this plan was followed by the Cornish engineers, and in many other instances mentioned by the author of the paper, with success: but this could never become general without replacing a large proportion of the boilers now in use, and in many cases making considerable alterations in the buildings in which they were fixed; the problem to be solved was, how to obtain combustion of smoke with the present boilers and "setting." He was also surprised at the case of hardship which Mr. Muir had attempted to make out for manufacturers, and at the complaint raised against the government for the energetic steps they were taking. The author of the paper thought that no prosecution should be commenced under the act, or fine inflicted, until the government had in each separate case advised with the owner about the dimensions of his boilers, flues, chimney shaft, steam-engine, &c., and then should compel him to adopt the views of their engineers, if unwilling voluntarily to do so. He thought that under the circumstances manufacturers would wish to be "saved from their friend,' and be allowed to burn their fuel and raise their steam in their own way, at the risk of being fined in a nominal amount before the magistrate. The facts of Mr. Muir's paper proved that the requirement of the act had been met, both with and without mechanical contrivances, so that no real case of hardship existed. The Society had been informed that he had applied, at Truman, Hanbury, Buxton, and Company's brewery, mechanical furnaces in 13 different cases, with perfect success, as was confirmed by Professor Brande and Mr. Haywood; and he was prepared to undertake to stoke the largest of them with an area of between 50 and 60 feet, from morning till night, with slack coal, without smoke being seen to issue from the chimney shaft.

Mr. Roy believed that all inventions were useless unless they also paid attention to the quality of coals employed. An experiment had been made lately with anthracite coal, and he had found that the same results might be produced with 8 cwt. of anthracite as with $10\frac{1}{2}$ cwt. of Welsh, showing a great advantage in favour of the anthracite. It had been employed at Whitbread's brewery for the last three or four years with great success. He believed it was economical in use, and entirely did away with the smoke. It was most important that it should be burned with bars about seven-eighths of an inch thick, that there should be ample room for the free circulation of the air. It was a very dear coal, but used in a proper manner it would be found economical.

The Chairman wished to know what was the price of the anthracite coal, as compared with the Welsh?

Mr. Roy said that he believed it was from 7s. to 10s. a ton dearer, but then it would do thirty per cent. more work; and would, therefore, be equally as economical in use as the common coal. Indeed, he had the previous day seen a furnace which, he was told, with proper attention, would do more work with one pound of anthracite than with two pounds of the common coal.

Mr. D. Shears would not trouble the meeting with many observations, after the practical remarks which had been made by some of the gentlemen who had preceded him, more especially by Mr. G. F. Wilson and Mr. Fraser, both of whom, from their great practice and experience, were fully competent to form sound opinions on the subject at issue. Although the Society must feel obliged to Mr. Muir for preparing a paper on a subject of so much interest at this time, yet it could not be denied that there was room for great difference of opinion. He (Mr. Shears), for one, could not refrain from saying that Mr. Muir had been too severe upon engineers and inventors, in his endeavour to refuse them any amount of credit which might be due for having sought to accomplish the desired object by mechanical contrivances. He could not refer to better evidence of the success of such endeavours, than by reference to the testimony of the two gentlemen before alluded to. In the case of Mr. G. F. Wilson, he had, in his capacity of Managing Director of Price's Candle Company, the great advantage of witnessing in daily operation something like thirty large boilers—and boilers all fitted with mechanical furnaces—viz., Hazeldine's and Juckes's—and he (Mr. Shears) could state, from his constant opportunity of seeing them, that the most undeniable success in the consumption or avoidance of all smoke had been accomplished in those works. In the case of Mr. Fraser, he had also very frequent opportunities of seeing and knowing that by the use of some fourteen or sixteen mechanical furnaces, both for boilers and coppers, the chimney-shafts of Messrs. Truman, Hanbury, and Buxton were entirely free from smoke, and he attached much importance to the practical experience of such speakers on this interesting subject. He could not agree with Mr. Muir that mechanical furnaces were unnecessary, for he knew of many instances in which numerous other contrivances had signally failed, admission of air under various conditions having formed the basis of such attempts. He did not appear to have been sufficiently remembered that a variety of circumstances greatly guided the adoption and success of nearly all contrivances for consuming smoke, and he thought it rather hard upon those who had, at so much expense and trouble, complied so entirely with the requirements of the public and the Government, that they should be taunted by the statement that their pains had been unnecessarily bestowed. He (Mr. Shears) knew well, from his own experience,

which had been rather considerable, that smoke could be prevented by careful hand-stoking, in well-constructed furnaces, where the needful attention and care *could be insured;* but the great difficulty was to compel *at all times* the class of men it was usual to employ for such purposes to exercise the required discretion and judgment. He had himself insisted on the smoke being consumed in furnaces under his own guidance, and most perfectly, too. This was nothing more than by careful firing—but then he also knew that the furnaces and boilers were of proper construction, and of sufficient power for the work they had to perform. He would not trouble the meeting further than by stating that however successful might have been in some cases the modes of admitting air as to the consumption of the smoke, yet he could say, from much experience and observation, that in very many cases the adoption of such plans, whether the air was hot or cold, or admitted before or behind, great injury had been occasioned to the boilers, especially where the air was allowed to impinge upon any part of the boiler. But perhaps one of the most important points to be borne in mind during the inquiry was, that some method had to be adopted in many cases which was suitable to *existing boilers and plant,* and this increased the difficulty; for where careful hand-firing might otherwise be made available, as in the case of boilers of full power or capacity, yet in cases where they were but barely equal to the work, it was a subject of serious consideration how the object could be accomplished by mechanical or other contrivances. It would be well, therefore, for those who were compelled to comply with the Act of Parliament under such circumstances, to consider whether greater economy would not be insured by boldly replacing their inadequate boilers by others equal to their requirements, even at some additional first cost.

Mr. Woodcock, Assoc. Inst. C.E., said that he would not detain the meeting by any description of the plans for consuming smoke which he had invented and patented; deeds were better than words, and these inventions were by their perfect success forcing themselves rapidly into notice. It was proved some few weeks back, at the Institution of Civil Engineers, where the speaker had the honour of reading a paper on "The best means of avoiding Smoke from Boiler Furnaces," and during the two evenings' discussion on the subject which followed, that by the use of this apparatus, under an ordinary cylindrical boiler, eight pounds and nine-sixteenths of a pound of water, supplied to the boiler at a heat of 42° Farh., were evaporated by every pound of small Newcastle coal used, and without smoke, thus contrasting most favourably with the capabilities of other furnaces brought under the notice of the Society of Arts this evening. The result was quite equal to any which could be obtained from the use of anthracite coal; and the price of this coal in London being double that of the small Newcastle coal, the question as to the relative value of the two was answered. Mr. Muir need not have fortified any position he assumed on account of the supposed higher authority of Mr. Charles Wye Williams; the latter gentleman had attacked the hot-air theorists (as he termed them) in a most unwarrantable manner, but, perhaps, it would be but generous to let this pass as the heat of argument; it was not right, however, that the principle should be sacrificed, or that Mr. Williams should be quoted as an authority, without the grounds upon which that authority was based being known. It was believed that these rested mainly on his treatise, and after a careful perusal of this work it would be incorrect to state that it did not contain much valuable matter, but it must be clear to every one that the conclusions were drawn first, and facts were afterwards cleverly compelled to fit these conclusions; almost every page of the book gave this impression, and an investigation of a French work, published some thirty or forty years since, by Mons. Péclet, "Traité de le Chaleur," would show that the bulk of the arguments were drawn from that source, but with the remarkable difference that M. Péclet argued for the use of hot air, Mr. Williams for cold. An inquiry into the origin of the use of his perforated plate would also show that it was much older than his patent, it having been in use in London for the last thirty years. This was proved at the Institution of Civil Engineers on the 14th November last. These facts would give the real state of the case as to Mr. Williams's book, and his patent also. It had been affirmed positively that smoke once made could not be consumed in the same furnace. Now his own furnace could at will be seen to be full of true smoke, such smoke being purposely formed, and being the result of imperfect flame, and yet without a particle of that smoke appearing at the top of the shaft. If it was not burned, what became of it? Nevertheless, the most consistent part of Mr. Williams's work appeared to be the conclusion arrived at that smoke could not be burned, seeing that he had never used the proper means, "heated air;", and, therefore, his experience furnished no instance of this desirable end being accomplished. Mr. Muir had challenged the London smoke-burners to produce a furnace which would make less smoke than an ordinary kitchen chimney. That challenge was gladly accepted, and a furnace could be found which, during a month's work, would not emit from the shaft a tenth part of this quantity.

Mr. Wilson, of Millwall, wished to put a question to Mr. Muir, relative to the proper dimensions of furnaces. He was a small manufacturer, and had great difficulty in applying any mechanical invention to his furnaces. He had been speaking that day to a gentleman who had two mills, and who had great difficulty in the application of mechanical inventions, from the necessity of keeping his works going night and day. He knew that with the majority of inventions the works would occasionally require being looked to, and what he desired to be informed was the area of the furnaces used by Messrs. Walker, of Salford, who, Mr. Muir had explained, consumed their smoke without the aid of mechanical appliances.

Mr. Muir was not aware, but he was sure, if Mr. Wilson would write a letter to Mr. Bury, the manager of Messrs. Walkers' works, that gentleman would give him every information on the subject.

Mr. Wilson thought that a most important question to small manufacturers was, what furnace space was required to get rid of the smoke without mechanical appliances. There were a large majority of manufacturers who only possessed one boiler; he himself had two, and they could not keep up their steam at all times if they were liable to derangement in the machinery.

Mr. Lee Stevens believed he could in some measure answer the last observation. One of his furnaces had been in operation day and night for twele months, at Messrs. Marshall's, of Leeds, without requiring the slightest repair. Mr. William Marshall, after one of the furnaces had been up six months, had an opportunity of examining it, and found there was not the slightest oxidization in the boiler-plates.

The Chairman regretted that their time was so limited; but he must now draw the discussion to a close. It appeared to him that the subject before them was one of great importance, as upon it depended whether the manufacturers could comply with the Act for the Consumption of Smoke, and how they could best do so. He did not expect that he could add much to the valuable discussion they had heard, but he was of opinion that nothing could so effectually meet the requirements of the case as ample room in the furnace, large boiler space, and slow combustion; for, wherever a fire required to be constantly fed there was sure to be an increased expenditure of fuel, and a great quantity of smoke. Indeed the combustion should be as slow as practised in Cornwall, where they only feed their fires once an hour, and very little smoke was produced. They had there the advantage of burning Welsh coal and complete supervision of their furnaces. The same results might be obtained by the use of anthracite. But wherever they had an active combustion and limited boiler space, mechanical aids were required to destroy the smoke. Then, as regarded locomotive engines, the steam, ascending, drew

up a large quantity of atmospheric air through the fire, and caused most active combustion, and consequent smoke. He believed that if the nuisance could not be wholly put an end to, it might be mitigated to a considerable extent. It had been got rid of to a very great extent in Manchester, for though the number of engines at work had been doubled within the last fifteen years, the quantity of smoke was not more now than at the commencement of that period; and this had been accomplished by the authorities instituting proceedings against offenders. He did not agree with the opinion of Mr. Muir that the Government were not justified in imposing fines on the manufacturers for causing smoke, for he believed they would never get rid of the nuisance without some stringent measures. He was of opinion that, without fines or penalties of some kind, the manufacturers would not take the trouble of seeing how the smoke was to be got rid of, or compelling their managers to do it. He was satisfied there was not an engineer in the country but who would most willingly lend a helping hand to abate the nuisance, and thus purify the atmosphere of large towns, and improve the health of the community. A frend of his calculated, but he (Mr. Fairbairn) did not vouch for the fact, that in Manchester £200,000 a year could be saved in soap alone by doing away with the smoke. He saw by the papers that in the metropolis Lord Palmerston's Act was being carried out through the exertions of the police, and one manufacturer, on being fined £5, was told by the presiding magistrate that if the nuisance was not abated, he would, on the second information, be fined £10, for the third offence £20, and so on, in arithmetical progression until the fines amounted to sufficient to pay off the National Debt. He (Mr. Fairbairn) would encourage all inventors. He believed that great merit was due to them for the manner in which they had improved the combustion of smoke, and it showed that active spirits were at work to obviate the nuisance which was so generally complained of. He had now only to propose, and he was sure they would all most cordially join him in it, that the thanks of the Society be voted to Mr. Muir for his very interesting and instructive paper.

Mr. Muir thanked the company for the manner in which his paper had been received, and claimed their indulgence for a few minutes to reply to the observations made, it upon no other ground, than upon that of his having travelled 400 miles in order to have the honour of appearing before that Society. With regard to the economy of Hazeldine's furnace, it appeared that it evaporated 6·88 lbs. of water to 1 lb. of coal, whilst from the experiments of Professor Playfair and Sir H. De la Beche, made for the Royal Navy, with an ordinary furnace stoked by hand, the rate of evaporation was found to run from 6½ to 10½ lbs. of water evaporated to 1 lb. of coal. The testimony with regard to the evaporation was not such, therefore, as to induce him to lay any great stress upon it. A great deal had been said about the consumption of slack or refuse coal. In Glasgow, with very few exceptions, nothing else was used. In some cases large coal was used because the manufacturers thought it advantageous, and in others, because they could not obtain a sufficient supply of slack, but the use of slack was the general rule. It was not right, therefore, to give any particular credit to Hazeldine's, Juckes's, or other inventions for the use of slack. He would not say anything with regard to brewers' coppers, because there might be some peculiarity in their construction, and after all, they would only stand as 1 to 1000 of other furnaces; but he had seen a brewer's copper, fired in the ordinary way, make very little smoke indeed. He wished to know whether Ford had renewed his patent for 6 years.

Mr. Maudslay.—Yes.

Mr. Muir had asked the question because he had mentioned the furnaces as Godson's, having been informed that Ford had sold the patent to Mr. Godson, of 72, Aldersgate-street. He had seen it, and thought it very good for small furnaces; it was the same as Dr. Arnott's domestic fire-place. There was likewise the model of a furnace, under the same construction, on the table, marked as Coupland's. He had not meant to say, as Mr. Maudslay seemed to think he had, that manufacturers ought not to be fined if they refused to adopt means for the consumption of smoke. He only differed as to the time at which compulsion should be exercised. But they could not expect the manufacturers voluntarily to adopt any system for the consumption of smoke until they were shown that it would he ultimately successful in effecting the object they had in view. He wished to know whether Mr. Shears was the proprietor of Hazeldine's furnace?

Mr. Shears replied that he was not, though it was a party of the same name, but unconnected with his establishment.

Mr. Muir said that a gentleman from Scotland came up to town and went to Mr. Shears, naturally expecting to find Hazeldine's furnace in operation. He did not, however, and Mr. Shears expressed his opinion that Juckes's, Ford's, and other furnaces might do very well, but that the smoke might be equally well got rid of without machinery and without expense. Mr. Stevens might not recollect it, but he (Mr. Muir) spent two forenoons, about eighteen months since, in inspecting his furnaces. He had no doubt that the admission of air through the split bridge (which was Mr. Stevens's patent) was advantageous when there was sufficient draft and proper attention. He first went with Mr. Stevens to some place near St. Paul's, where he saw there was a good draught, and there little was or no smoke. He next proceeded to Messrs. Miller, Ravenhill and Co., and there he saw a large quantity of smoke, which was explained by its being stated that the men had not properly attended to the firing. This he had seen happen in a hundred cases; and all he could say was, that if the master was at the cost of a good system, and the man who was employed to do so did not attend to it, then fine him. He was aware that Juckes's furnace was successful in some places, but it had failed where he had been the means of introducing it. He was instrumental in having it adopted at Messrs. Crums' Calico Works, Thornliebank, near Glasgow, and he obtained a certificate from them that the consumption of coals was two and a half tons a day. Being, from what occurred afterwards, doubtful of the correctness of this, he measured the furnace. He calculated the quantity consumed per day, and he discovered that they were consuming 3½ tons of coal instead of 2. They afterwards became displeased with Juckes's furnace, and when he called one day he found they were about to send a portion of it to the melting pot. He, however, persuaded them not to do so, as it answered in London; it would injure the inventor, and he would try to sell it. They gave him a month to do so; he wrote to a number of firms using Juckes's furnaces, offering it at a considerable reduction in price, but it still remained unsold. There were also three other of those furnaces which cost £500, and which any gentleman might have at a very reduced rate. They had heard that night something of the advantages of anthracite, but he had been told that Mr. Bodkin, Lord Palmerston's counsel, insisted in one case on a person being fined for using coke and anthracite mixed. Mr. Bodkin had also insisted that every furnace should be supplied with a smoke-consuming apparatus; but had his arguments been opposed by counsel of equal eminence and ability as Mr. Bodkin, he was sure no magistrate could have given a decision in his favour. He did not wish to drive a coach and six through the Act of Parliament, but the convictions under the act were a mere sham—a sham which might soon be put an end to, and an efficient act obtained in its place. He was satisfied that neither the public nor the manufacturers could properly carry out the act until they had the means given them of determining which was the best system of consuming the smoke according to the circumstances of each case. He would refer to the observations of Mr. Fraser,

to say that he had seen Juckes's furnace in operation at Messrs. Truman's. He did not deny that it answered very well there, but it failed in the manufactory where he had recommended its trial, and the result was a loss of £500 to the manufacturer. These facts proved that it was a very difficult matter for a manufacturer to choose from among the many plans.

The Chairman had been informed by the Secretary to the Commission for the Board of Health that the returns from the furnaces where they consumed their own smoke debited the owners with an average saving of 17 per cent. in their fuel.

A Gentleman complained that the government establishments at Woolwich and Greenwich were the largest smoke-makers in the kingdom, and that no attempts appeared to be made to abate the nuisance there, where the Government had the whole thing at their command.

The Secretary stated that the drawings and models of inventions for suppressing the Smoke-Nuisance, which were then exhibited, would remain on view during the remainder of the week.

He then announced that the Paper to be read at the next meeting, Wednesday, January 24th, was "On Peat and other Vegetable Charcoal, and some of its Uses," by Mr. W. Longmaid.

Also, that the following arrangements had been made for succeeding meetings :—

Jan. 31. Mr. S. C. Homersham, "On the Chalk Strata considered as a Source for the Supply of Water to the Metropolis."

Feb. 7. Mr. Thomas Dickins, "The Commercial Consideration of the Silk-worm and its Products."

Feb. 14. Mr. J. A. Franklin, "On the expediency of at once Decimalizing English Moneys and Weights."

Feb. 21. There will be NO MEETING, it being Ash-Wednesday.

Feb. 28. Professor John Wilson, F.R.S.E., "On the Iron Industry of the United States."

March 7. Mr. J. B. Lawes, "On the Sewage of London; its Composition and Value as a Fertiliser."

Also, that on the evening of *Friday*, the 2nd of February, there would be a Special Meeting to consider the proposed European Congress at Paris, as to the Improvement of International Commercial Law.

## Home Correspondence.

### SUGGESTIONS ON NEW MATERIALS FOR COMMERCE.

Sir,—The following remarks and observations on the paper I read before the members of the Society of Arts on the 29th November, coming as they do from a thoroughly practical man—Captain Messum, one who has had great experience as a trader—are so important that I cannot do better than submit them for the consideration of the members, under the constant desire of aiding, as far as possible, the extension of our range of commercial operations.

Your obedient servant,
P. L. SIMMONDS.

5, Barge-yard, City, Jan. 8, 1855.

Liverpool, Jan 7, 1855.

Dear Mr. Simmonds,—I have just been quietly reading your very valuable paper, read before the Society of Arts in November, and I know you will pardon the following remarks, which have practically come to my knowledge :—

First, as to Roots.—The Kaffir potato is indigenous to the north-east part of the Cape Colony, something resembling the red kidneys of England, but much smaller. This, I presume, could be somewhat remedied by better cultivation ; but what the root does not produce in size it does in quality—the taste is excellent, and they are preferred to those grown from imported seed. There is a large tuberous root, something resembling the Cassava in shape, but the plant grows similar to the Manioc. It is not cultivated, but the Hottentots feed readily on it. Throughout the whole desert of Namaqua Land there grows a small bulbous root (Orchis) ; these are roasted by the natives, and form at seasons their principal food ;—they taste like roasted chestnuts. Arrowroot grows better in Natal than any place I have seen it. The most palatable root, and most profitable I know of, is the *Taro* or *Tarah* of the South Sea Islands. It grows something like the beet-root : the top, or greens, is made into a famous dish by the natives, called Poi, or Pollie-Samoie. I have found the root keep good on board ship longer than two months.

Fibre-Coir.—English shipmasters have a great antipathy to rope manufactured from this material, but those who have been in the country ships in India prefer it to European hemp for every purpose, except the roping to the sails, and some minor purposes. The large sizes made for standing rigging in India are good, and when once thoroughly stretched, do not contract and expand with wet and heat so much as hemp ; the small-size rope manufactured in India is laid up too hard, and should be three-strand instead of four. The best coir-rope manufactured is by the natives of the Fejee and Friendly Islands—each yarn is three-plait. A gang of mizen rigging made from this rope had lasted eight years when I left the vessel, and was perfectly good. It may be in the vessel yet, for aught I know. Madagascar has been entirely overlooked by you as to fibres. Mauritius has received annually from thence 80,000 to 100,000 rattanas. These are about five feet square, of a coarse but good manufacture, something like sacking, but much stronger, made of fibre very long in the staple, and certainly equal to the best Russian hemp. They are principally used to dry the sugar on—each one contains about one hundredweight. The raw material from which this article is manufactured is most valuable. The sugar-bags made by the Kaffirs, at Compensation, Natal, for Mr. E. Morewood, were made of a fine strong plant, far superior to the Vacoua bags of Mauritius—it has a long fleecy fibre, well worthy of attention.

Gums.—I have long had my attention directed to this article, and should wish to have some practical knowledge of the different descriptions. It is generally known that South Eastern Africa abounds in gum ; from the Mimosa, in Natal and Kaffraria, thousands of tons could be collected, but those who have engaged in it say it will not pay to gather at 2½d. per pound. You have a great difficulty in getting the natives to collect it. When surveying the West Coast we found several different kinds of gum, and specimens were sent to Hull, but I have never seen a report on them. I believe, between Angra Pequina and Port Alexander, there is Gum Benzoin or Benjamin, and Gum Anime. A gum contained in the pith or centre of a plant grows about three feet high. This same plant has a gum of a different description coming from the branches ; and others, that I have lost recollection of, unless referring to my journal of that date. North of Port Alexander, and through all Benguela, quantities of ochilla weed are obtained on the coast, and gum copal from some short distance inland.

Gutta Percha.—I saw before leaving Mauritius samples of excellent quality brought from Madagascar. In

Natal the tree grows in all the sheltered valleys bordering on the sea coast. Natal is the country for all species of Euphorbia. Here you see this magnificent tree towering above 60 or 80 feet, looking down with contempt on its surrounding neighbours; if these are valuable, any quantity could be obtained. I am not acquainted with the exact plan used in India for puncturing the tree.

Timber.—I only have to make a few observations on the timber of Southern Africa. The Cape Colony is thought to be very deficient in this material, but in the district of George, the most magnificent forests exist. The Zitzikamma forest, extending from Plattenbergs Bay to the River Zitzikamma, is as little known as the centre of Africa, a distance of about 60 miles from W. to E., and 30 from N. to S. Here the elephant, buffalo, and larger game rove undisturbed by man. The giant of the forest is the *Yellow Wood*, a close-grained, light-coloured wood, durable for building purposes; it makes good furniture, and when polished in appearance equals satin-wood; it is very durable under water. (I used, at the Knysna, to repair my bulwark, the bottom of a punt that had been under water twenty years; it was perfectly sound). It makes good staves for ordinary casks, is always used for butter casks, as it has no resinous smell, and makes good deck planking for tropical climates. I have seen them grow without a branch 60 feet. *Stink Wood*, hard and very durable, but rather difficult to work, is used for furniture, takes a very high polish, and makes splendid gun-stocks. A great quantity is used by the navy in Simon's bay; they contract annually for about 600 loads. It is good for ship-building—capital outside planking above water. There is also Assigie, used for spokes, axles, and felloes of waggons. Red-milk wood, suitable for the same purposes; white milk wood, "iron wood," white alse, red alse, all used about the different parts of a Cape waggon, which is something like a donkey, never known to die a natural death; all the latter make excellent crooked timber for ship-building.

Sweeetmeats and Jellies.—You have never tasted Matingalo jam! then you have never tasted the best preserve made at Natal. I think this fruit would grow in England, and improve by cultivation. Four years ago I took some slips to Mauritius, in February last they were thriving well; I had some fruit, and Mr. Duncan, the Curator of the Botanical Gardens, gave me his opinion as above. At Mauritius, they preserve a great quantity of fruits. I have exported from thence pine apples, preserved whole, in tins, containing syrup; mangoes, leches, and other fruits preserved in the same way, with jellies and marmalades. They have a large manufactory at the Fleur Mauricienne.

Fisheries—The Cape exports annually to the Mauritius about 2,500 tons of fish, which is about three-fourths the consumption of the island; the remainder they obtain from their dependencies, principally Rodriguez, some small quantities from the Persian Gulf, and an occasional cargo from North America; the principal consumers are the Indian population. Guilbach, or Cape Salmon, is the first as to quantity; they are all taken with hook and line, and weigh about 14 lb. The cost of production ready for shipment, is about £12 per ton; the Malays at the Cape cure a great deal in vinegar (for home consumption), the same as pickled salmon in England; and it is not a bad representation of it. For exportation they are opened down the back, the intestines taken out, head cut off, salted for a night, and dried in the sun.

Snook, similar to the baracouta, is a long, slim, oily fish, taken with any shining bait; it is a perfect salt water pike; these are cured the same way as the guilbach; the cost of production for exportation is about £16 per ton; they are esteemed before any fish imported into Mauritius, fetching about £2 per ton more than cod; these fish are fine eating, whether cured or fresh; the Malays cure them without salt, by drying in the sun with a little pepper and spice; they are then delicious.

Silver fish, similar to the bream of England, each weigh from six to eight pounds; they are got up for exportation, the same as the others; the cost of production is about £10 per ton; they are least esteemed of any at the Mauritius market, but when fresh they are very nice eating.

Harders are a mullet, about eight inches long; they are principally cured in small casks, in brine, for up-country use; the farmers are very fond of them, but few are exported. They have also mackarel, very large, very fat, better cured than fresh. Roman and white fish are very excellent.

Sardines in myriads swarm round the bay at one season of the year; klip fish, king klip fish, and soles rather scarce—considered a luxury.

Thousands of cray fish are caught daily; four of the largest can be obtained for one penny, but it is not fashionable to eat them, notwithstanding which they are very good. The value of the fish exported from the Cape may be estimated at £25,000; this, with other productions, pays for the sugar consumed, and leaves a balance in favour of the Cape. The quantity could be increased almost *ad infinitum*, were a market found. I question if the cost of production could be lowered; salt, labour, and packages form considerable items in dried fish; but sardines in the French style, potted cray fish in the American, and the choicest fish preserved fresh in tins, might be made profitable. The quantity of fish throughout the whole extent of the coast bordering on the Lagulha's Bank is immense, and would be the richest fishery in the world. I think it probable that some of the fish of Southern Africa may have a swimming bladder suitable for making isinglass. I should wish to know the kind required and the mode of operation, and I am confident of being able to send to England a sample next year—of what quality, remains to be proved.

Of sharks perhaps the West Coast of Africa is the most prolific, both in variety and quantity. All the fat or oily matter is contained in the liver, which is nearly all oil. The one you speak of on the American coast, the liver filling ten barrels, is probably an error; the largest species of shark is known as the Bone shark. It has a very large mouth, no teeth, but a hard bony gum. In 1848, when at Ichaboe, I harpooned one of these monsters, (recollect I had been six years whaling in the Pacific, considered myself an expert hand, and was provided with good whale-boat, crew, lines, lances, and harpoons) about noon, and was fast for full six hours before I slew it; the difficulty in killing it was, it was not compelled, like the Mammalia, to come to the surface for air, but stuck as near the bottom as possible in ten fathoms of water. When we did succeed in getting it to the surface, as soon as it felt the prick of the lance, it darted off, carrying the boat after it at the rate of ten or twelve miles an hour; however, it was eventually killed, and we attempted to hoist it on board the ship, but a luff tackle fall, rove of 3-inch rope, parted, and we had to tow it on shore to the Island of Ichaboe at high-water. When the tide fell it was high and dry; it measured in extreme length 32 feet; its jaw went over the head of a 180 gallon cask, when it was dried. The liver, when cut up in slices, filled two tierces and a tub (about 80 gallons in all), it made 48 gallons of clear pure oil, besides about ten gallons of thick and inferior. Our method of boiling it was very imperfect. I think the whole fish may have weighed three tons.

Eggs.—I note the hint you have thrown out on sea-bird's eggs; could you get information as to how they must be imported to be useful in the manufactories. I could supply certainly fifty tons per annum, if their being packed in salt and in barrels would do. Of alligators, are you aware that oil of a fine quality is procured from them, considered most valuable for scalds, burns, and rheumatism; they are the perfect pests of the rivers of Natal; the skins are generally thrown away. The hippopotamus is found in all the rivers and lakes; it yields an immense quantity of fat, equal to the finest butter; its flesh is excellent, and equal to bacon when cured the same way; its skin as yet has been only used, locally, for whips or sjamboks. What would be its value in England?

The cowrie shell, similar to those used in India, is found on the coast of Natal. Large quantities of pearl shells were exported from Algoa Bay, but always resulted in a loss. It has almost ceased to be an article of exportation. Considerable quantities of the real pearl oyster may be obtained throughout the whole of the Friendly and Fejee Islands. At Savage Island the beach was covered with them; Madagascar will be a very likely place, as beautiful specimens of shells come from there.

Jerked Beef, Hides, and Tallow.—I know of no place so well situated for this commerce as Walwich Bay, on the west coast of Africa; although the country adjacent is a perfect desert, yet in the valley of the Swacup nutriment sufficient for 1,000 head of cattle may be found. This is the best outlet—perhaps the only one—for all the country of the Namaquas north of the Orange River. East of the Great Lake and the country explored by Dr. Livingston, and north of the country of the Damarez, is rich in cattle; the climate is so drying that I have kept beef a month without a particle of salt; all the juices are dried up by the atmosphere. Here a curing establishment might be established, with a good boiling apparatus. Fuel would have to be brought. The hides could be salted, the fleshy parts jerked, and all the remainder boiled down, except the horns and hoofs. By trading with the natives, oxen may be bought at about 7s. 6d. per head. We used to get three for a musket. Port Alexander is also a good place. Ivory may be obtained here, as well as bees-wax, skins, and ostrich feathers. Many thousands of pounds of feathers could be obtained at the rookeries of the different sea-birds on the islands of the Southern Ocean, but there is a difficulty in getting rid of the fishy smell they have.

Seaweed.—In a space of sea contained between the Gulf-stream, Madeira, 25° north latitude, and the tropic, is the Sargossa Sea—named from immense fields of weed known by that name. Any quantity could be obtained. Is not this the same weed that is burned into barilla—at the Western Islands, Madeira, &c.—if so, could it not be as easily burned in Britain, after being imported in its raw state?

Should any of the foregoing suggestions be of any interest, you can make what use you please of the information, and my name for the authenticity.

Yours faithfully,
WILLIAM MESSUM.

## LIQUID MANURE.

Sir,—The following notes of a lecture, given by Mr. Wilkins, at the London Tavern, on Thursday evening last, may be interesting to some of your readers, the subject being the application of liquid manure to the roots of plants.

Mr. Mechi (who presided), in introducing the lecturer, stated that he had, with two or three other gentlemen, seen some experiments at Reading, the result of which was most extraordinary. Mr. Wilkins had there taken some very poor land, near the station, and divided it into a series of double beds, for various kinds of produce, one bed being treated by Mr. Wilkins's process, and the other adjacent to it by the ordinary method; in every instance the produce of the former largely exceeded that of the latter, the seed being sown in both beds at the same time, and from the same parcel. It was a matter of calculation, whether the produce would give a sufficiently large return to justify so great an outlay, but he thought that if the cost of paving, &c., were even £100 per acre, it was a question whether the increased crop would not return an ample interest on the outlay and a large profit. All the crops on the beds at Reading, treated according to Mr. Wilkins's process, exhibited extreme freshness and luxuriance, and especially, in the case of the mangold-wurzel and carrots, great freedom from fangs. The practical application of the sewage of our towns to the land by means of pumps and pipes, as he distributed liquid manure at Tiptree Hall, was a subject deserving great attention. Prof. Way had estimated the value of the sewage of London at two millions sterling; it would be a very great result if it could be disposed of even for one million. The water companies pump up and convey a ton of water several miles for about a penny, and if it can pay to bring the water for London from Hampton, it would, he thought, be quite as economical to pump out the sewage of London to the waste lands and heaths in the neighbourhood, and, by making sterile land productive, largely increase the food of the population. By applying manure as a top-dressing, the surface was to a certain extent caked or hardened, but in Mr. Wilkin's system the top soil remained uncaked, and absorbed freely the rays of the sun.

Mr. Wilkins commenced by stating that by his improved system of agriculture, Russia would be superseded in the growth of hemp and flax, and England would be independent of all nations for the necessaries of life; that two crops, nay, three crops, and for cattle seven crops, annually might be produced.

In the year 1853 the lecturer took a piece of waste land at Wokingham, adjacent to Mr. Walter's property, which he laid out and planted with flax and hemp, according to his own method, as follows:—The upper soil being removed, a paved floor of brick was constructed, at about 18 inches from the surface, round which was placed brick on edge 4½ inches high, forming a raised rim round the entire plot, the whole being made perfectly watertight; semicircular tiles with open joints were placed longitudinally on this floor, having their convex side upwards and communicating at one end with a vertical pipe, to receive the liquid manure, and at the other with a plug, by raising which the quantity of sewage water, in the bed could be reduced or entirely drained off; there was also another pipe by which could be observed the height at which the fluid stood in the bed. The rows of drain pipes were laid parallel to each other, their distance apart being regulated by the width between the rows of seeds about to be sown.

The top soil was then replaced to a level with the surface, and the flax and hemp sown in rows exactly over the line of drain pipes; the liquid manure was applied down the pipe once or twice a week, allowed to stand a short time in the bed, and then drained off. The first crop of hemp was sown in the middle of April, and the second crop, from new seed, three months after, on the same ground; both crops were about six feet long. Specimens of these were produced, as also of the two crops of flax grown on the same land.

Mr. Wilkins considered that the application of liquid manure to the root of a plant was the true principle of nature; that the tip of the root was the mouth of the plant, the leaves were its lungs, and that, in order to render that plant luxuriant, its food must be supplied to its mouth, and not to its lungs. He did this by his method, the liquid being drawn up by capillary attraction and evaporation, to the roots.

The lecturer then exhibited some specimens of potatoes, mangold-wurzel, Indian corn, beetroot, Italian rye-grass, and Lucerne, produced on the experimental garden at Reading, laid out on the principle as before described. The rent paid by him for this piece of ground (seven acres and a small cottage) was £2 per annum. The plants in each double bed were sown on the same day from the same seed. These beds were each 100 feet square, those on the new principle receiving about two feeds of liquid manure weekly, and no manure being applied to the adjacent one. The result of the experiment was that on the beds cultivated on his system the potatoes were double the weight of those on the unprepared piece, being taken up in eleven weeks. The mangold-wurzel was produced at the rate of about sixty-nine tons per acre, the average weight of the roots being twelve pounds each, whereas on the unprepared piece it was four pounds, and on a piece of ground prepared with a top dressing of liquid manure, six pounds. The Italian rye-grass was cut

five times on the prepared bed to one cut on the other; the fifth of the former being exceedingly tender and juicy, while the one of the latter was tough and dry. The Lucerne also gave three cuts on the new system to one on the old. The Indian corn came to a good-sized ear on one piece, but no corn ripened on the other. The wheat and Swede crop did not succeed, owing, as Mr. Wilkins supposes, to bad seed. The white turnips were sown on September 2nd; on one bed turnips of a large size were produced, on the other the seeds never vegetated. After the potatoes were taken up on the prepared bed winter brocoli was sown, and in six weeks was ready for table. This was followed by Savoy cabbages, fit to cut last month, or three crops produced between May and December. A cattle cabbage was grown weighing twelve pounds; its stump was allowed to remain on the ground, and it had now on it fifteen young cabbages. In June he had planted a small potato, picked up at Wokingham, of a kind which but seldom arrives at a large size; this was taken up early in September, in the presence of Mr. Mechi, when the haulm was found to be five feet long, and the produce of the root seventeen potatoes; having a total weight of 8½ pounds, one potato alone weighing two pounds.

An ash-leafed kidney, planted in sand, on the top of a house, in eleven weeks produced eighty-four potatoes.

The results of feeding cows on the rye-grass produced, was that one cow gave seven quarts of milk when fed on the grass from the bed on the new system, but only six quarts when fed on that from the other. The lecturer had no doubt that the cream and butter would be largely increased. It was mentioned that the application of sewer water to the roots of some geraniums had caused them to be in perpetual bloom, and suggestions were thrown out for the application of this principle to conservatories and sitting-rooms.

Mr. Wilkins estimated that the cost, according to his present construction, with bricks or tiles, would be about £100 per acre; but he believed, by forming the water-tight bottom of gas tar and sand, that the expense would be reduced to about £50 per acre. Even at the larger cost, on the very worst land, he was certain a very large profit would accrue, and that, by the employment of his principle, England might become independent of all nations for the necessaries of life.

I think that this method is peculiarly applicable to cottage gardens, where it will no doubt largely increase the crop; but it appears to me that the difficulties in carrying it out on a large scale will be very great, though I do not say they may not be overcome by talent and energy.

If executed in a series of small beds, the cost of distribution would be excessive. This is a point upon which Mr. Wilkins has not entered, and which would be insignificant in an experiment on a small scale. If, on the other hand, the beds or reservoirs are constructed of large area, the ordinary drainage of the land will not be so efficiently carried on; it would be difficult to keep the reservoir perfectly water-tight; and in undulating ground the sewer water would not be retained in the reservoir, but drain off over the lower edge.

I therefore do not think that the construction adopted by Mr. Wilkins will be likely to succeed, though I am of opinion that the system may, in time, be brought into profitable use on a large scale, by some modification of the present draining tiles and mode of laying them, so as to combine in one operation the two objects of surface-drainage and underground application of liquid manure.

The subject could not be in more able hands than those of Mr. Mechi, who will, I have no doubt, give it a fair trial on a large scale, and express his valuable opinion thereon. I hope before the end of another year we may have this and other information connected therewith, and thus be enabled to come to a conclusive decision on this important subject.

H. P. STEPHENSON.

London, 37, Charing-cross, January 15th, 1855.

## Proceedings of Institutions.

CROYDON.—Strenuous exertions have lately been made, by the friends and members of the Literary and Scientific Institution, to enlarge its sphere of usefulness. The management has been entrusted to gentlemen of energy and perseverance, and it is hoped that with the support of the public, the Institution will be rendered worthy of this large and populous town. The first lecture of the winter quarter, was given by Mr. Henry Phillips, "On the City of the Sultan;" it was very fully attended, and gave universal satisfaction. Mr. Phillips will shortly be followed by Mrs. Balfour, on "Memorable Youthful Poets," and by Mr. George Dawson, on "Alfred the Great." This Institution has just agreed to a General Interchange of Privileges with the other Institutions in Union.

## To Correspondents.

ERRATA IN REPORT ON TRADES WHICH INJURE THE EYES.—Page 123, col. 1, third line, 2nd par of small type, for *smoker* read *worker*; page 123, col. 2, line 31, for *fine* parts read *fore* parts; and page 123, bottom of 2nd col., and page 124, top of 1st column, for *pinkers, pinker,* and *pinked,* read *prickers, pricker, and pricked.*

The Honorary Secretary to the Stockton-on-Tees Mechanics' Institute writes to say that so far from there having been an *entire absence* of officials at Mr. G. S. Phillips's lecture "On the Poetry of the Pope Era," as mentioned in the Journal of the 29th ult., *six* of the Committee and *one* of the Secretaries attended. The notice in question was obtained from an extract from a local print enclosed to the Secretary.

## MEETINGS FOR THE ENSUING WEEK.

MON. Architects, 8. Mr. T. L. Donaldson, "On Some of the Constructions now in course of Erection between the Louvre and the Palais Royal at Paris."
Entomological, 8. Anniversary.
Geographical, 8½. 1. Mr. Keith E. Abbott, "Geographical Notes taken during a Journey performed in Persia." 2nd. series. 2. Lieut. R. Burton, "Proposed Expedition to the Zomali Country in Eastern Africa."

TUES. Royal Inst., 3. Professor Tyndall, "On Magnetism."
Meteorological, 7. 1. Dr. Buist, "On the Means of Determining the Amount of Evaporation from the Earth's Surface." 2. Mr. Doggett, "On the Weather in Connection with the Growth of Barley."
Civil Engineers, 8. Mr. J. Brunlees, "The Sea Embankments in Morecambe Bay; Ulverstone and Lancashire Railway."
Med. and Chirurgical, 8½.
Zoological, 9.

WED. Royal Soc. Literature, 4½.
Society of Arts, 8. Mr. W. Longmaid, "On Peat and other Vegetable Charcoal, and Some of its Uses."
Microscopical, 8.

THURS. Royal Inst., 3. Mr. W. B. Donne, "On English Literature."
Numismatic, 7.
Antiquaries, 8.
Royal, 8½.

FRI. Philological, 8.
Royal Inst., 8½. Professor Tyndall, "On the Nature of the Force by which Bodies are Repelled from the Poles of a Magnet."

SAT. Royal Inst, 3. Dr. J. H. Gladstone, "On the Principles of Chemistry."
Royal Botanic, 3¾.
Medical, 8.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Jan.* 12*th*, 1855.]

*Dated 16th December*, 1854.

2656. D. D. Deming, New York—Machine for cutting cloth, &c.

*Dated 22nd December*, 1854.

2701. L. J. F. Margueritte, Paris—Caustic and carbonated potash and soda.
2703. A. Suter, 65, Fenchurch-street—Wind guard.
2705. F. Prince, Haverstock-hill—Nipples of fire-arms.
2707. E. Loysell, Paris—New game.
2709. J. Downie, Glasgow—Fire-arms.
2711. A. E. L. Bellford, 16, Castle-street, Holborn—Breech-loading fire-arms. (A communication.)

*Dated 23rd December*, 1854.

2713. J. Walker, Wolverhampton—Bricks, tiles, pipes, &c.
2715. G. Anderson, Rotherhithe—Purifying sewers and buildings.

*Dated 26th December*, 1854.

2720. A. Dormoy, Seuillon, near Langres—Iron shovels.
2721. C. E. White, Fulham, and F. Robinson, Putney—Railway signals.
2722. B. Bishop and J. Dyer, Birmingham—Hinges.
2724. F. S. Thomas, Fulham, and W. E. Tilley, 6, Kirby-street, Holborn—Plating metals with tin, nickel, or alumina.

*Dated 27th December*, 1854.

2725. J. Dundas, Dundas Castle, Linlithgow—Ordnance.
2726. J. Nash, Market Rasen—Drying malt, grain, or roots.
2727. G. Carter, 42, Lombard-street, and H. C. Symons, 52, Castle-street, Southwark—Boilers and furnaces.
2728. T. Boyle, 45, Skinner-street, Snow-hill—Reflectors for artificial light.
2729. J. L. Dunn, Glasgow—Useful products from waste sulphates and nitrates.
2730. W. E. Newton, 66, Chancery-lane—Looms. (A communication.)
2731. J. Comstock, New London, U.S.—Trip hammers.
2732. Lord Berriedale, 17, Hill-street—Washing cloth or yarns.
2733. J. Cumming, Glasgow—Ornamental fabrics.

*Dated 28th December*, 1854.

2734. C. May, Great George-street—Screws.
2736. J. Cockcroft, New Accrington—Printing textile fabrics.
2740. W. Ward, Sheffield—Stoves.

*Dated 30th December*, 1854.

2754. C. Bissell, Birmingham—Sights for rifles.
2756. E. Mayeur, 62, Tredegar-square—Centrifugal pump. (A communication.)
2760. R. S. North, Gorton, near Manchester—Railway switches and crossings.
2762. J. H. Johnson, 47, Lincoln's-inn-fields—Motive power. (A communication.)

*Dated 1st January*, 1855.

2. W. W. Lewis, Hanley-castle—Charcoal.
4. G. Crane and I. J. Crane, Chester—Coating for ships' bottoms.

*Dated 2nd January*, 1855.

6. B. Britten, Anerley—Obtaining a copy of writings, drawings, or tracings in ink.
8. H. L. Dormoy, Paris—Twisting silk and other fibrous substances. (A communication.)
10. C. J. Fincken, Paris—Preserving windows, &c., from condensation and damp, and from smoke, soot, and dust.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed January 12th*, 1855.

1531. William Armand Gilbee, 4, South-street, Finsbury—Improvements in the application to weaving of certain textile plants not hitherto employed, either alone or in combination with silk, cotton, and other fibrous substances.
1537. Thomas Bennett Foulkes, Chester—Improvements in the manufacture of self-adjusting gloves.
1541. John Hackett, Derby—Method of fastening the ends of india-rubber elastic cord and india-rubber elastic web.
1559. John Ashworth, Turton—Improvements in apparatus to be employed in the construction of the permanent way of railways.
1565. John Bailey Denton, Stevenage—Improved hoes and spuds.
1567. George North, Lewisham-road—Improved apparatus to be attached to garments for protecting watches, purses, and other articles from being stolen from the person.
1568. William Warcup, Lyndhurst-villa, Coronation-road, Bristol—Improvements in the construction of springs for carriages and similar purposes.
1580. William Beckett Johnson—Improvements in steam engines.
1587. William Ball, Rothwell Kettering—Improvements in drills.
1592. Jean Barthélemy Gillet, Agde (Hérault), France—Improvements in capstans, winches, and windlasses.
1595. Francis Whitehead and William Whitehead, Crayford—Improvements in safety lamps.
1606. Nicholas Callan, Maynooth College—Means by which iron of every kind may be protected against the action of the weather and of various corroding substances, so that iron thus protected will answer for roofing, for cisterns, baths, gutters, window frames, telegraphic wires, for marine and various other purposes, and by which brass and copper may be similarly protected.
1608. Richard Archibald Brooman, 166, Fleet-street—Improvement in treating raw silk fabrics while being dressed and dyed. (A communication.)
1609. James Sedgwick, Lewisham—Improvements in ship-building.
1639. William Church, and Samuel Aspinwall Goddard, Birmingham—Improvements in ordnance.
1657. Samuel Frankham, Greenland-place, Judd-street—Improvement in the construction of furnaces.
1680. Edwyn John Jeffery Dixon, Bangor—Improvements in apparatus for teaching reading and arithmetic.
1741. William White, York-villa, Kensington-park, Bayswater—Improvement in deodorising the contents of cesspools, privies, and also like matters in other places.
1808. Thomas Webster Rammell, Trafalgar-square—Improvements in stoves and fire-places.
1835. William Henry Smith, M.D., Philadelphia, Henry Bessemer, Baxter-house, St. Pancras, and Robert Longsdon, Hornsey-lane—Improvements in the manufacture and treatment of slag and vitreous substances, and the combination of other substances therewith.
1894. Pierre Amable de Saint Simon Sicard, Paris—Improvements in apparatus for raising and destroying submerged vessels, rocks, and other bodies, and also in apparatus to facilitate the examination of submerged bodies.
2181. William White, York-villa, Kensington-park, Bayswater—Improvements in the manufacture of manures.
2183. Ancel Alexander Routledge, Neath—Improvements in the manufacture of detonating railway signals.
2295. Jabez Morgan, Kidderminster—Improvements in machinery or apparatus for cutting metals.
2310. Thomas Frederick Tyerman, Weymouth-street, Portland-place—Improvements in preparing hoop iron and such like metal surfaces used for bondings in buildings and structures.
2329. Henry Walmsley and John Day, Failsworth, near Manchester—Improvements in looms.
2335. James Atherton and John Kinlock, Preston—Improvements in machinery or apparatus for preparing and sizeing or dressing yarns or threads.
2344. Frederic Rainford Ensor, Nottingham—Improvements in bobbin net or twist lace machinery.
2358. John Bird, Chance's Fire-brick Works, near Dudley—Improvements in reverberatory furnaces.
2359. William Beardmore, Stowage, Deptford—Improvement in the bearings of the axles of railway carriages and locomotive engines.
2367. Allan McDonald and Alexander McIntosh, Alexandria, Dumbarton—Improvements in machinery for stretching and smoothing cloth or woven fabrics preparatory to or in the course of being printed.
2375. David Ferrier, Edinburgh—Improvements in facilitating a reference to books.
2380. George Tomlinson Bousfield, 8, Sussex-place, Loughborough-road, Brixton—Improvements in machinery for turning prismatic forms.
2421. Alfred Vincent Newton, 66, Chancery-lane—Improved mode of manufacturing soluble silicates.
2435. Joseph Wilson, Hopton, Yorkshire—Improvements in the manufacture of printed warp fabrics.
2443. George Tomlinson Bousfield, 8, Sussex-place, Loughborough-road, Brixton—Improvements in the manufacture of wrought-iron carriage and other wheels and pullies.

*Sealed January 16th*, 1855.

1583. Samuel Mitchell, Dewsbury—Improvements in the manufacture of cards for carding wool, cotton, silk, and other fibrous materials.
1586. James Longley, Hunslet-road, Leeds—Machine for turning and finishing tubs, pails, casks, and other wooden vessels of an elliptic, oval, or other eccentric form.
1596. John Hackett, Derby—Covering india-rubber thread, whether vulcanized or otherwise, with sewing silk and with other articles.
1614. Thomas Firth, Huddersfield, and John Wilson, Mirfield—Improvements in finishing woollen, worsted, silk, and other woven fabrics, and in the apparatus employed therein.
1616. William Septimus Losh, Wreay Syke, near Carlisle—Improvements in bleaching.
1634. William Stephens Garland and Josiah Glasson, Soho Foundry—Means of consuming smoke in furnaces.
1658. Barton H. Jenks, Bridesburg, Pennsylvania, U.S.—Improving the art of weaving, being an improvement in looms for weaving fancy fabrics.
1666. Francis Morton, Liverpool—Improvements applicable to girders or rafters to be used in the construction of roofs, bridges, buildings, and other erections.
1670. Robert John Keen, Liverpool—Improvements in the mariner's compass.
1692. Christopher Ridout Read, Moorgate-street—Improvements in slide-valves of steam engines.
1698. James Griffiths, Wickham Market—Improved lever bit for horses.
1752. Edward Monson, Birmingham—Improved machinery for manufacturing, cleaning, and polishing daguerreotype plates.
1824. Joseph Barrows, Handsworth—Improved instrument to be used in cutting loaves of bread and other articles of food.
2256. John Maddox, Thomas-street, Brick-lane, Edward Gardner, Buxton-street, and George Dyer Green, Weaver-street—Improvements in weaving fringes.
2350. Louis Napoleon Langlois, Paris—Improvements in the construction of steam boats.
2356. Edward Simons, Birmingham—Improved candlestick.
2372. Charles Dalrymple Cranstoun, Elgin—Improvements in coupling and uncoupling railway carriages and rolling stock.
2382. Henry William Harman, Dock-yard, Northfleet—Improvements in windlasses, capstans, crabs, cranes, and other machines or apparatus for raising, lowering, or moving heavy bodies.
2406. Adolphe Pécoul, Marseilles—Improved system of marine log, to be called "sounding log."
2432. William Hann, Hetton Fence Houses, Durham—Improvements in propelling vessels.
2446. Henry Robert Ramsbotham, and William Brown, Bradford—Improvements in combing wool, cotton, tow, certain descriptions of hair, and other fibrous substances.
2474. George Collier, Halifax—Improvements in the manufacture of mohair plush.

Journal of the Society of Arts.

*FRIDAY, JANUARY* 26, 1855.

## MEETING OF COUNCIL.

January 24, 1855.

At the meeting of Council held this day the following resolutions were passed :—

1. The Council desires to express the best thanks of the Society to Her Majesty's Government and to the Government of the Emperor of the French, for causing the postage between the two countries to be reduced to four pence for a single letter; a reasonable sum, which in its component parts of 2d. for the usual French inland rate, 1d. for the sea transit, and 1d. the usual British rate, gives effect to a principle which the Postage Association, the petitions of most numerous places and associations in the United Kingdom, and Mr. Elihu Burritt, have for a long time advocated.

2. The Council considers this reduction especially well-timed, and has confidence that it will be the means of increasing the friendly alliance between France and the United Kingdom, and advancing the Arts, Manufactures, and Commerce of the two nations.

3. The Council trusts that the initiative taken by France and the United Kingdom, may suggest to the United States the policy of applying the principle of an ocean postage to the inland rate of the two countries.

Ordered—That the Secretary transmit a copy of these resolutions to the Postmaster General, and thank him, in the name of the Society, for his own personal labours.

Also—That the Secretary transmit copies to the French ambassador, with a request that he will communicate the same to the Imperial Government of the Emperor, also to the ministers of the United States, and also to Mr. Elihu Burritt.

## EIGHTH ORDINARY MEETING.

Wednesday, January 24, 1855.

The Eighth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 24th instant, John Brady, Esq., M.P., in the chair.

The following Candidates were balloted for, and duly elected ordinary members :—

| | |
|---|---|
| Chaplin, Frederick William. | Maxtone, James. |
| Chapman, Thomas, F.R.S., F.S.A. | Redpath, Leopold. |
| Emmens, William. | Streatfield, J. Fremlyn. |

The following Institution has been taken into Union since the last announcement :—

384. Bristol, City Lectures Literary Association.

The paper read was

## ON PEAT AND OTHER VEGETABLE CHARCOAL AND SOME OF ITS USES.

By William Longmaid.

The subject to which I propose to direct your attention this evening is Charcoal, and some of its uses. The materials forming the earth's surface have been described by geologists and chemists, as consisting of comparatively a few simple substances; and their distribution and uses instructively and beautifully illustrate the power, the wisdom, and the goodness of the Almighty Creator, and furnish unlimited evidence of design.

Of undecomposed substances, probably there is no one that plays more important and varied parts than carbon; if we contemplate the diamond, that beautifies the diadem of royalty, the still more beautiful electric light, or the vast deposits of coal, so extensively distributed in this favoured island, carbon must be regarded as an agent of primary importance.

If we extend our researches to organic beings, we find that with the exception of the framework of animals and the shells of crustacea, carbon forms a moiety of the solid materials of all organic beings, whether animal or vegetable; the beautiful flowers and foliage that adorn the earth, the colours that deck the plumage of the feathered tribes, no less than the tints that clothe the inhabitants of the teeming oceans and rivers, the fragrant perfume wafted on the gentle breeze, all owe their existence in part to carbon; nay, even some of the solid rocks that form the framework of the great globe itself, are compounded in part of this substance.

However varied in form, and widely-diffused carbon may be in nature, in its countless combinations it is no less useful, in the arts, sciences, and manufactures; indeed, we trace its effects everywhere, in fact, if carbon were to be withdrawn from the earth, organic existence would cease, and the physical condition of the earth itself would be changed.

It may not be amiss, then, to devote a few minutes this evening to the consideration of carbon, in some of its forms and uses, as it is found in the arts and manufactures, particularly under the term vegetable charcoal, the produce of wood and peat.

Charcoal produced from vegetable matter is carbon isolated from the constituents of water, with which it is always combined in organic substances; there are several methods ordinarily employed for this purpose; one in considerable use is most rude, and no doubt of great antiquity; it consists in digging a pit in the earth, and piling up pieces of wood or peat in large heaps, which are covered with clods of earth in such a manner that the pile may be ignited at the base; when the fire is well kindled, more clods are placed over the pile, in order to prevent the too free access of atmospheric air, and which is eventually excluded; the heap is allowed to stand from one to five or six weeks, the length of time depending on the size of the operation. Another method is much practised in some parts of the Continent, and consists of a furnace somewhat in the form of a kiln, with apparatus to exclude the air; it is filled with the material ignited at the base, and the operation proceeds much in the same manner as before described. Modern science has provided a more perfect operation in destructive distillation in retorts, whereby the volatile products are condensed and are of great practical utility.

In the first method I have described, about 18lbs. of charcoal are obtained from every 100lbs. of dry wood; this is considered a fair yield; the other products are mostly lost. In the second method more tar and pitch are obtained with the same quantity of charcoal. But by the more elaborate process of distillation, naptha, acetic acid, ammonia, and other matters, are obtained, together with about 20 to 25 lbs. of charcoal for every hundred pounds of wood.

There is yet a more recent process for the manufacture of vegetable charcoal, for which, jointly with my son, I have obtained letters patent; this process consists in steeping vegetable matter in dilute sulphuric acid, and drying it at a low temperature, whereby we obtain from 40lbs. to 65lbs. of charcoal for every 100lbs. of dry material submitted to the operation.

I presume the experiment I am about to make with sulphuric acid and sugar, has been exhibited in every lecture room in the United Kingdom; this demonstrates the principle of the new mode of manufacturing charcoal, the sulphuric acid has a greater affinity for the elements of water than carbon, and the latter is isolated. We have found that every description of vegetable matter to which we have applied this mode of treatment, has exhibited the same phenomena.

The chemical action that takes place is well understood, and presents no novelty; but the application of this principle to useful purposes, on a large scale, I believe has not before been accomplished; this experiment will demonstrate the nature of the process; this is sawdust of pine timber, and has been steeped in sulphuric acid of the strength of 3 degrees of Twaddle's hydrometer. I will now place it on this plate, and apply a lamp underneath—we shall soon see the result.

Perhaps it is impossible to over-estimate the importance of charcoal. England is possessed of vast deposits of mineral coal, which enables our manufacturers to produce iron at a cost that bids defiance to all competition. The deposits of coal and iron-stone may be regarded as the foundation of all our greatness as a nation, but whilst the iron is produced in quantities of which the mind can scarcely conceive an adequate idea, and whilst it is of a quality fitted for an endless variety of purposes, for which strength and cheapness are the prime qualifications, it is totally unfit for the manufacture of steel. This circumstance renders this country dependent on foreign countries, chiefly Russia and Sweden, for iron of superior quality. The sole cause of the superiority of foreign iron, is the fact that charcoal is the fuel employed for smelting the ore.

The coke used by the British smelter contains a sensible amount of sulphur, chiefly in combination with iron, and exists in the coal in the form of iron pyrites; it is found practically impossible, in the great operations of iron smelting, to separate it at a cost that would render it practicable.

On the other hand, charcoal is all but absolutely free from sulphur, and it exists in vegetable matter in the condition of sulphuric acid, and combined with alkali, thus forming a neutral salt, which combines with the earthy matters of the ore, and thus forms an ingredient of the slag. If from any unforeseen circumstances our supplies of foreign iron should cease, our steel and cutlery manufacturers would be driven to great extremity, and this branch of British industry, of world-wide reputation, would be in danger of considerable derangement.

There are other branches of manufacture dependent on charcoal for their success;—gunpowder and tin-plates; it isalso largely used by founders and engineers, and more recently it has been used as a deodoriser, disinfecter, and decoloriser, and also as a manure.

A cursory glance at the position and limited surface of England, with its dense and increasing population, will be sufficient to convince us that space cannot be spared for the growth of timber for fuel; this will be still more evident, if we consider for a moment the consumption of coals in the metropolitan district for the year 1854, which amounted to 3,400,000 tons. The quantity of wood necessary to produce charcoal of equal heating power, would exceed 400,000,000 cubic feet. If we add to the quantity required for London, the quantity required for the consumption of the country and for exportation, we shall find that the entire surface of Great Britain would be inadequate to grow timber sufficient to manufacture charcoal of equal heating power. Whilst this is undoubtedly the case, and with an ever-increasing demand for fuel, attention has been directed to the *bogs* of the United Kingdom, as offering an exhaustless mass of organic matter, ready to be converted by the hand of science into fuel of first-rate quality, eminently suited for most of our manufacturing and domestic purposes.

The extent of bog land in Ireland alone exceeds 3,000,000 acres in surface, in many localities ascertained to be of a depth of 30 feet and upwards.

It is well known that peat charcoal, when employed as fuel for smelting iron, and tempering edge tools, &c., has produced articles of surpassing excellence; it is largely used on the Continent in smelting works, and for domestic purposes.

Peat is vegetable matter undergoing partial decomposition, and probably its formation commenced at a very remote period of the world's history. It is found in natural basins, formed by the inequalities of the earth's surface, wherein the water is dammed up and prevented from flowing into adjacent streams and rivers. In these lakes vegetable matter has accumulated and is undergoing various changes, and final decomposition. In the earlier deposits it is characterised by a nearly homogeneous structure; but the later and more superficial deposits present a less decomposed and compacted character, and has the general appearance of an entangled or felted structure, composed of partially decomposed moss and grass, and not unfrequently shrubs and trees; the moss and grass have the appearance of gradual and successive decomposition at the roots, whilst they continue a vigorous vegetation at the surface.

The entire mass, both of the more compact and the less solid peat, is composed chiefly of ligneous matter, and may be considered as analagous to woody fibre; its quality, however, is frequently affected by the special circumstances of locality. The best samples we have met with have contained, when dried, about 70 to 75 per cent. of carbon, but other samples were contaminated with earthy matters to the extent of 5 to 10 per cent. The average impurities may be taken at 4 to 5 per cent., and we have found some samples of peat charcoal yielding 94 per cent. of fuel.

The attention of the scientific world is now fully awakened to the importance of rendering this vast source of wealth available; not that the coal fields of Great Britain are likely soon to be exhausted, notwithstanding the millions upon millions of tons raised annually, but as a matter of economy in the race of the arts, manufactures, and civilisation, it is of first importance to get the greatest possible amount of good at the lowest possible cost. What, then, is the present state of the fuel market? The demand for coke and coals for locomotives, for marine engines, for exportation and other purposes is so enormous, that the price has been raised to such an extent as to threaten the destruction of extensive industrial operations carried on on the Tyne and in other coal districts. Immense quantities of coke are being sent to the extremities of Great Britain and Ireland for working the locomotives of the railways, whilst many of the lines traverse vast tracts of bog capable of being made into fuel, equal in value to coke, and, in such localities, at a third of its cost.

There is another remarkable feature which may be noticed. Ironstone is at this moment being raised in the immediate vicinity of deposits of peat, but in the absence of any economical carbonising process, to render it fit for smelting iron, the ore has to be sent to smelting works, at a considerable charge for carriage. It is a remarkable fact that iron-stone is found constantly occuringin the vicinity of deposits of peat, and when once this treasureis brought fairly to bear, we may anticipate the production of iron of the finest quality.

It may be truly affirmed of Ireland that she contains within her borders all the raw material, except cheap fuel, to make her a worthy competitor of Great Britain as a manufacturing country; and if once a cheap and practical

method be devised of rendering the peat into good charcoal, I can see no end to the prosperity of that country,—abounding, as it does, in rich deposits of iron, copper, lead and sulphur ores in unlimited quantities, together with rock-salt, clay, limestone, slates, and granite, having also fine lakes and rivers, the rude materials that form the foundation of a nation's greatness as a manufacturing people. In addition to the mineral deposits, Ireland possesses in her hardy sons the bone and muscle and the energy necessary to raise her to the first rank as a manufacturing nation; and I do not despair of seeing the peat-bog in course of transformation into charcoal, and her idle population become industrious and prosperous manufacturers. I venture to predict, that when the manufacturing capabilities of that country, so rich in native, and at present unappreciated materials, become fully known, capital will flow readily to her aid. But as long as Irish manufacturers have to draw their chief supplies of coal and coke from England and Scotland, her manufactures must languish, and so long will her vast mineral treasures remain undeveloped, and her population be without profitable employment.

The question may arise,—Why is the iron produced by vegetable charcoal of better quality than that by mineral coke? The answer is obvious; iron has an intense affinity for sulphur, and mineral coal contains iron pyrites, a portion of the sulphur of which remains with, and injures the texture of the metal smelted by its agency, and renders it unfit for the manufacture of steel, as it is impossible, except at an enormous cost, when once the sulphur has combined with the iron, to make a perfect separation.

Vegetable charcoal also contains some sulphur, but in all cases in a neutral form, combined with potash, soda, or other alkaline re-agents; in this condition it readily combines with the earthy matters of the ore, and forms an ingredient of the slag. The peat charcoal we propose to manufacture also contains sulphur, chiefly in the neutral state, as alkaline salts, but a small portion also remains as free acid. In smelting operations the alkaline sulphates combine with the earthy matters of the ore, forming slag, and the free sulphuric acid is decomposed. One atom of the oxygen of the acid combines with an atom of carbon, forming carbonic oxide, and liberating the remaining oxygen and the sulphur as sulphurous acid; thus all the sulphur of the free sulphuric acid is evolved into the atmosphere.

In pit coal the sulphur exists in varying quantities from one to fifteen per cent. When it exists in larger quantity than two to three per cent. it renders the coal unfit for many manufacturing purposes.

There is another quality of fuel of great importance, its heating power. The following table is an extract from Dr. Ure's work, and may be regarded as the mean results of numerous experiments made by that gentleman. It gives the quantity of water raised from the freezing to the boiling point, and the quantity of water of the temperature of 212°, evaporated by the combustion of one pound of fuel in each case:—

| | Pounds of water raised from 32 to 212 degrees. lbs. | | Water at 212° evaporated. |
|---|---|---|---|
| Perfectly dry wood . . . | 35 | ... | 6·36 |
| Wood in its ordinary state | 26 | ... | 4·72 |
| Do. charcoal . . . . | 73 | ... | 13·27 |
| Pit-coal . . . . . . . | 60 | ... | 10·90 |
| Coke . . . . . . . . | 65 | ... | 11·81 |
| Peat . . . . . . . | 30 | ... | 5·45 |
| Peat charcoal . . . . | 64 | ... | 11·63 |

It will be seen from the above table that wood charcoal stands first in heating power, coke second, and peat charcoal within 1·3 per cent. equal to coke.

Charcoal has also the peculiar faculty of absorbing watery vapour and gases to an extraordinary extent. Professor Liebig states the result of experiments conducted by Saussure, that one volume of charcoal in 24 to 36 hours absorbed 90 volumes of ammoniacal gas, 65 sulphurous acid, and 55 of sulphuretted hydrogen. It also absorbs nitrogen and many other gases. This property of charcoal has of late been turned to practical account, as it has been used as a disinfector and deodoriser, some interesting particulars of which will be found in a paper read to this Society by Dr. Stenhouse, in the early part of last year.* Since that period experiments have been made by Mr. Barford, at Bartholomew's Hospital. The particulars were published in the *Lancet* a few weeks since. The writer, after describing the substances possessing the property of deodorising and disinfecting, and the chemical action on which they respectively depend, and also pointing out their several defects, adds, that they are all open to serious objections; but the one which practically will be found the most effectual, I believe, has received the least patronage. This is charcoal, a body whose disinfecting powers have long been known, but its mode of application has been quite neglected.

A most perfect trial has been made in the dissecting rooms of St. Bartholomew's Hospital, which must abound in noxious gases and putrescent odours. On thoroughly heating the charcoal and placing it in shallow vessels about the rooms, it acted so promptly, that in ten minutes not the least diffused smell could be detected. So quick and effectual was its action, that arrangements have been made for its constant use. As a purifier of hospital wards, both civil and military, it might be applied with great advantage, saving patients from the unpleasant smells and effluvia from gangrenous wounds; thus the patient himself and those in adjacent beds, would not be subjected to the influence of putrescent odours. All these the charcoal would effectually absorb. Charcoal is more efficacious than any other disinfectant when applied in the manner described, absorbing gases of every kind. It does not require the presence of any other substance to assist its action, but without stint or scruple collects noxious vapours from every source, not disguising, but condensing and oxydising the most offensive gases and poisonous effluvia, converting them into simple, inert, stable compounds. It is easy of application, and is economical, comes within the reach of the poorest, and can be safely placed in the hands of the most ignorant, thus combining advantages not possessed by any other disinfectant.

Mr. Barford also described a process for purifying the charcoal, so as to renew its powers, but this need not be practised, for the charcoal, after being used in the hospitals, is more valuable as a manure, by reason of the gases it has absorbed; thus its use need not entail any expense on such establishments. This brings us to the consideration of charcoal as a manure, for which purpose it is likely to become an important agent, especially from the circumstance of its possessing such intense affinity for nitrogenous gases and aqueous vapour.

Professor Liebig states that peat and spent bark are most difficult forms of organic matter to deal with as manure; that peaty matter remains for years exposed to the influence of air and water without undergoing change, and in this state yields little or no nutriment to plants. Recent experience has, however, shown that when organic matters, such as peat and spent tan, are converted into charcoal, they become exceedingly valuable as vehicles for the transmission of water, nitrogenous compounds, carbonic acid, &c., to the plants, first separating these matters from the atmosphere, and again yielding them up when required.

The mode of applying charcoal as manure is simple; it should be ground to a coarse powder, and then strewn over farm yards, manure heaps, stables, cow-houses, pigstyes, cess-pools, or placed in manure tanks, urinals, &c.

It is suitable for being applied, also, without mixture by the drill or broad cast, in the proportion of 4 to 7 cwt. per acre, to all green and corn crops, and will be found a valuable addition to most soils, especially those which are composed of clay.

* *Vide* "Journal of the Society of Arts," Vol. ii., p. 245.

Perhaps I may be permitted to make a short digression, for the purpose of introducing to your notice another preparation of peat; this is peat manure produced by steeping the peat fresh from the bog in a solution of caustic alkali; it is then dried and ground.

Contrary to the general opinion of writers on agricultural chemistry, that the atmosphere and water are the sources from whence vegetables derive their carbon, I entertain the opinion, that they would at all times take up a large proportion of their carbon by the roots, whenever it is presented in soluble compounds, such as organic matters, dissolved by means of alkalies, in which condition it has been found, by actual experiment, that growing plants do take up and assimilate the carbon of such compounds, when they are applied in a suitable form.

In the substance I have now the honour of submitting to your notice a very large portion of the inert peaty matter, described by Liebig, as being so difficult of treatment and slow of change, is rendered soluble by the process I have described; not only so, but the remaining organic matters are in a condition to undergo rapid change. We have in this powder from 50 to 60 per cent. of organic matter combined with salts of soda, and nitrogenous compounds soluble in water, this, surely, cannot fail to become a most important addition to our list of artificial manures. Sea-weed treated in the same manner yields still more remarkable results.

Trusting to be excused for this digression, I will return to the subject of charcoal. Some of the sawdust charcoal, of which a sample is on the table, has been manufactured into gunpowder of very fine quality, but, strange to say, there is little probability of its being generally used by powder manufacturers. With one honourable exception, all those whose attention I have called to this article, have declined to use it, or to adopt sawdust as a material for the manufacture of charcoal. One firm informed me that they never introduce any novelty until it has been fully approved by the Government; another used only elder; others restrict themselves to oak, willow, or dog wood, for the manufacture of charcoal, each firm enjoying the opinion that no other wood is fit for making powder of superior quality but the special kind they individually use; and then, why should they make any alteration, for their fathers and grandfathers did the same before them. This will serve to show the difficulty that sometimes exists in introducing novelties, and getting them adopted by established manufacturers.

In conclusion, I trust I have furnished you with some points for discussion, which I consider the principal object of this paper.

Should it be my lot, in the ordering of an All-wise Providence, to be made the humble instrument of developing the resources of our bogs and other unapplied and unappreciated products, to assist in raising the people of Ireland to a just appreciation of the vast mines of wealth that abound in their favoured land, it will be a source of satisfaction to me to the latest period of my life, independent of any pecuniary advantage I may derive.

## DISCUSSION.

The Chairman said the subject which had that evening been brought under their notice was deserving of the serious consideration of the members of the Society, and he hoped, if perfectly carried out, it would lead to very great results. He trusted that a discussion would take place upon it, from which something would be elicited which would ultimately be of service to the community at large.

Mr. Yarrow, as engineer to the Irish Amelioration Society, incorporated by royal charter in 1847, for reclaiming and utilising the bogs of Ireland, would briefly state the results he had arrived at. He divided the subject into three heads:—1st. The chemistry of peat, which comprised the manufacture of paraffine, naptha, ammonia, and volatile oils; 2nd, the conversion of peat into charcoal, for sanitary, agricultural, and manufacturing purposes; and, 3rd, the solidification of peat for fuel. The chemistry of peat he should dismiss in a few words, for, however interesting the various processes might be as a matter of science, in practice they had not been commercially remunerative. As a fuel he considered a wide field existed, but, as he observed Mr. Gwynne present, who had devoted considerable time and attention to the production of an economical fuel from peat, he would leave that important subject open for that gentleman to speak upon, and confine his remarks to charcoal prepared from peat. The society with which he was connected had established works upon the Bog of Allan, and for several years had converted many thousand tons of peat annually into charcoal, which had found a ready sale in England for many purposes; and he might mention that ten tons of charcoal had been forwarded yesterday, with the Government stores, by the society for use in the military hospital at Scutari. The principal use of the charcoal, however, appeared to be when applied in a filter for the purification of town sewage. He referred to a model of a sewage filter that had been constructed by himself at Aylesbury, in Buckinghamshire, at the cost of Lady Frankland Russell (a member of the Society) and to whom the public were indebted for thus practically solving the great question of purifying the sewage from populous districts. The size of this filter was six feet by ten feet, and the section of the town thus purified contained two thousand people. The sale of the charcoal manure not only covered every outlay, but left a handsome surplus. The filter used was a modification of the one brought before the notice of the public by his Royal Highness Prince Albert (the President of the Society of Arts), about four years since; and in the case of Aylesbury and many other towns had been found to act most effectually. He concluded by expressing his firm opinion that the merits of peat were but even now imperfectly understood, and it was only by scientific investigations similar to these so ably conducted by the author of the paper read that evening, that correct conclusions could be arrived at.

Mr. Reed remarked that the town of Aylesbury had unfortunately given another proof of being two centuries behindhand. The beautiful apparatus alluded to by Mr. Yarrow had been destroyed; whilst the same was in operation, the public could travel over that part of the road with comfort and satisfaction. They had now diverted that most offensive drain across the road, and its contents were discharged into a field on the north side of the road, at a distance, he should say, of not more than 200 yards from the high road, which rendered the atmosphere in the vicinity of it of the most offensive character; whereas, when the filtering apparatus was in operation, not the slightest taint in the air was perceptible to the passers-by. He thought, therefore, if through the information given by Mr. Yarrow, the local Board of Health should be induced to re-erect this admirable apparatus for purifying the air, one very important result would be obtained from this meeting, which he was sure would give infinite satisfaction to the 6,000 inhabitants of the town of Aylesbury.

Dr. Booth inquired of Mr. Longmaid what was the cost of the sulphuric acid for the preparation of one ton of charcoal; also the additional expense of labour, and other matters, that the subject might be placed practically before the meeting in a commercial point of view.

Mr. Longmaid replied, that the cost of sulphuric acid for a ton of charcoal would be 3s. or 3s. 6d., and, possibly, the sulphurous acid might be recovered and used over again. He was not able to state that positively, but he thought it capable of being carried out. With regard to the other matters of cost in the manufacture of the article, the peat was taken wet from the bog and put into a tank with the acid. As soon as it was saturated it was passed through rollers, fitted to form it into blocks, something of the shape of bricks. These were afterwards placed in a drying chamber. The whole expense was

very trifling indeed. He should say the charcoal might be made by his process at a cost of not more than 10s. or 12s. a ton. He supposed the selling price in London would be from £3 to £4 per ton.

Mr. Yarrow said the market price was about £3 per ton, and the Irish Amelioration Society had found that the cost upon the bog was from £1 to a guinea per ton. The remainder of the cost was made up of freight and other expenses, and the manufacture, so far as his own experience had gone, had not been remunerative at £3 per ton.

Mr. Gwynne stated that he would avail himself of the invitation of the Society, to make a few remarks upon this important subject. He had listened with great interest, and he hoped with profit, to the able paper read by Mr. Longmaid—who had informed the meeting of a great variety of purposes to which charcoal, both from wood and peat, might be applied; but he wished to mention a few others which Mr. Longmaid had not named, more especially with reference to peat and peat-charcoal. For sugar-refining purposes, peat-charcoal, when carbonized and reduced to powder by certain processes, and mixed with phospate, sulphate, and carbonate of lime, sulphate of soda, other alkaline carbonates, sulphate of alumina, baryta, or siliceous sand, would be found equal in effect to the animal charcoal at present used for that purpose. It was applicable to the manufacture of pigments and paints, of blacking, the purification and clarifying of syrups, the cleansing, decolouration, and refining of oils; the filtering and cleansing of chemical preparations, medicaments and decocting, the filtering and purification of water, for arresting decay and decomposition of animal and vegetable matters, &c. It was also applicable to the manufacture of gunpowder; carbonised peat might also be combined with bituminous matter, Venice turpentine, coal-tar, solution of glue, linseed oils, gums, &c., giving it tenacity and rendering it capable of being formed into ornamental articles, such as picture-frames, mouldings, embossed surfaces, images, statuettes, &c., &c. Embossed surfaces might be produced by pressure from suitably cut dies or plates, heated or not, as required. In carrying out these various objects, profitable employment would be afforded to many individuals; but every object for which peat or peat charcoal could be used, dwindled into insignificance when compared to the three great purposes to which it could be beneficially applied—viz., gas, steam, and household purposes; and, greatest of all, the smelting of iron and other ores. Mr. Mallet, in the introduction to his pamphlet, "On the Artificial Preparation of Turf," published in 1845, says, "The mass of fuel in the bogs of Ireland is too great and too valuable to be wasted and lost by a rude method of getting a scanty crop from the surface. If all the bogs in Ireland capable of being made into turf be taken as low as two millions of acres, and at an average depth of three yards, the mass of fuel which they contain, estimated at 550lbs. per cubic yard, when dry, amounts to the enormous sum of 6,338,666,666 tons; and taking the value of turf, as compared with coal at that ascertained in the following pages—viz., at 9 to 54—the total amount of fuel in Ireland is equivalent in power to about 470,000,000 tons of coal, which, at 12s. per ton, is worth above £280,000,000 sterling." There are three millions of acres of bog in Ireland, at an average depth of 19½ feet, but taking it at two millions of acres, at only 12½ feet deep, there would be 6,972,000,000 tons of air-dried peat. One ton of solidified peat was of more value than one ton of coal, and that 6,972,000,000 tons of air-dried peat could be made into 4,648,000,000 tons of solidified peat, which, taken at 10s. per ton, would give £2,324,000,000 sterling as the value of two millions of acres of Irish bog.

Mr. H. P. Stephenson said there was one point upon which he could not agree with Mr. Yarrow, and that was with regard to the employment of charcoal as a deodoriser of the sewage of towns. He thought when they considered that the cost was about £3 per ton, the expense would hardly admit of that article being extensively used for that purpose, especially as the method of distributing the liquid manure by the hose and jet, was, in his opinion, more economical. The experiments of Mr. Jasper Rogers had satisfactorily proved that peat charcoal was a perfect deodorizer, but at the same time he thought, on economical grounds, it must give way to the system of steam pumps and the hose and jet.

Mr. Yarrow said it was well known that Croydon had always been the pet town of the Board of Health, and every known improvement had been carried out there, the whole of the sanatory works being completed under its sanction. In Croydon there were about 600,000 gallons of sewage per day, and they had had the best advice as to the means of conveying it away; but notwithstanding all the advantages they possessed it had been ultimately determined to use charcoal filters. An advertisement had recently appeared in the papers for sixty tons of peat charcoal per month, and the manure produced might be taken on the average at double the quantity of charcoal used.

Mr. W. Fothergill Cooke said, landed proprietors in woodland districts had of late years cleared a considerable portion of land of the cumbersome hedge rows, with a view to improvement in cultivation. The hedge rows in Hampshire were sometimes 50 or 60 feet in width, instead of only two feet, and when these were cleared away a large mass of roots and stumps had to be grubbed up, which were almost valueless. The clearing of the ground was generally paid for by measurement, and the raising of two tons of roots and stumps would cost about 10s. on the average. If any one present could state any practical method of rendering the roots valuable, he would confer a great benefit upon a large class of the community. He believed by the time he had completed his operations, he should have 600 tons of those roots lying useless, and which at present he should almost be glad to dispose off for the mere carting off the land.

Mr. Charles Bernard said he had understood Mr. Longmaid to express an opinion opposed to that of many writers upon agricultural vegetation, that carbonaceous matter was only taken up by growing plants from the atmosphere. All writers on agricultural matters now acknowledged the fact, that when the carbon was made soluble by potash, or combination with lime, the carbon was taken up by growing plants. Then, with regard to the application of charcoal to manufactures, it was to be lamented that manufacturers were very often slow to adopt improvements, but they could not so much wonder at that slowness when they considered the many thousands of pounds that were invested in a business, the profits upon which depended upon the observance of the most exact regularity, and the introduction of any new process might for a length of time materially damage the profits of the concern. He made that remark as an apology for the manufacturers. According to Mr. Longmaid's statement, there was only a difference of 8s. upon £3 10s.; the price would still, he thought, interfere with the use of charcoal as a deodoriser to any extent at a distance. He considered the true value of Mr. Longmaid's patent consisted in the use of the charcoal on the spot for smelting iron; but it must be left to practical results to determine its value.

Mr. Longmaid said, he thought the gentlemen who had just spoken was labouring under a misapprehension. It was not a difference as between 8s. and £3 10s., but the fact was, he could produce an article which sold at from 50s. to £3 a ton, at a cost of 10s. to 12s. a ton. He believed the whole cost by his process would not exceed 10s. or 12s. per ton. With reference to the object mentioned by Mr. Fothergill Cooke, he (Mr. Longmaid) thought there would be no great difficulty in converting the roots of trees into charcoal by the process he had described that evening, or at least there was no great difficulty in it which might not be overcome. Of course, it was not so easy to saturate the organic matter in a solid lump as when it was in a state of subdivision; but it might be done by a process similar to that adopted in creosoting

railway sleepers and other timber. By this plan, the timber was placed in air-tight chambers, the air was then exhausted, and the pores of the wood being by that means laid open, they became susceptible to the steeping process. The acid could then be injected into the pores of the wood;—which when dried would become charcoal.

Mr. SCOTT wished to offer to the meeting the result of his experience as to the application of powdered charcoal as a dressing for potatoes. He could state that during the years 1846-7-8, when the disease of that root was most prevalent throughout the United Kingdom, his crop of potatoes in Cheshire, which had been dressed with charcoal, was comparatively free from disease. Charcoal was well known to be most useful as a deodoriser. He had used it in his stables, and it was known that nothing was more injurious to a horse than the smell of his own house, but the charcoal had the effect of rendering the stables sweet and wholesome, and after it had performed that office it was available for manure. Mr. Longmaid had referred to the immense tracts of bog land in Ireland, but he (Mr. Scott) could state that the working of it had never yet been found to pay those who engaged in it. He had had an extensive acquaintance with a space of 150 square miles of bog, but he had always found them to be convex and never concave, and for the most part on high ground. He could say he never saw a concave bog. With regard to the advantages of converting wood into charcoal, they were at present extremely problematical. The peat bog for fuel was worth, perhaps, from £6 to £8 per acre, whilst the land was prepared for reclamation, but when converted into charcoal, it had never yet, he believed, been found to pay, and therefore it was hardly fair to characterise this as one of the unappreciated and undeveloped resources of Ireland. He made these remarks not with a view of conveying information upon the subject under discussion, but merely to remove what he thought might leave an erroneous impression on the minds of those present.

Mr. LONGMAID said he could account for the growth of the bogs in the form which the last speaker had described. Although they eventually became dammed up in natural basins, that did not interfere with the formation of the peat, high in the centre and lower towards the edge of the basin. In Dartmoor there were extensive bogs, and during the last great war with France, a large extent of surface was cleared away and the gravel laid open: that was now again covered with bog, which had grown since 1815, and some of which had been recently removed.

Mr. GWYNNE thought he could reconcile the disparity in the statements, with reference to the formation of the bogs. He believed he was correct in saying that they were generally about 200 feet above the level of the sea, but although they were so much elevated, yet some of the bogs were in basins, some of them forty feet in depth. With regard to the use of peat and its value in Ireland, he differed in some respects from Mr. Scott. There were upwards of 3,000,000 of acres of bog in Ireland alone, and at the rate they were now using it, it would yield a supply for 2000 or 3000 years to come, and therefore it could not be said that at present they were using it to any great advantage; and with regard to its application to the manufacture of the best qualities of iron, the ironmasters need be under no apprehension of a lack of that commodity for centuries to come.

Mr. PARK said he had for several years taken an interest in this subject, and he must say he thought the matter had been treated by Mr. Longmaid in a legitimate manner, still he would say the application of charcoal as a manure had not received sufficient attention. There could be no doubt that calcined peat was the best known medium for conveying manure to plants. It was light and capable of application in various ways, and any vendor of manure, upon being informed of the nature of the soil, would recommend that kind of manure most suitable to be used, under the circumstances, in combination with charred peat.

The CHAIRMAN said that Sir Robert Kane had been instructed by the Commissioners of Woods and Forests to investigate this subject, and that gentleman had come to the conclusion that there were products to be obtained from peat which would ultimately produce the most important results to the mercantile community of this great and enterprising nation. Sir Robert Kane, in his report, gave the result of his consideration of a patent which was taken out by Mr. Rees Reece, and in that report he stated that all the products to which Mr. Rees Reece laid claim were capable of being produced, having tested the experiments in his own laboratory, and obtained the same results. The only difference between Sir Robert Kane and Mr. Reece was as regarded the cost of obtaining these products. He thought the paper they had heard that evening was calculated to do great good to society at large; and the man who was the means of eliciting discussion upon so important a subject deserved to be placed in the first scale of society, and amongst the benefactors of his race; therefore, he felt that the gentleman who had introduced the subject was deserving of their best thanks. They were also much indebted to Mr. Gwynne—a gentleman who had taken great pains and had laid out a large amount of capital in bringing forward the products of his native country—in which, it was gratifying to find, he had been so eminently successful. He felt bound, from the knowledge he possessed of Mr. Gwynne, to pay that deserved tribute to his exertions.

Mr. SCOTT, in explanation, stated that he did not intend to convey the impression that nothing was realised out of the Irish bogs, but he meant to say that up to the present time the operations had not been of a remunerative character to those who engaged in them.

The Secretary announced that the Paper to be read at the next meeting, Wednesday, January the 31st, was "On the Chalk Strata considered as a Source for the Supply of Water to the Metropolis," by Mr. S. C. Homersham.

Also, that on the evening of *Friday*, the 2nd of February, there would be a Special Meeting, when Mr. Leone Levi would read a short Paper, "Observations on the Proposed Congress for the Improvement of International Commercial Law," as introductory to a discussion on that question.

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## THE FACTORY SYSTEM IN THE UNITED STATES.

There was lately opened at Lawrence, Massachusetts, a New Hall, in connection with the Pacific Mills, which is quite a new feature in the factory system. Here it is expected that during each week there will be provided, free to all of the operatives of these mills, a lecture or a concert, or some pleasing and profitable exhibition. It was hoped that the future would prove the existence of *sympathy* for the interest of all engaged in the service. On the occasion the operatives assembled to the number of 800, and were addressed by Mr. W. Chapin, the resident agent of the corporation, who proceeded to describe some of the distinctive features of the Pacific Mills. The *library* contained 1500 carefully-selected volumes, 500 of which were in constant circulation. This was open to all on the payment of a single cent each week. Then there was the *Relief Society*, which was essentially peculiar to this establishment. Every one of the employed, over 14 years of age, is required to give from his wages two, four, or six cents per week, unless the fund become too large; and in case of sickness he has proper medical attendance, of his own choice, free of expense, and a proportionate allowance of 1 dollar 25 cents to 3 dollars 75 cents per week during sickness, even if it should extend to six months. 125 persons had received the benefit, and upwards of 1,100 dols. had been distributed, while no one person had contributed more than a single dollar to the fund. The *Savings Bank*, connected with the cashier's office, where sums from five cents to 100 dols. and more, were received, and an annual six per cent. interest allowed, was distinctive, yet it was gratifying to know that this corporation was not alone in adopting such a means of good to its workpeople. Upwards of 10,000 dols. had been deposited by the operatives in six months. The *Boarding Houses* contained unusual provisions for health and comfort, but were susceptible of improvement. Mr. Young, treasurer and general agent, then made a few remarks, averring that here was proof that a corporation sometimes has a soul.

## GUNNERY.

By Lady Bentham.

A given force can only originate a corresponding amount of motion, and that whether the motion be absorbed by a single operation, or whether that motion be divided in the production of two or more different operations. This axiom applied to gunnery is wholly in favour of the principle of non-recoil, for it is evident that if a part of the force consequent on the explosion of gunpowder be employed for causing the gun itself to recoil, that portion of force is abstracted from that which would otherwise be employed for the expulsion of a missile.

At the present day there appears to be a general tendency towards the doing away with recoil, by giving great weight to the gun itself, which certainly would effect the purpose; but there seem to be two objections to this mode of preventing recoil; the one that of consequent expense, and the other—an important one—the dead-weight of a piece of artillery sufficiently ponderous to resist recoil. In fortified places on shore it is true that this objection is of little moment, but it is not so either in the field or on shipboard, as in both these instances the amount of force employed depends entirely on the dead-weight of the ordnance that can be carried into action; a truth which, though apparently self-evident, needs frequent repetition ere its importance is likely to be duly estimated.

Hitherto the science of gunnery has been in a manner stationary, but now a spirit of investigation has been roused in regard to it, and very recent inventions have been tried on a large scale, some of them promising good results; but what has been done by the Board of Ordnance has, with good policy, been kept as far as possible secret, wherefore no estimate can be made of their intended improvements. On the other hand, those attempted by the Lords Commissioners of the Admiralty are made public; in some instances more or less success has attended the introduction of novelties. The Lancaster gun, for example, carries further than any other piece of ordnance, but it is said to have the defect of liability to burst;—this is probably the consequence of some irregularity in the bore, which prevents ready escape of the missile. The Lancaster gun is also said to deviate from its intended aim, but that, as the deviation is constantly the same, it can be allowed for; this error, doubtless, originates in the manner of rifling the interior of the piece, and would, without difficulty, be remediable. There can be no doubt that the principle of the rifle is as applicable to large artillery as it is to small arms.

The particular form of shot best suited for its propulsion, and for its subsequent passage through the air, has not yet been decided on. Sir Howard Douglas first indicated an ovate form, and since then different modifications of it have been adapted to small arms; but if the principle be good for them, it can be no less so for missiles of a greater diameter and weight. Experiments would, however, be necessary to ascertain whether a shot should be ovate, oblong, pointed, or of any other shape. Unfortunately experiments, in most instances, have hitherto been confined to the ascertaining of the superiority of one thing over another of the same description, whereas experiments of an exhaustive nature would usually be attended with little more expense or trouble than partial ones.

As to non-recoil, so long as ordnance is placed at the embrasure of a fortress, the piece must of necessity recoil for the purpose of reloading it; but in all other situations this is needless. On shipboard it was at one time alleged that those who served a gun would be exposed in loading it to the enemy's fire; this danger was obviated by Sir Samuel Bentham, by his substitution of a *rope* ramrod for the usual inflexible one, and, in point of fact, even less than the average number of casualties were experienced in the many vessels armed on the principle of non-recoil. The Berwick smacks, and other coasters, so armed at his suggestion, lost not a single man in action, though some of them had to encounter, and drove off, privateers of much superior force and bulk. It has been already said in the *Journal of the Society of Arts*, that why non-recoil was discontinued could never be discovered, and Mr. Bridges Adams, in a subsequent number, suggested various reasons for this desuetude. They might all of them have had their influence, but the chief cause would seem to have been the inappropriate fitting of non-recoil ordnance by the Navy Board; that board having objected to Sir Samuel's interference in this matter, and ordered non-recoil guns to be fitted according to a model. At that time the ports of a vessel varied, perhaps, a foot or two in their height from the deck, so that a chock was often necessary to raise the gun-carriage to a proper height, but the Board made no provision for such cases.

The principle of non-recoil will doubtless soon be very generally adopted; the principle being identical, whether it be exemplified in Sir Samuel's mode, namely, by attaching the ordnance by a breeching to the strong timbers constituting the frame of a vessel, whether by the dead weight of the gun itself, or by any other means; it must, however, be kept in mind, that in certain cases, the principle cannot be introduced so long as guns continue to be loaded at their mouth, for instance, in fortifications where the embrasures are but little larger than the piece itself; hence arises the expediency of devising a good contrivance for loading artillery at the breech. Whenever this desideratum shall be achieved, the embrasures of fortifications, and the port-holes of ships, may be safely contracted, and even covered by a moveable screen to protect the men, save only an opening of the diameter of the bore of the gun.

A notion is very generally entertained that the *whole* of a vessel carrying heavy ordnance must be proportionately strong, but experience in actual warfare has proved that

any vessel that can bear a sea is strong enough to carry heavy artillery, provided the gun itself be duly supported. For example, in the Liman of Otchakoff, in the action of the 7th of June, 1788, according to General Fanshawe's account, there were five men-of-wars' *long boats*, which had been armed by Sir Samuel Bentham with "each an 18-inch howitzer in the stern."—See *United Service Journal*, 1829, part 2, page 334. The Russian flotilla which vanquished the Turkish fleet on the 17th of the same month, consisted wholly of small vessels, not intended for warfare, and the largest of which had conveyed the Empress Catherine II. and her suite down the Dnieper, but Sir Samuel had strengthened them under those parts intended to receive artillery. It was this flotilla that took, burnt, or destroyed nine ships of the line, as already noticed in the *Journal of the Society of Arts* for August 25, 1854. General Fanshawe, in his letter to General Conway, has related in regard to the Turkish fleet, that "nothing could present a more formidable front than this line, extending from shore to shore, in numbers ninety-six sail, so thick that an interval could scarcely be perceived between their sails; whilst our diminutive force did not reach either shore by above two miles, and might with equal advantage have been attacked on both flanks." * The whole of the article from which the foregoing is extracted might be well worth study by all persons interested in naval warfare, especially if to be carried on in shallow water.

Sir Samuel, in giving an account of that flotilla to the editor of the *United Service Journal*, August, 1829, prefaced his letter by the following observation:—"This engagement affords, in my view of the subject, an additional degree of interest, as evincing the splendid results which may be obtained by the employment in naval warfare of *shells*, *carcasses*, and shot of the *largest* size, when fired point-blank from vessels drawing little water against ships of the largest size, points which I have for more than thirty years past never failed to point out, and recommend on every occasion when there offered a chance of drawing attention to the subject." It may be added that shells, though now of such general use in naval warfare, were strenuously resisted by the naval authorities till within the last five-and-twenty years, which, together with the general adoption of all Sir Samuel's principal improvements in naval architecture, can hardly fail to inspire confidence in his opinion as to the superiority of vessels of war drawing but little water; but he had to combat received notions, supported, as they were, by our almost universal success at sea. Indeed, he had had very unusual experience in naval concerns, since it had fallen to his lot to build sea-going vessels, to man the above-mentioned flotilla, and also to command it, and to conquer with it a far superior fleet in point of bulk, and of the usually considered requisites for naval superiority.

The long peace we so happily enjoyed necessitates the going back for examples to a period long since past, but the practice of Sir W. Sydney Smith will be accepted as powerful evidence in favour of non-recoil. This distinguished and successful officer had witnessed, off the coast of France, the armament of some of the experimental schooners, with non-recoil guns. Sir Sidney adopted the principle, and made good use of it in his noted defence of Acre against Buonaparte, then in the plenitude of his military successes. Mr. Spurring, the draughtsman who had been employed by Sir Samuel in those experimental vessels, was in the *Tiger*, Sir Sidney's ship, and her carpenter, Mr. Bray, was remarkably intelligent; to him Sir Sidney confided the works on the breech tower of Acre, the defence of the town gates, and the fitting of a floating battery. Mr. Bray's description of the manner in which these several works were executed was transmitted to the Admiralty on the 25th November, 1803, of which the following is an abstract:—"The two 68-pounder carronades used at the siege of Acre were fitted in two djerns," (a species of barque of five or six tons burthen drawing very little water), "on the non-recoil principle. The slide of the carronade was first taken away, then the carronades were fixed with their beds, the spindle being let through a platform made in the djerns and forelocked, so that the carronade could be turned round in any direction; after which another bed of timber was brought on the first to form a support against the breech of the bed, and take off part of the strain from the spindle. Those guns did material execution, frequently dismounting the enemy's guns in their batteries, from some of which the djerns were distant about a musket shot, and from others a pistol shot. I have with nine men fired seventy-five rounds from the two carronades in twenty minutes during the siege."

This fact, it may be observed, affords an example of one of the great advantages attendant upon this principle, namely, the great rapidity with which it enables ordnance to be fired, though served by less than half the usual number of men; and Mr. Bray further says, "Sir Sydney Smith was present when I worked *five* guns, fitted as before mentioned, with *eleven* men only.

"I also fitted" Mr Bray adds, "a long 24-pounder in the stern of a vessel of a different construction from a djern. * * * The breech was bedded on a coil of new rope. The gun threw shells to a great distance, and on one side of this long gun was fixed a 32-pounder carronade, and on the other a 42-pounder brass howitzer, on the same principle, secured to the transom of the vessel.

"I also fixed another 42-pounder brass howitzer on the breech tower, for the purpose of battering down the aqueduct walls to fill up the entrance to the French mine, and many other guns during the siege, all of which were essentially useful, and did great execution.

"After I had fitted all these guns on the non-recoil principle, Sir Sydney Smith confided the defence of the town gates to me at the djerns, * * * which effectually prevented the enemy's approach to the gates. The djerns in which the guns were placed were *old* and of *weak* construction, nevertheless they were not materially affected by the shock, except making them a little leaky towards the end of the siege, which lasted sixty days, although I kept up an incessant fire, particularly during the times when the enemy stormed the town; and then our expense of shells was so great, that I was obliged to fill shells in the central djern, which served us for a magazine; and such was the enemy's fire on these vessels, that they have been set on fire with hot shot from the enemy several times in the day."

At the same time that Mr. Bray's "Memorandum" was transmitted to the Admiralty, their Lordships were furnished with sketches of the manner in which he had fitted the ordnance in question, engravings of which may be seen in Sir Samuel's "Naval Papers," No. 7, pages 34 to 37. It appears that the 32-pounder fitted at the English battery on shore at Acre, was supported by ground-pieces of *fir* timber, about 8 inches by 9 inches, let into the ground, then planked over with 3-inch planks. On board the djerns, 43 feet long by 15 feet broad, the platform on which the ordnance was placed was made of rough balks, about 8 inches by 9 inches, crossing each other, and pegged together, but not fayed. The three pieces of ordnance mounted on board a kind of lighter 40 feet long, 15 inbreadth, had shores against the trains of their carriages to prevent recoil.

That Bonaparte was baffled in his designs upon Acre is matter of history, not of a Journal of Arts, but the means by which Sir Sydney Smith effected the discomfiture are within the province of a Society of Arts. Sir Sydney, abandoning routine, adopted a mode of mounting ordnance which he had seen to be effective, and he employed vessels to carry it, which, according to received notions, were wholly unfit for such a service, in the essential points of size, of draught of water, and of strength. Under existing circumstances, the vessels he armed for the defence of Acre seem to afford a very useful example, for they are convincing proofs that very small craft may be

* "United Service Journal," 1829, part ii., page 335.

easily strengthened so as to bear heavy artillery, and that under nearly constant fire for a period of forty successive days; consequently, in the course of two or three weeks, existing small vessels might be fitted for sea, they being an armament which could not but be effective against a powerful enemy, and which to work require less than half the usual number of men.

It may seem unjustifiable thus to persist in advocating the inventions of Sir Samuel Bentham, but in its justification some peculiar circumstances should be considered, such as that the public department in which he served keeps no register of improvements in it, nor of their authors, nor any index of proposals for its amelioration, so that what does not happen to be brought before the Board of Admiralty of the present day is unknown to it. Sir Samuel Bentham, too, was at least half a century in advance of the age in which he lived, and in addition to science, he habitually employed reason and common sense in all his investigations. At all events the articles published in the *Journal of the Society of Arts* relating to his inventions have elicited observations from many quarters as to gunnery, which cannot fail to elucidate that science, and to contribute to the success of our arms against a formidable antagonist.

8th January, 1855.

## Home Correspondence.

### ON THE OILS AND OTHER VEGETABLE PRODUCE OF BRITISH HONDURAS.

Belize, British Honduras,
Dec. 15th, 1854.

SIR,—I beg to acknowledge the receipt of your letter of the 1st of November, and thank you much for the obliging terms in which it is expressed. I have also received your Journal of November 3rd; that of the 26th of October has not come to hand. I have perused Mr. Wilson's letter, which does not at all discourage me, or cause me in the slightest degree to relax my efforts to make the cahoun oil more generally known and used by the British public. Notwithstanding Mr. Wilson's opinion respecting the merits of that oil,—without presuming to differ from him upon a subject to which he has devoted so much attention,—from all that I have read, and seen, and heard, I have arrived at the conviction that cahoun oil is destined at no very distant date, to take the highest rank amongst vegetable oils. Mr. Wilson (very naturally) forms his opinion from the specimen which was sent to him. But I warned your readers that the specimens which I had the honour of forwarding to you, were not to be regarded as fair representations of the cahoun oil, because they were manufactured in a very imperfect and unscientific manner; nevertheless, the manager of the British Sperm Candle Company places it,—so far as it is applicable to the manufacture of candles,—in a higher niche than the best cocoa-nut oil.

Mr. Wilson says, "The cahoun oil will not be found for manufacturing purposes, whether for soap, candles, oil, or grease, worth more than the fine cocoa-nut oil of the Malabar coast, which comes to this country in large quantities."

The general manager of the British Sperm Candle Company gives a practical opinion upon the subject, for, having actually made three candles from the oil which you sent to him, he says, "I consider the cahoun nut oil superior to cocoa-nut oil for making composition candles, for the odour is more pleasant and the compound is less oily," [that is, not so liquid.] "The *best cocoa-nut oil*" [including, I presume, the Malabar oil,] "is now selling in London at 51s. per cwt., and, I think, there would be no difficulty in selling the cahoun nut oil at a higher rate in very large quantities."

Now, here are two very different opinions expressed by gentlemen, both of whom are well acquainted with the subject on which they write, and each occupies too high a position to permit us to suppose for an instant that either of them would give expression to anything but a conscientious conviction. The testimony is conflicting: How is it to be reconciled? The manager of the Sperm Candle Company founds his opinion upon experiment. Mr. Wilson would appear to have formed his in the absence of such experiment; at all events, it is not in evidence that he made any. Under these circumstances I would say, *Utrum horum mavis accipe?*

But I am content to take the opinion of Mr. Wilson. He says that the cahoun oil, for the purposes which he mentions, will not be found *to be worth more* than the fine cocoa-nut oil of the Malabar coast. From this mode of expression, I think it may be inferred that Mr. Wilson is of opinion, at any rate, that it is *worth as much*. If, then, that be so,—if the cahoun oil and the Malabar cocoa-nut oil be placed upon the same footing as regards quality, with which can the English market be the most readily and cheaply supplied? The time occupied in the passage from Malabar to London, is, I suppose, from four to five months; the voyage from Honduras to England is performed in six or seven weeks. This circumstance, then, I should imagine, must give to the cahoun oil what may be termed a collateral advantage over the Malabar cocoa-nut oil, and, *cœteris paribus*, which is admitted, must render the former the more desirable commodity.

Mr. Wilson says, "the reason why Mr. Temple finds the oil expressed in Honduras," (I am sorry to say it is not *expressed*,) from the cahoun palm nut is superior to that from the cocoa palm nut is probably this:—The cahoun nuts being small and without milk, would be dried whole, and thus be protected by their brown skin from any risk of mould, which, without some care is taken, *the cocoa-nuts are liable to at the inside, and where broken*." This is very valuable testimony in favour of the cahoun nut, and the fact mentioned by Mr. Wilson, undoubtedly gives it another advantage over the cocoa-nut. The shell of the cocoa-nut is, then, in proportion to its size, and is consequently easily broken. Falling from no very great height, its own weight would occasion it to be fractured. Not so with the cahoun nut. The shell of that nut is remarkably hard, and though probably not thicker than that of the cocoa-nut, the texture is altogether different. Then, again, being so much lighter and smaller, (the cocoa-nut being the size of a cannon ball, and the cahoun nut not larger than an egg,) it is not liable to so many accidents. The shell admits of a most beautiful polish, and is capable of being turned into a great variety of useful and ornamental articles. Mr. Wilson speaks of the *milk* of the cocoa-nut, I presume he means the water which that nut contains. This water, when the nut is taken from the tree early in the morning, and whilst the dew is yet upon it, is a cool and delicious draught. It is slightly effervescent and greatly aperient. The milk is made from the kernel itself, and in this manner the kernel is grated, a little warm water is poured over it, and the liquid is then filtered through an open cloth. This milk is excellent with coffee, and indispensable to a curry.

But Mr. Wilson gives me more credit than I deserve, in supposing that I derive my opinion of the superior merit of the cahoun nut by such a scientific mode of reasoning as that which he suggests. I will state in a few words why I think that the cahoun nut is, and must be, superior to the cocoa-nut. In the first place the cocoa-nut tree prefers an arid, sandy soil,—a soil in which nothing else will grow. Here it grows spontaneously—here it luxuriates. On the desolate beach, where no other tree or shrub of any kind, or patch of green presents itself to the eye, these trees are seen in groves, their branches waving in the wind like the nodding plumes of a hearse; and, as the gale sweeps past them, giving utterance to wailing, melancholy, funereal sounds. There is something indescribably solemn and ghost-like in the appearance of a large avenue of

cocoa-nut trees on the sea-beach by moonlight, more particularly if there be a fresh breeze blowing at the time. The cahoun tree is found only on the most fertile land. It is never to be seen on the sea coast, nor within eight or nine miles of it. Where this tree grows there is the richest pasture—there plants and fruits of every variety flourish in great profusion—there you see flowers of sur passing beauty and fragrance—and there also birds of the brightest plumage. Well, then, we have it on the authority of Lucretius that, "ex nihile nihil fit," and a greater authority has said, "Do men gather grapes of thorns, and figs of thistles?" What inference do I draw from this? Simply, that as the cocoa-nut tree derives its nutriment from a sandy, sterile soil, where nothing will exist, and the cahoun tree receives its sustenance from the richest materials, the fruit of the latter must be very much superior to that of the former. This is one reason why I think more highly of the cahoun-nut than of the cocoa-nut. There is another. If you chew a portion of the kernel of the cocoa-nut the flavour is agreeable, and the process of mastication produces in the mouth a lacteous substance. But if you submit the kernel of the cahoun-nut to the same dental process, the result is a positive oil. But the strongest argument in favour of the superiority of the cahoun-nut is the broad fact that one bottle of the oil extracted from it will burn as long as two bottles of oil made from the cocoa-nut. The trunk of the cocoa-nut is very lofty, and the branches grow only at the top. The cahoun is much shorter, and the branches commence at the root. These *branches* contain so much oil that, when a tree is cut down, they are eagerly devoured by the cattle. It is a singular circumstance that the bees generally select the top of the cahoun trees in which to build their hives and deposit their honey.

Mr. Wilson says that he had a conversation with an intelligent gentleman from Venezuela, who knew the cahoun oil well, and spoke highly of it. If the cahoun tree grows in Venezuela, it is rather remarkable that Humboldt, in his account of that country, makes no mention of it. I am glad to find that, through the publicity given to cahoun oil by means of your Journal, a demand has already been created for that article. Messrs. Hyde and Company, one of the oldest mercantile houses connected with Honduras, possessing a large capital, and animated by a warm desire to develop the resources of the country, and contribute to its general prosperity, have determined to give their aid to a more extensive and more perfect production of cahoun oil. Mr. Travis, the representative of that firm, has communicated to me the following extract from a letter addressed to him by Mr. Hodge:—

"The high price for oil in consequence of the Russian war, has caused a demand for cocoa nuts and oil, and we have also inquiries for cahoun nut and oil. As an experiment we have promised to bring here five tons of cahoun nuts in the shell, which please ship in one of our own vessels for London. Should it succeed we shall send machinery for crushing, &c. Please state the cost and every particular."

Mr. Travis writes to me as follows:—"We informed them in answer that there are abundance of cahoun nuts, but our difficulty will be labour, as this country is so thinly populated, and labour high. In time, if the men living on the banks of the rivers find that they could always sell the cahoun nuts in Belize, a steady supply would be obtained, which would increase every year."

Mr. Sheldon, the head of another highly respectable house connected with Honduras, who sails for London by the present packet, has also resolved to try the experiment. He has directed ten tons of nuts to be sent to him.

I have sent to England by this packet, in order that they may be forwarded to you, ten bottles of cahoun oil, which I think will be found to be of a better quality than that previously transmitted. Perhaps you will be good enough to send one of them to Mr. Wilson. But even this oil, not being artistically made, is very far inferior to what it ought to be, and what it would be if it were properly expressed.

In a former letter I stated to you that the avidity with which every person in Belize, or connected with it, pursued the mahogany trade, had caused this fine country to be neglected, and had stifled every attempt to cultivate its soil and develop its vegetable wealth. The greatest discouragement has always been exhibited to any enterprise having for its object the replenishment of the earth. It appeared as if the curse of Cain had descended to his vocation. To talk of a spade was rebellion against the true faith, and the most distant allusion to a plough, caused people to nod and wink, and give dark hints about a strait waistcoat, though the morality of some of the people has not been particularly searched, yet they have ever manifested the strongest objections to the "rake's progress." The most amusing, and at the ame time, ridiculous reasons were sometimes alleged. One wiseacre once observed to me that agricultural operations in Honduras were impracticable because the *clay stuck to the feet.* This was almost as beautiful a *non sequitur* as that which is related of the traveller, who had no doubt that the town he was passing through in the early morning was Stoney Stratford, because he had never been so bitten by fleas in the whole course of his life as he had been during the previous night. I have before explained the real causes of this discouragement. It is true that the treaties between the crowns of Great Britain and Spain, whilst giving permission to the subjects of the former to cut mahogany and logwood, strictly prohibited any species of cultivation for the purposes of trade. But that prohibition had no share whatever in the inactivity and indifference of the people with respect to agriculture. The old mahogany cutters had too much of the spirit of their buccaneering predecessors, to be bound by any provisions contained in treaties, if their interests had appeared to them to lie in a contrary direction. Besides, the treaties which forbade cultivation prohibited also many other things, which prohibition was as little regarded by the government as by themselves. As the mahogany trade is becoming less and less profitable every year, or rather, I should say, more and more ruinous, the attention of the inhabitants is awakening to the importance of discovering some other staple which may occupy its place. This will not be a work of much difficulty, inasmuch as the soil is teeming with plenty, and the numerous rivers and freshwater lagoons, not only supply to it a constant irrigation, but also a means of transit for its produce. I have lately read in the newspapers a discussion concerning castor oil as a remedy for cholera, and also a correspondence in which the writers complained of the very high price which was charged for that medicine. Now the *Palma Christi*, or castor oil plant, grows wild in this country. When it has once introduced itself into your garden, it grows with the pertinacity of the most determined weed, and it is almost impossible to extirpate it. Castor oil might, therefore, be made in this country in such immense quantities that the price of that inestimable drug might be reduced so low as to bring it within the reach of the poorest individuals, and whether it be a remedy for cholera (which appears yet to be a moot point) or not, it is unquestionably one of the most powerful, and at the same time harmless of purgatives, and it ought to be in every habitation, whether that habitation be a palace or a hut. There are some medicines the sale of which it would not be safe to entrust to any but the chemists, but there would be no more danger in a grocer dispensing that drug, than there is in his selling figs and raisins. If the grocers would admit castor oil as a regular article of their trade, it would confer a great benefit upon the poor.

It is not generally known that castor oil is the best oil for the hair, nourishing the roots, and giving it a beautiful gloss and a tendency to curl. Poor Elliott Warburton, in his most interesting book, "The Crescent and the Cross," describes the long, dark, shiny, clustering locks of

the Nubians, and, if I mistake not, he ascribes the luxuriance of that feature to the profuse application of castor oil.

I have sent to you by this packet a box of the *mild* castor oil seeds of this country, in order that their value may be tested. I have also directed to be forwarded to you some bottles of Cayenne pepper, grown and manufactured by myself. This pepper will be found to be superior to the pepper which is generally imported from the West Indies, which, for the most part, is greatly adulterated with a red powder, which is found upon the flower of the Anotta plant. The pepper which I have sent, is made entirely of the small bird pepper, (the bonnet pepper, of which it is sometimes made, is inferior in flavour and less pungent,) which is dried in the sun, and then pulverized upon an Indian rubbing stone. This stone is unquestionably of great antiquity, being precisely the same as that which is represented on several Egyptian remains. It is used for grinding maize, or Indian corn, and is altogether different from the *quherne* of the Ancient Britons, which was employed for a similar purpose. There are many features and characteristics amongst the Indians of this portion of the American continent, which lead one to suppose that they are of Phœnician origin.

I now wish to bring under your notice a most valuable plant indeed, a native of this part of the world—I mean the *guaco*. This plant, although not altogether unknown to science, has not yet been admitted into the Pharmacopæia of London, of Edinburgh, or Dublin. It is a creeping plant, and grows wild in the bush, in moist places, and on the margins of pools and rivulets. The leaves, stalk, and root, are extremely bitter. Its medicinal properties are extraordinary. There will be no difficulty in believing that Honduras, abounding as it does in dense and interminable forests, is not without its due compliment of snakes. In fact, they are as plentiful as blackberries in England, or "as thick as autumnal leaves that fall in Valhambrosa," and they are, for the most part, extremely venomous. Rattlesnakes are very numerous, and there is a small snake, called by the Creoles, the *Tomagoff*, the bite of which is considered to be fatal. Where there are snakes (nature abhors a vacuum) there will be snake doctors, and we are not without a fair sprinkling of sable-skinned disciples of Esculapius; these professors are well acquainted experimentally with the virtues of the *guaco*. When one of them is called in, or rather called out, for the victim is almost invariably in the bush, to treat a snake bite, he, like more civilized empirics, has recourse to a good deal of mummery, such as crushing the head of the snake, (if it can be got) making an infusion of it, and giving it to his patient to drink, which is a proof that the doctrine of homœopathy is not unknown to the medical practitioners of these umbrageous recesses. But the real medicine which he gives to his patient, and which, when given in time, invariably performs a cure, so it is said, is a decoction of the leaf of the guaco. In a book styled "New Remedies Pharmaceutically and Therapeutically considered" by Dr. Dungleson, Professor of the Institutes of Medicine in Jefferson Medical College of Philadelphia, there is, at page 335, an interesting article on this plant, in which he describes the effects produced by it when administered in cases of snake bites, and Asiatic cholera. The article is too long to insert in this letter, but I should recommend your readers to an attentive perusal of it.

Dr. John Young, a very old and successful practitioner of Belize, has obliged me with some manuscript observations of his brother, the late S. Francis Young, who was a gentlemen of very considerable scientific attainments and medical skill, and who also practised for several years in this country. As they are extremely interesting, I am sure they would not be unacceptable to you,—therefore I do not hesitate to transcribe them:—

"The guaco is a creeping or climbing plant, growing in moist and shady parts of the forests of Central America, and delights in the rich black vegetable mould so abundant in intertropical forests. It is found in great vigour near the margin of springs, in shady situations, as well as along the banks of rivers. When in its growth it meets with a shrub, or any other body, it attaches itself to it by winding in a spiral manner round it. The leaves which have reached full maturity are about six inches in length, and of a proportionate width; and, at a little distance from the leaf-stalk, are sagittated and serrated. The leaves of middle growth, as well as the young ones, are of a dark purple hue, with a tinge of green on the under surface, an appearance by which the guaco is readily distinguished from other plants of the creeping or climbing kind, which may, in other respects, strongly resemble it. The upper surface is of a green, glossy, and silky aspect, and of a velvety feel, from being covered with a short and exceedingly soft down. The taste of the leaf, stalk, and root, is an intense bitter, which leaves a strong impression on the tongue, more lasting than that caused by the generality of bitters. It imparts its bitterness readily to spirit, and water; and is, therefore, administered internally in the forms of tincture, infusion, and decoction. It is universally had recourse to as an infallible remedy in cases of snake-bite throughout Peru, Central America, and Mexico, in all which divisions of the American continent it is known under one and the same name—guaco—by all tribes of the Indians, notwithstanding that there exists nearly 200 different dialects.

"So satisfied are all classes of people among whom this invaluable product of the vegetable world is known, of its extraordinary medicinal powers and specific virtues in cases of snake-bite, that every Indian or negro whose avocations cause him to traverse the western world, invariably has a supply of this friendly plant, in a dry or prepared state, to meet any accident that may befal him from his inadvertently placing his foot upon one of those dreaded and deadly foes of mankind. The writer has had four cases of snake-bite under his care, in all of which the guaco was used as the sole remedy, and with complete success.

"The first case was that of the mate of a vessel on board which a snake was supposed to have been taken in a hollow piece of logwood. While loading the ship's boat from the shore a snake frequently protruded itself from among the pile of logwood, and was frequently attempted to be killed by the sailors; it, however, with its natural dexterity, eluded every endeavour of theirs by as quickly retiring among the pieces of logwood, many of which were hollow, thus affording a secure retreat. In one of these pieces, there can be little doubt, it found its way on board. About eight o'clock at night, the mate, while walking the deck, on which a quantity of logwood still remained, suddenly felt something bite him near the ball of the great toe. The pain was exquisite, quickly extending itself in shoots up the limb, and affected his side. There was a giddiness of the head and an acute pain in the pit of the stomach, and sickness. He was almost immediately thrown into violent convulsions, and the posterior muscles of the body became so powerfully affected with spasms as to send the head and shoulders backward to such a degree as to resemble a severe case of tetanus. When my brother, who was hastily sent for, arrived on board, he immediately concluded it was a case of snake-bite, and was in the act of sending ashore for the *guaco*, a quantity of which, by good chance, he had, when I arrived with it, having heard of the mishap. At this moment a very violent fit, of an epileptic appearance, with violent spasms of the head, of the kind mentioned above (although greatly aggravated) took place. These spasms had appeared about every ten minutes. We hastily descended to the cabin, and as soon as the power of swallowing returned administered a wine-glass full of very strong tincture of the guaco. We waited in extreme anxiety to see the result of this our firs essay in grappling with a formidable enemy hitherto accounted invincible, with a power, new to us, indeed, but the fame of which was widely spread. It may well be

imagined how great was the intensity of our impatience in awaiting the lapse of the usual period intervening betwixt the convulsive attacks. Ten, twenty, thirty, and forty minutes over without any return of the convulsions. The pulse was strong, full, and accelerated—there was much pain in the head, with somewhat of drowsiness, and a profuse flow of perspiration. We left the patient, ordering the same dose to be given in about an hour and a half after the first dose, should no convulsion appear, but immediately on a threatening of such. About a quarter of an hour after we left a slight convulsive attack came on, when the dose was repeated. As we had left orders to be sent for should matters again become unfavourable, we were agreeably surprised to pass the night without being called, the last attack being so slight as not to appear to his father sufficiently serious to cause him to disturb us, more especially as he was satisfied he had a sufficient remedy with him. The young man in a day or two was quite well. I may here observe that the snake was neither seen before nor found on board afterwards, it having in all probability slipped over the side of the vessel after inflicting the wound. No one, however, ever expressed a doubt as to the identity of the bite with the snake which had so cleverly evaded the boat's crew.

"The other three cases occurred to two Indians and a Carib, and were treated in the same manner. In all, after giving guaco, the pulse became exceedingly strong and full, with intense headache and flushed countenance, followed after a time with a profuse flow of perspiration. These symptoms would doubtless have led me to the free use of the lancet, had I not previously reflected well on the treatment I should adopt. A strong tincture was used and given by the wine-glass full. It might be said that the quantity of spirits would of itself account for all the symptoms which manifested themselves after the exhibition of the guaco, but when it is mentioned that the whole of the last-mentioned sufferers were in the almost daily use of drinking large quantities of spirituous liquors, this surmise becomes dissipated. I have not a doubt upon my own mind that the symptoms were produced by the guaco, and as the necessary results of its internal exhibition, in whatever form given, provided the dose be large, and given with a bold hand, and that previous depletion, either by the lancet or otherwise, had not preceded its use. I, moreover, am of opinion that the entire success of the treatment arose from the action of the guaco on the body not having been interfered with, or in any way modified, by a random recourse to the lancet, without reflection that its use might altogether destroy the efficacy of the peculiar power admitted to reside in this singular plant. * * * The guaco is frequently used in intermittent fever instead of bark or quinine, and as a good stomachic in dyspeptic or debilitated state of the intestinal canal."

I shall procure some guaco at the earliest opportunity, and forward it to your Society. I think it is very desirable that the properties of this plant should be tested in England. I should recommend that some animal—say a dog or a rabbit—should be bitten by the most venomous snake in the Zoological Gardens, and that a strong dose of the tincture of guaco should be administered immediately afterwards. Dr. John Gowry says, "When speaking of the valuable properties of the guaco plant, Dr. F. Young has sometimes expressed himself as of opinion that it would be found a safe and sure cure for hydrophobia, the bite of the snake and mad-dog being equally animal poisons."

It is time, however, that I should conclude this letter, which has grown to such an unreasonable length. Should my communication, however, be fortunate enough to meet with your approval, I shall trouble you again, for I have yet much to say concerning the productions of this country.

I remain, sir,
Your's very faithfully,
R. TEMPLE.

## THE DISCUSSION ON THE SMOKE NUISANCE.

1, Fish-street-hill, City,
London, Jan. 22, 1855.

SIR,—I beg the favour of your correcting an error in your report of what I said on Wednesday last, in the discussion on Mr. G. W. Muir's paper on "The Smoke Nuisance," an error that I may say partook of the faltering manner of my delivery, caused by previous exhaustion.

In agreeing with Mr. Muir that sufficient dimensions, draught, &c., were necessary to economical combustion, I did not admit that these alone would effect that object, or cause the prevention of smoke; but, on the contrary, I affirmed that such preliminary conditions still required some appropriate invention as an indispensable adjunct. For if it were not so, how is it, where ample dimensions, draught, &c., already exist, that, without smoke-preventing appliances, the chimney-shafts of such premises evolve just as much smoke as others?

Allow me to add a few words relative to the paper itself.

With an evident bias against inventions for the prevention of smoke, and very particularly so against those of comparatively recent date, Mr. Muir gave the Society much valuable information; but, whilst he referred to precedents commencing with the present century, he completely ignored all that has been done in the metropolis during the last eighteen months—since, in fact, he saw the first few furnaces out of the hundreds I have myself in operation; and what is of more consequence, as far as his own testimony is concerned, Mr. Muir omitted all mention of his personal experience as Inspector of Smoke Nuisance in Glasgow, which, for practical purposes, would have been of paramount importance in the opinion of his audience.

I should further state that I dissent from several leading propositions set forth by Mr. Muir; but which, having been so admirably expressed by Mr. William Fairbairn, F.R.S., who presided with so much efficiency on the occasion, among the points upon which he differed with the author of the paper, it would be presumptuous in me to repeat.

I am, sir,
Your most obedient servant,
J. LEE STEVENS.

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SIR,—In Mr. G. W. Muir's interesting paper "On the Consumption of Smoke," he referred to the silk mills of Messrs. Walker, in Salford, as a proof that, by a proper construction of the furnace and boiler, the opaque smoke may be almost entirely consumed without any special apparatus. I have great pleasure in confirming this statement, having visited the above mill some months since, after the old boiler had been replaced, and the engine altered. The following comparison strikingly illustrates the difference in the consumption of fuel between the old and the new modes of construction:—

| *Engine.* | *Boiler.* | *Pressure.* |
|---|---|---|
| | FORMERLY:— | |
| Hand gear, in good order. | Good Waggon. | 8lbs. |
| | ALTERED TO:— | |
| Variable expansion, by Petrie, of Rochdale. | Galloway's Patent, Well clothed. | 12lbs. |

The saving effected by the change in the engine was 40 per cent., and by the boiler 26 per cent., equal to 66 per cent.

The plan is, as Mr. Muir states, "to draw the red coal to the front, and throw the fresh to the back. When this is done the flame from the front plays over the fresh fuel, and ignites the upper portion, thus burning it downwards. The fire is also carried forward by the draught, and the whole mass is soon ignited. *An immense quantity is thrown on at once, the furnace being supplied but thrice per day.*" Thus a large amount of labour is saved. I saw the furnace supplied, and went outside the mill to see the

amount of smoke made. It did not equal that proceeding from an ordinary cottage fire, and speedily ceased altogether.

While on the subject of smoke-consuming, could you inform the public where they may obtain the domestic smoke-burning grates invented by Dr. Arnott, and explained by him at one of your meetings last year?

I remain, sir,
Yours respectfully,
JAMES HOLE.

Leeds, Jan. 22, 1855.

## STATISTICS OF THE IRON MANUFACTURE.

Sir,—The important position held by the manufacturers of iron, and the increasing importance of that manufacture, it being, as I stated on a former occasion, *progressive*, so that every new application has the effect of still further proving its value and universal usefulness, has lately induced me to propose a project, which I have for sometime contemplated, of offering to undertake the duties of a kind of general secretary to the iron trade, in the collection of statistical matter relating to the production and application of iron in all its branches, in this and other countries, feeling satisfied that the more its advantages are known, the more will be the general requirement for its possession. With this view I wrote to the chairman of the Ironmasters' Meetings, in Staffordshire, and since then I addressed a letter to the Editor of the *Mining Journal*, which was published in that paper of Saturday last, and was deemed worthy of a favourable notice by the editor in one of his leading articles. The same object now induces me to address you, in the hope that my letter may be allowed a place in the columns of your Journal, as a subject intimately connected with the Arts, Manufactures, and Commerce of the country.

When I read my paper on "The Growth and Expansion of our Foreign and Colonial Trade in Iron, and the Fiscal Obstructions to its Fxtension," I was particularly struck with an observation made by the chairman (James Wilson, Esq., M.P.), in commenting upon the discussion which took place after the reading of the paper. It was as follows:—

"There was one remark which had forcibly struck him, as tending to clear away the mist and exaggeration with which the iron trade was surrounded. When they saw particular cycles in trade in which an article was rising ten or twenty per cent. annually in the amount consumed, succeeded by a mania like that of railways, they became naturally afraid of a revulsion. There could be no doubt that in its progress from protection to freedom the iron trade had been subject to revulsions, and they found that distress had occasionally existed in the iron districts, and it was because of their large population that they laboured under some apprehensions on the subject. There had been a remark made, however, which he thought ought, in a great measure, to relieve them from apprehension; for, though, the iron districts, like all others, must still be subject to fluctuation, yet that remark showed that the trade was in the main founded on a solid basis. Mr. Simmonds had remarked that all the railways in the kingdom only contained 1,500,000 tons of iron, but Mr. Bird had improved upon the remark, by showing that they contained 2,500,000 tons; when, therefore, they came to see that the make of iron for the year was upwards of 3,000,000 tons, that would show that the railways could not have exercised any very material influence on the trade, as the whole of the rails yet used was not equal to one year's produce of iron. That was a fact calculated to show them that it was not upon railways, or on any peculiar department of the trade they must chiefly rely, but upon the cheapness and perfection of their make, rather than occasional speculation, though that might produce a temporary effect upon prices." These observations appeared to me, when I heard them, of great and striking importance; they do so still more at the present time, when one of the revulsions in the trade is actually taking place. It must, when considered, lead to the conclusion that the present state of depression can be but temporary, because the great consuming channels of the country are still in full activity—namely, the agricultural, manufacturing, and shipping interests. And in America, although circumstances have occasioned a check, the use of iron is so well understood and appreciated—and in foreign countries where it is, I may say, becoming known—the demand cannot stop for any lengthened period, and the more the advantages we possess become gradually known, so much the sooner will the supply of this most essential metal be required for general use, and Government will be called upon for the abandonment of the remains of restrictive tariffs.

It is with an intention of making known the uses of iron in this country, and the means we have of supplying any required quantity, provided supplies of ironstone, conveniently situated, are forthcoming, that I offer my services,—having been accustomed for many years to make it a study to collect and arrange materials connected with the iron manufactures—provided I have reasonable support. How far the Society, as a body, will be willing to assist such an inquiry, I, of course, can have no means of knowing, but possibly many of the members may not object to come forward if an arranged plan for the attainment of the object I have in view can be organised.

I remain,
Your faithful servant,
HARRY SCRIVENOR.

Liverpool, January 23, 1855.

## BENZINE—BENZOLE.

Sir,—I notice in your Journal, No. 110, page 104, a letter by Mr. Mansfield, quoting and remarking on a passage from a paper by Mr. F. Crace Calvert, in a former number. I observe also, at page 131, a note from Mr. Calvert in answer to this letter.

I am exceedingly unwilling, and it is quite contrary to my habit, to take part in controversy. I am not now about to break my rule, but I feel bound to ask you to insert the following remarks in your next number. I think it my duty to do so, not only on general grounds of justice, but because the experiments of Mr. Mansfield, to which he refers in the letter which I first mentioned, were made by that gentleman in my laboratory, at the Royal College of Chemistry, and because I watched the tedious process which Mr. Mansfield patiently carried on for many months, and by which he obtained, amongst other interesting results, the facts which he truly states to have been his discovery.

I am disposed to regret the tone of warmth which appears in Mr. Mansfield's letter. I must, however, point out, that the few words in which Mr. Calvert replies to Mr. Mansfield's strictures in no way meet the objection which Mr. Mansfield raises to Mr. Calvert's statement concerning "Benzine." The chief points to which Mr. Mansfield calls attention in his letter, are circumstances of scientific history and of literary fact. He appeals on this matter to the only tribunal which can consider it,—that of science.

Such questions as the following are not subjects for Courts of Law: Are "Benzine" and "Benzole" accepted synonyms? Who gave the name "Benzine" to a product contained in coal-naphtha? Is "Benzine" coal-naphtha purified, or is it a peculiar substance? Who first found "Benzine" in useful quantity in coal naphtha? Who first pointed out its utility as a solvent of grease and as a detergent? Who first introduced it into England?

These are the main points raised in Mr. Mansfield's letter against Mr. Calvert's statement. The answers to these questions are matters of history, and not of law; and I am bound to declare, that the assertions made by

Mr. Mansfield regarding these points are in every respect exactly correct.

It is true that Mr. Mansfield, in his letter, raises by implication a secondary question, as to the validity of Mr. Calvert's recent patent. On this question, of course, I have nothing to say; this is simply a matter for legal decision; but, in the present case, it is only a subordinate question, and to merge the first dispute in the second, which is altogether beside it, appears to me an evasion of the point at issue.

I am, sir, yours, &c.,
A. W. HOFMANN.

Royal College of Chemistry, Jan. 24, 1855.

## FIRE DAMP.

SIR,—A proposal to illuminate coal mines with gas, may at first sight appear visionary and chimerical, but it is hoped that when the experiment is tried and tested, in the mode devised, the project will prove both sound in principle and successful in practice. The manufacture of gas in a convenient chamber of the mine, can be easily accomplished at a trifling cost, and it only requires sufficient ventilation, to which the additional heat will contribute, effectually, to complete the process. The laying and fixing pipes in proper positions and suitable distances, presents little difficulty. The burners must be carefully protected from danger by means of gauze-wire safety covers, the lamps being lit by a galvanic battery and conducting wires. As it is well-known that fire damp explodes on ignition by an electric spark, the presence of the insidious element can be at any time detected by the aid of this simple agency, and precautions adopted to neutralise its baneful power. A large portion of its ingredients will be gradually consumed by the combustion created, and the formidable enemy not only subdued, but rendered instrumental to its own destruction.

Should the anticipated results be realised, an apparatus, combining various scientific discoveries, will be contrived, that affords increased security to the workmen engaged in this perilous occupation, while facilitating the operations of labour, with diminished risk to human life.

M. T. K.

## THE F.S.A. QUESTION.*

SIR,—Observing a correspondence in the *Journal of the Society of Arts* relative to the wrong application of the initials F.S.A. to members of the Society of Arts, such initials being the distinction of the Antiquarian Society, as one who has been inadvertently guilty of permitting this irregularity, I beg to offer a remark on the subject.

The initials F.S.A. having been applied to my name by friends and others who were aware of my being a member of the Society of Arts, I was induced to make inquiries into the propriety of such addendum, when I was referred to "Maunder's Treasury of Knowledge," wherein, at page 354, under the head of "A List of Abbreviations with their Explanations," will be found :—

"F.A.S.—*Fraternitatis Antiquariorum Socius.*

"F.S.A.—*Fraternitatis Artium Socius.*"

With such an authority there seemed no question as to the legality of the affix, and as I did not see any reason why I should be ashamed of being associated with such a very important and useful institution as the Society of Arts, I not only did not check the application of such initials to my name in public notices referring to me, but also permitted them to be applied in sundry books and pamphlets published by me.

As this erroneous information in "Maunder's" may possibly have caused others to err as well as myself, this reference to it is interesting to the question.

I have the honour to be, Sir,
Yours obediently,
H.C.

Gosport, 13th Jan., 1854.

* The Secretary begs to inform the members of the Society, that neither by the Charter, by the Bye-Laws, nor by custom for upwards of one hundred years, is there any authority for members to place after their names any letters denoting membership.

## THE COST OF PEAT CHARCOAL.

204*a* Upper Thames-street, Jan. 25th, 1855.

SIR,—I had much pleasure in listening last evening to Mr. Longmaid's paper on "Peat and other Vegetable Charcoal," but having been obliged to leave early, I was unable to put that gentleman right as to the cost of preparing "Peat Charcoal," which, I understood him to say, was about 12s. per ton.*

This, certainly, is an error, as "The Irish Amelioration Society" calculated their cost at 20s. per ton, after allowing for a *supposed profit* on paraffine, sulphate of ammonia, &c., extracted from the bog. I say supposed, because we know the Society has not prospered. I therefore now give you the cost of preparing and bringing to market the charcoal from English bog, for which I am agent, and which, with one exception, is the only source of supply in England.

With respect to treating dry bog pulverised, with sulphuric acid, I think commercially it would be a failure.

Yours faithfully,
MARK FOTHERGILL.

Cost of making peat charcoal, and delivering for sale in London, per ton :—

| | £ | s. | d. |
|---|---|---|---|
| Draining, and value of bog . . | 0 | 6 | 9 |
| Contract for cutting, piling, drying, and burning . . . . | 1 | 10 | 0 |
| Grinding . . . . . . | 0 | 2 | 9 |
| Carriage from bog to wharf in London . . . . . | 0 | 9 | 5 |
| Warehousing expenses . . | 0 | 4 | 6 |
| | £2 | 13 | 5 |
| Leaving for rent, profit, agency, outlay for kiln, drying sheds, utensils, &c. . . . . | 0 | 6 | 7 |
| | £3 | 0 | 0 |

* Mr. Longmaid's statement was, that this would be the cost by *his new* process.—ED.

## REMARKS ON REPORT ON TRADES WHICH AFFECT THE EYES.

SIR,—In the admirable Report of the Committee on Industrial Pathology on Trades which Affect the Eyes, no suggestion is made in the case of persons exposed to excess of light, as glass-blowers, smelters, &c., where coloured media are inadmissable. Would it not be well to try the Lapland snow-blinkers, which are very effectual in preventing snow-blindness, a species of amaurosis very common in the Arctic regions.

The snow-blinkers consist of two hollow shells, of any light material, large enough to cover the eyes, with a long and very narrow horizontal slit for vision.

Perhaps a vertical slit might suit some trades, or even one in the form of a very slender cross, such as we often see in the vizors of ancient helmets.

The blinker spectacles ought to be made exceedingly light, and easy to put on and off, and should be so fitted as to enable the wearer to throw them back with a jerk of the hand when not looking into the melted metal. A pure Cochin China egg would be exactly the thing, cut in two lengthways; some of them will bear very heavy blows without injury.

Your's very truly,
HENRY W. REVELEY.

Parkstone, Poole, Dorset, January 15th, 1855.

# Proceedings of Institutions.

Bury (Lancashire).—The annual meeting of the Athenæum was held on the evening of the 16th instant, in the Lecture-hall of the Institution. The chair was taken at seven o'clock, by the president, John R. Kay, Esq., after which the meeting proceeded to the election of the various officers for the ensuing year. At eight o'clock the secretary read the report of the past year, from which it appears that the Institution is in a very satisfactory state, the average number of members for the past year having been 757, and the number in the last quarter being 850, which is an average increase of 184 members over last year. The receipts for the year have been £656 6s. 5d., and the disbursements £651 15s. 5d., leaving a balance in the treasurer's hands of £4 11s. There have been added to the library 279 volumes in the past year, including a present from the Lord Bishop of Manchester of 132 volumes of the Cabinet Cyclopædia. The classes are well supported, the news-room in a prosperous state, and the lectures and other departments of the Institution well appreciated by the members.

Derby.—The fourth annual report of the Railway Literary Institution, whilst regretting that so many of the Company's servants still stood aloof from the Institution, expresses the confident hope that as its means of usefulness are increased, its advantages will be better appreciated. There has been an increase during the year of 57 members, the total number being now 252. The number of volumes in the library amounts to 1,300, and the weekly issues to 114. Various donations have been received, including £2 each from the borough members, and £25 from Sir J. Paxton, M.P. The receipts from all sources were £117 10s. 2d., the disbursements £93 4s., leaving a balance in the treasurer's hand of £24 6s. 2d.

Dunmow.—On Wednesday, the 3rd instant, the General Annual Meeting of Members of this Institution was held in the enlarged Town-hall, when the committee gave in their report and produced their accounts. It was shown that the funds were in a very prosperous condition, there being a more than usually large balance in hand, to be appropriated to the purchase of books, &c.; and also that the general prospects of the Institution were brighter than they had ever been since its commencement. On the following evening, the Rev. C. Lesingham Smith, the President, delivered a lecture on "The Holy Sepulchre at Jerusalem, and the various buildings which have been erected over and around it." A number of large sketches and diagrams, executed by himself, were referred to in illustration of the lecture, which was well received by a numerous audience.—The Rev. H. Gammidge gave a lecture on Wednesday, the 17th instant, to a numerous audience, on "Steam Power and its Applications." He commenced by remarking that the extensive influence now exerted by steam power, and the many ingenious contrivances connected with it, render it a subject worthy of attention and inquiry. After a brief statement of the fundamental principles upon which the power rests, he proceeded to give some account of the observations made upon the phenomena in early times. Various names, from Hero of Alexandria to the middle of the last century, were mentioned, special prominence being given to the labours of Edward Somerset, Dr. Papin, Newcomen, and James Watt. The lecturer then went on to point out some of the numerous and important applications of steam power made in modern times, and the bearings it has thus had on the welfare of the human race. Its employment in the several departments of manufacture, in printing, in locomotion by land and sea, and in agriculture, all passed under notice, its adoption by the latter quiet and ancient science being regarded as an unmistakeable proof of the complete ascendancy of steam power. The lecturer concluded by arguing from the past, yet greater things in the future, and by expressing the conviction that this marvellous agency, much as it has already done, is destined to do still more, in securing the highest and happiest results for the nations of mankind.

Highworth.—The Second Annual General Meeting of the Members of the Literary and Scientific Institution was held on Monday, the 1st instant. The meeting was well attended. The Rev. Edward Rowden, Vicar, and President of the Institution, took the chair, and called on Mr. J. C. Salmon, Honorary Secretary, to read the Report of the Committee, which stated that the number of members for the past year, some subscribing one pound, and others ten shillings each, was fifty eight, showing a diminution of six members of these classes as compared with the preceding year. The subscribers of one shilling per quarter were eight. Upwards of seventy visitors have been introduced to the Reading Rooms during the year by members of the Institution. Agreeably to a resolution at the last annual meeting, the Institution has been put in Union with the Society of Arts, by which it had already experienced a considerable pecuniary saving by purchasing books from publishers in connection with the Society. Sixty-four volumes have been purchased during the year, making the total number in the library 296. The report concluded by urging the members to deliver lectures or prepare papers on subjects of general interest, and on which they might feel qualified to dilate, as the funds of the Institution were not more than sufficient to meet the ordinary requirements. After the reading of the Report, several of the members present offered to give lectures gratuitously. A vote of thanks was unanimously accorded to the Secretary, for having originated the Institution, and for the gratuitous services he had rendered since its establishment.

Pimlico.—On Monday, the 22nd instant, Mr. Adolphus Francis gave a dramatic reading of Bulwer Lytton's play "The Lady of Lyons," at the Literary, Scientific and Mechanics' Institution. Owing to the inclemency of the weather the attendance was small, but, judging from the attention and applause which was accorded to Mr. Francis, it was evident that his manner of treating the play was much admired. During the earlier portion of the month two lectures on "Voltaic Electricity," illustrated by experiments, were delivered by Mr. John S. Blockey, of the Royal Polytechnic Institution, and one on "Edgar Allan Poe—his Life and his Muse," by Mr. Frank E. Fowler, which he illustrated by reciting several of the poetical works of Poe, more especially "The Raven" and "The Bells."

## MEETINGS FOR THE ENSUING WEEK.

Mon. Actuaries, 7. Mr. S. Brown, "On the Rate of Sickness and Mortality amongst the Members of Friendly Societies in France."

Tues. Royal Inst., 3. Professor Tyndall, "On Magnetism."
Civil Engineers, 8. Mr. J. Phillips, "Description of the Large Iron Roof, in one Span, over the Joint Railway Station, New-street, Birmingham."

Wed. Society of Arts, 8. Mr. S. C. Homersham, "On the Chalk Strata considered as a Source for the Supply of Water to the Metropolis."
Geological, 8. 1. Mr. Odernheimer, "On the Geology of the Peel River District, Australia." 2. Mr. Rosales, "On the Geology of the Ballarat Gold-Fields, Australia." 3. Mr. D. Forbes, "On the Geology of part of Norway."

Thurs. Zoological 3.
Royal Inst., 3. Mr. Donne, "On English Literature."
Antiquaries, 8.
Photographic, 8. Anniversary.
Royal, 8½.

Fri. Society of Arts, 8. Special Meeting. Mr. Leone Levi, "Observations on the Proposed Congress for the Improvement of International Commercial Law."
Botanical, 8.
Royal Inst., 8½. The Astronomer Royal, "On the Pendulum Experiments lately made in the Harton Colliery for ascertaining the Mean Density of the Earth."

Sat. Asiatic, 2.
Royal Inst, 3. Dr. J. H. Gladstone, "On the Principles of Chemistry."
Medical, 8.

## PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS,

*Delivered on 23rd January*, 1855, *and during the Christmas Recess.*

Par. No.

9. Ecclesiastical Commission (Ireland)—Report.
13. Turnpike Trusts—Return.
6. Clergy (City of London)—Return.
8. Destitute Children (Dublin)—Return.
12. Waterford, &c., Mails—Return.
10. Metropolis Buildings Act—Correspondence.
17. Corporal Punishments (Navy)—Return.
16. Epidemic (Bermuda)—Copy of Despatch.
11. Naval Stores, &c.—Statement.

Bill—Savings' Banks and Friendly Societies Investments.
Agricultural Statistics (Ireland)—Return.
Coal Mines—Reports of Inspectors.
Royal Forests—Instructions to the Surveyors.
Railway Accidents (August, September, and October)—Reports.
Quarantine (Plague of Malta in 1813)—Appendix V. to Second Report of Dr. Burrell.
Convict Prisons—Report by Lieutenant-Colonel Jebb.
Jamaica—Papers.
Australia (Discovery of Gold)—Further Papers.
Australian Colonies (Crown Lands)—Further Papers.

*Session* 1854.

448. Indices to Reports of Commissioners (Docks and Harbours)—1802-1853.
507. Railways—Abstract of Return.
461. Taxes Repealed, &c., (Revenue and Expenditure, Loans and Grants)—Return.
57 (11). Trade and Navigation—Accounts.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Jan.* 19*th*, 1855.]

*Dated 1st December*, 1854.

2525. J. Whitworth, Manchester—Cannons, guns, and fire-arms.

*Dated 28th December*, 1854.

2735. M. Williams, Chelsea—Suspending looking-glasses.
2737. P. Haworth, Manchester—Band fastener.
2738. R. Threlfall and R. W. Pitfield, Bolton-le-Moors—Spinning machinery.
2739. J. Murdoch, 7, Staple-inn—Waterproofing woven fabrics. (A communication.)
2741. J. Gray, Liverpool—Adjusting ships' compasses.
2742. G. J. Bensen, 7, Christian-street—Refining sugar.
2743. H. C. Hill, Parker-street, Kingsland—Portable barracks.

*Dated 29th December*, 1854.

2744. J. Nasmyth, Barton-upon-Irwell—Forging masses of iron.
2745. F. Thompson and W. Wagstaff, 12, Pall-mall East—Photography.
2746. A. Dietz and J. G. Dunham, Raritan, New Jersey, U.S.—Reaping machines.
2747. A. Stansfield and J. Greenwood, Todmorden—Power-looms.
2748. I. Z. Bell, Sandfield-place, Lewisham-road—Boots and shoes.
2749. H. Widnell, Lasswade—Carpets.
2750. E. Loysell, Paris—Injecting machine.
2751. T. Thorneycroft, Wolverhampton—Ship-building.
2752. J. Pillans, 40, Brompton-crescent—Preparation of hematosin and fibrinous and serous matters.
2752. H. R. and I. A. Fanshawe, North Woolwich—Waterproof garments.

*Dated 30th December*, 1854.

2755. R. Chapman, Manchester, and J. Miller, Stalybridge—Spinning machinery.
2757. G. Mallinson, Manchester, and H. Ridings, Newton-heath—Woven fabric.
2759. G. E. Dering, Lockleys—Motive power by electricity.
2761. T. Slater, Somers-place West, and J. Tall, Crawford-street, Marylebone—Planes.
2763. B. Hughes, Belfast—Bakers' ovens.

*Dated 3rd January*, 1855.

12. J. K. Harvey and D. Pearce, London—Calendar inkstand.
14. H. Fontaine, Marseilles—Engravers' presses.
16. W. Kendall and G. Gent, Salford—Machinery for cutting metals.
18. J. H. Johnson, 47, Lincoln's-inn-fields—Coating iron with copper. (A communication.)
20. C. Hustwick and W. Bean, Kingston-upon-Hull—Railway buffers and springs.
22. J. Venables and A. Mann, Burslem—Raised ornaments on metal, pottery, &c.
24. T. W. Rammell, Trafalgar-square—Furnaces.

*Dated 4th January*, 1855.

26. C. Watt, Victoria-wharf, Regent's-park-basin—Preparing coffee.

*Dated 5th January*, 1855.

28. G. Bowden, 1, Little Queen-street, Holborn—United adhesive book-headband and register ribbons.
30. L. D. Girard, Paris—Motive power.
32. J. Livesey, 20, Kennington-gore—Printing. (A communication.)

*Dated 6th January*, 1855.

34. B. Cook, Birmingham—Separating metallic filings.
36. T. Delabarre and A. Bonnet—Preservation of food.
38. D. Joy, Worcester—Pistons.
40. G. H. and H. R. Cottam, Old St. Pancras-road—Iron bedsteads.

*Dated 8th January*, 1855.

42. W. G. Craig, Gorton, near Manchester—Railway buffer cases and rams.
44. J. Player, 2, Winchester-buildings—Prevention of smoke.
46. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Alcohol. (A communication.)
48. A. Nagles, Ghent—Cleaning surfaces of woven fabrics.

*Dated 9th January*, 1855.

50. S. S. Shipley, Stoke Newington—Washing machinery.
52. T. Hodgson, Morley's Hotel—Paddle-box life-boat.
54. A. G. Guesdron, Paris—Table.
56. N. J. Amies, Manchester—Winding yarn.
58. E. Bow, Glasgow—'Blackening' for foundry purposes.
60. I. Lamb and F. B. Fawcett, Kidderminster—Fabrics.

INVENTION WITH COMPLETE SPECIFICATION FILED.

79. A. E. L. Bellford, 32, Essex-street, Strand—Tanning. (A communication.)—12th January, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed January 19th*, 1855.

1599. Sir John Scott Lillie, Pall-mall—Improvements in fire-arms.
1621. Richard Roberts, Manchester—Improvements in machinery for punching, drilling, and rivetting.
1623. Auguste Castets, Paris—The extraction of a substance for supplying the place of quinine.
1629. William Grundy, Bury—Improvements in the manufacture of drugget.
1647. William Littell Tizard, Aldgate—Improvements in fermentation and in apparatus employed therein.
1695. Richard Archibald Brooman, 166, Fleet-street—Improvements in machinery for dressing flax, hemp, and other like fibrous substances.
1697. John Simon Holland, Woolwich—Improvements in locks.
1755. Peniston Grosvenor Greville, Lombard-street—Improvements in the manufacture of cards for working wool and cotton.
1849. William Shepherd Smith, Charlotte-street, Fitzroy-square—Improvements in pianofortes.
1975. Peter Rothwell Jackson, Salford—Improvements in the manufacture of wheels.
2051. Pietro Feloj, 183, Fleet-street—Improvements in the manufacture or construction of a knife and fork.
2645. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture of piled goods, and in the machinery or apparatus employed therein.
2475. George Collier, Halifax—Improvements in the manufacture of pile fabrics and other weavings.

*Sealed January 23rd*, 1855.

1630. Ephraim Hallum, Stockport—Improvements in machines for preparing, spinning, and doubling cotton and other fibrous substances.
1641. John Chilcott Purnelle, Tachbrook-street, Pimlico—Improvements in obtaining and applying motive power.
1643. Louis Christian Koeffler, Rochdale—Improvements in finishing or polishing yarns or threads.
1644. Robert Henry Thompson, Old Charlton—Universal self-acting sawing machine.
1676. John Yuil Borland, Manchester—Improvements in machinery for preparing and spinning fibrous materials
1684. Henry Adams, 3, Leonidas-terrace, New-cross—Revolving ventilator.
1696. Thomas Edward Merritt, Maidstone—Improvements in apparatus for taking photographic pictures in the open air.
1714. Charles Weightman Harrison, Richmond—Improvements in obtaining and applying electric currents, and in the treatment of certain products derived in obtaining the same, part or parts of which improvements is or are applicable to the production of motive power.
1715. Auguste Boissonneau, Paris—Improvements in artificial eyes.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| Date of Registration. | No. in the Register. | Title. | Proprietors' Name. | Address |
|---|---|---|---|---|
| Jan. 19. | 3677 | Shirt Collar | John Edward Smith | 26, Wood-street, Cheapside. |
| ,, 20. | 3678 | Educational Seat and Desk | Richard Webb George | 28, Edward-street, Portman-square |

Journal of the Society of Arts.

*FRIDAY, FEBRUARY* 2, 1855.

## SPECIAL PRIZES.

In addition to the General Premium List, the Council has determined to offer Special Prizes as follows:—

For two pounds of the best and finest FLAX THREAD, spun by machinery, suitable for lace-making. *Twenty-five pounds, or a Gold Medal of the same value.*

Note.—The Committee of the Normal Lace School of Ireland will be requested to report on the Specimens submitted.

For the best Essay on the Means of Preventing the NUISANCE of SMOKE arising from fires and furnaces; treating the subject practically, reviewing the various plans which have been put forth as remedies, with the experience of their success or failure, and the results of their adoption as to expense or economy, in erection and in working. The legislative measures necessary for the prevention of the nuisance, and the causes of the failure of the local acts for its suppression, should also form part of the Essay. *Twenty-five pounds, or a Gold Medal of the same value.*

Note.—The two foregoing prizes of £25 each, have been placed by Benjamin Oliviera, Esq., M.P., at the disposal of the Council for premiums during the year 1855.

For a COMPOSITION for the feeding rollers used in printing paper-hangings by cylinder machinery, similar in consistency and action to those used in letter-press printing, but adapted for working in water-colours. *The Society's Medal and five pounds.*

Note.—This premium has been placed at the disposal of the Council by S. M. Hubert, Esq.

For a "School" MICROSCOPE, to be sold to the public at a price not exceeding 10s. 6d. *The Society's Medal.*

To be a simple microscope, furnished with powers as low as those of a pocket-magnifier, for the purpose of observing flowers, insects, &c., without dissection. The lenses should range from two inches to one-eighth of an inch; the focal adjustment to be by rack-work, extending sufficiently above the stage to allow a thick object to be brought under the lowest power. It should be furnished with plyers, a concave mirror, and an illuminating lens, also a live box, or, instead of it, two or three glass cells of different depths, a few slips of common glass, and a few pieces of thin glass for covers.

Makers are requested to state at what additional price they will undertake to supply a doublet of 1-16th or 1-20th of an inch, applicable to any instrument as above described.

For a Teacher's or Student's MICROSCOPE, to be sold to the public at a price not exceeding £3 3s. *The Society's Medal.*

To be a compound Achromatic Microscope, with two eye-pieces and two object glasses, one magnifying 120 diameters with the lower eye-piece, the other magnifying 25 diameters with the lower eye-piece. It should be furnished with a diaphragm, having various-sized openings, mirror, side illuminator, live box, forceps stage and case.

In the event of the Medal being awarded, the Council is prepared to take 100 of the smaller and 50 of the larger Microscopes, at the trade discount.

The instruments for which the medals shall have been awarded will be retained by the Society as standards, and the successful competitors must enter into a guarantee to supply their Microscopes at the foregoing prices, and of equal quality with those retained, and to change them if not found satisfactory.

The Council, in all cases, expressly reserves the power of withholding the Premium or Medal altogether, should the Essays and articles sent in competition not be considered worthy of reward.

The Essays and articles intended for competition, must be delivered, addressed to the Secretary, at the Society's house, free of expense, on or before the 1st of May, 1855.

By order,
P. LE NEVE FOSTER,
Secretary.

Society's House, Adelphi, London,
31st Jan., 1855.

## EXHIBITION OF INVENTIONS.

The Seventh Annual Exhibition of Inventions is fixed to open to the public on Monday, the 2nd of April next. These Exhibitions of the Society have now for so long formed part of its general action, and are so well known, that it is scarcely necessary to enlarge on the object and advantages of forming the collection. It may, however, be stated, that the importance of exhibitions of this character has long been pointed out, and the experience of the Great Exhibition afforded the unmistakeable testimony of fact in support of the arguments in favour of their utility. The Commissioners of Patents have already done much good by the publication of complete and excellent Indices; and the last volume just issued, giving references showing where all existing information in respect of patented inventions may be readily found, has done much to lighten the

labours of individuals, and cannot fail to assist the progress of Arts, Manufactures, and Commerce. The work of the Patent Office, however, is incomplete, until in connection with it a permanent Museum of Inventions be formed, where all may see what others have done and are doing.

The Society endeavours, in the meantime, to supply this want to some extent. Limited, however, as the Society's Exhibitions necessarily are, being dependent entirely on the voluntary assistance of the inventors themselves, they at least show the practicability of the idea, whilst their utility has been unquestioned. It is hoped that members and others will exert themselves to render the forthcoming Exhibition as complete as possible.

Articles for exhibition, consisting of specimens, models, and drawings of inventions, must be sent in not later than Monday, the 19th March, and applications for space by intending exhibitors should be made to the Secretary as early as possible.

## NINTH ORDINARY MEETING.

WEDNESDAY, JANUARY, 31, 1855.

The Ninth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 31st inst., John Scott Russell, Esq., F.R.S., Vice President, in the chair.

The following Candidates were balloted for and duly elected ordinary members:—

| | |
|---|---|
| Best, Hon. Robert Rainey. | Mein, Robert |
| Cockayne, Octavius. | Sloper, Joseph |
| Day, Thomas. | Thomas, Christopher James. |
| Frith, John Griffith. | White, Edward. |
| Fussell, Rev. James G.C. | Wilcocks, John. |
| Masters, James | |

The Paper read was

## THE CHALK STRATA CONSIDERED AS A SOURCE FOR THE SUPPLY OF WATER TO THE METROPOLIS.

BY SAMUEL COLLETT HOMERSHAM, M. INST. C.E.

The surface of the globe we inhabit is composed of land and water. The whole area of the surface of the globe contains 197 million square miles, of which land occupies 53 million square miles, and the ocean 144 million square miles. The ocean, therefore, occupies nearly three times as much of the surface of the globe as the land.

From this vast surface of salt water there is evaporated fresh or pure water, which rises and mixes with the air in the form of watery vapour. If a high current of such air meets a colder current, the invisible vapour is condensed into fog, which is seen from the earth as cloud, but if the air be blown inland, and especially over uplands and hills, the vapour is condensed into water by the cooling power of the ground, and falls down in the form of rain, hail, or snow.

Rain produced in this manner, after falling upon the land, imparting fertility to the soil, and supplying the wants of animal and vegetable bodies, for the most part either drains from off the ground into ditches, brooks, and rivulets, the waters of which, uniting together (from off large surfaces of country) form rivers, or else the greater portion of the rain goes down through the surface of the ground as fast as it falls, into underlying porous rocks, until it is arrested by impermeable matter, such as a stratum of clay, when it accumulates in the pores or crevices of the rocks, constituting subterranean sheets of water between the planes of stratification. These again accumulate until the pent up water can find a vent, as springs, at a lower level upon the surface of the earth, or can force its way by underground channels to the ocean.

Evaporation from the watery surface of the globe, in this way, is continually affording a supply of rain, and the rain deposited upon the land is constantly replenishing and feeding with water not only the springs, streams, and rivers visible upon the surface of the earth, but also large subterranean sheets of water.

When the ground is impermeable, the rain falling upon the surface in part enters into the composition of animal and vegetable bodies, and in part evaporates from the ground and mingles with the air in the form of vapour, while the remainder, when unobstructed, drains off the higher surfaces into the valleys, until it ultimately reaches a river and flows on to the sea.

In the hilly districts of Derbyshire, Lancashire, Middlesex, and other parts of Great Britain, it is very usual to collect water in large reservoirs, constructed by placing an embankment across a valley of an impermeable geological formation, such as millstone-grit, London clay, &c. These reservoirs are sometimes very capacious, and are used to collect large quantities of water for the use of canals, water-wheels, and for domestic consumption.

The following are examples of such reservoirs used for canals:—

The summit level of the Peak Forest Canal, which is situated near Whaley Bridge, in Derbyshire, is supplied with water by two such reservoirs, one called the Combs reservoir, and the other the Todd's Brook reservoir. The Combs reservoir, constructed in 1800, is capable of holding 54,289,000 cube feet; it is fed with water from floods that drain off a water shed or drainage ground consisting of 2984 statute acres, or about 4⅔ square miles.

The Todd's Brook reservoir is capable of holding 47,412,270 cube feet; it is fed from the flood water draining off a water-shed of 4030 statute acres, or about 6¼ square miles.

The annual depth of rain falling in this locality varies from 33 inches in a dry year to 50 inches in a wet year. In a dry year it is found that the depth of rain flowing off the ground and not consumed by animal or vegetable bodies, or by evaporation, is as much as, or even more than, 24 inches in depth. Of this 24 inches, the greater bulk flows off the ground, after heavy rains, in a very short space of time. Thus, in the dry year of 1844, when only 33 inches in depth of rain fell during the year in the vicinity of the Todd's Brook reservoir, as much as 18 inches in depth of this quantity fell in less than thirty days, and as much as 15 inches in depth of the 24 inches that flowed off the ground, passed off in floods in 35 days; in fact, it is only when heavy floods flow off the drainage ground in larger volumes than the mills situated upon the stream below these reservoirs can use, that any water is impounded, so that these reservoirs depend for their supply of water upon floods, and so regularly do these floods take place, that in no one year since the construction of the Combs reservoir, (now more than fifty years ago) has this reservoir failed to collect very large quantities of water.

In the valley of the river Brent, situated in a north-westerly direction, and about 5½ miles from Cumberland-gate, Hyde-park, is a large reservoir upon the London clay, similar to those before described, for collecting flood-water for the use of the Paddington Canal; and near Elstree, in Hertfordshire, is another reservoir, also situated on the London clay, and used for a similar purpose.

The following is an example of such a reservoir for the supply of mills:—

A few miles to the north of Bolton, in Lancashire, is situated a large reservoir capable of containing 100 million cube feet; it is fed with water from a drainage ground of about 2,000 acres, or a little more than 3 square miles. This reservoir collects and stores the water draining off the ground for the use of millowners situated below the reservoir.

The following is an example of such a reservoir for the supply of a large city :—

The Corporation of Manchester have nearly finished constructing five reservoirs, situated about 12 miles east of Manchester, in the valley of the river Etherow, that will contain, collectively, about 600 million cube feet of water. The top water of these reservoirs added together when full, would cover more than 400 statute acres of land, and they receive the rain water flowing off a watershed of about 18,000 statute acres, or 29 square miles. The Corporation of Manchester have bound themselves to send regularly down the brook-course from the reservoirs fed by this drainage ground about 17 million gallons per day for the use of the mills below, and after delivering this quantity, the Corporation calculate that at least as much more water as that sent down to the mills, will remain to be taken to Manchester for the use of the inhabitants.

These volumes of water are equal to about 31 inches in depth per annum flowing from off the drainage ground, and although the full amount calculated upon may not be realized in a dry year, yet large volumes of water during every year regularly flow off retentive soils in floods, and are collected in reservoirs for various purposes.

Numerous other illustrations might be given, to show that a very large proportion of the rain that falls upon retentive ground, is not consumed in supporting vegetation, or dried up by evaporation, or in feeding streams and rivers in dry weather, but that a large excess flows off the ground, so as to cause floods. These frequently occasion considerable damage.

Most persons will remember reading of, if they have not themselves seen, large quantities of land suddenly inundated with water from the overflowing of a river, or from the rain draining off high land ; these inundations are common from rivers which carry off the rain falling upon retentive soils, such as clays, and from hills composed of mpervious rock.

In the *Times* newspaper of November 16, 1852, a description of several heavy floods will be found in various parts of the country. The following is extracted :—

"Extensive Damage on the Great Western.—During the whole of yesterday morning the traffic on this line was impeded. in consequence of a series of slips having occurred during the night between Paddington and Hanwell station. The early down-train was unable to get further than four miles down the line, when the engine-driver and guard discovered it to be flooded for several miles, in consequence of the water breaking through the sides of the cuttings; and it was further discovered that in about thirty or forty places extensive slips had taken place, principally on the up line. * * * During the whole distance between Hanwell to within four miles of Paddington, the line was under water, in some places more than two feet deep. In many parts the sides of the cuttings were washed completely over the line, and gangs of men, as we passed, were engaged in removing the debris. The train which should have arrived at Paddington by ten o'clock did not reach until half-past one, and the express shortly after. Many thousands of acres on each side of the line were covered with water."

"Egham, Surrey, Nov. 15, 1852.—The Thames here has overflowed its banks to an almost unprecedented extent, laying immense tracks of highly-cultivated land under water. All traffic on it is stopped, the towing-path being no longer discernable. The view from Cooper's-hill, Englefield-green, presents to the eye one vast watery plain, and, though novel, causes regret at the amount of injury done. At the foot is the celebrated Runnymede, a plain of about 160 acres, covered with water to the depth of from three to four feet, having the appearance of a lake, and on which numerous boats may be seen gliding along."

These floods were caused by a large quantity of rain falling in a short space of time. The average depth of rain that falls at Greenwich in a year amounts to about 24 inches. If this proportion of rain fell in equal depth during every day in the year, only 1-15th of an inch would fall on each day. But, as we all know, for many days and even weeks together it frequently happens that not a drop of rain falls, and at another time it rains for many days in succession, during which period the depth of rain that reaches the ground is very inconsiderable. At other times a great depth of rain falls in a very short space of time; thus on the 14th of July, 1853, at Lewisham, Kent, $2\frac{8}{10}$ inches fell in 17 hours; on the 28th of July, 1853, at Greenwich, $1\frac{1}{10}$ inch fell, of which $\frac{1}{4}$ of an inch fell in 20 minutes; on the 20th of August, 1853, $\frac{1}{4}$ of an inch fell in five minutes, and on the 22nd $\frac{72}{100}$ inch fell in ten hours; on the 9th of June, 1852, at Greenwich $1\frac{4}{10}$ inches fell, and on the 10th 1 inch fell, equal to $2\frac{4}{10}$ inches in about 40 hours; on the 25th of July, 1852, at Greenwich 2 inches fell, of which 1 inch fell within 15 minutes, and $\frac{1}{2}$ an inch fell in a quarter of an hour at another time in the day ; on the 15th of August, 1852, at Greenwich $1\frac{1}{10}$ of an inch fell ; on the 4th of October, 1852, at Greenwich 1 inch fell, from nine a.m. to nine p.m.; on the 23rd and 24th of July, 1851, at Lewisham $1\frac{95}{100}$ inch fell ; on the 28th of August, 1851, at Lewisham, $1\frac{1}{2}$ inches fell in the night. These observations are recorded by Mr. Glashier, F.R.S., secretary to the British Meteorological Society, in his Quarterly Reports on the Meteorology of England and Scotland. All these are instances that occurred in a district where such falls are less in amount and less frequent than among uplands and hills.

It is when these large depths of rain fall in so short a space of time, that the banks of rivers are overflowed, and the adjoining low ground is inundated with water, more especially when the soil is in a damp or wet state.

It is floods caused in this way that fill the large reservoirs I have described, for supplying canals, water-wheels, and towns.

Indeed, collecting water in these reservoirs may be compared to the plan of collecting water in a rain-butt for the supply of a household. When rain falls on the roof of a house, butts collect the water, and store it for use in dry weather. To ascertain how much water can be caught from the roof of a house in any one year, it is only necessary to know the area of the roof of the house, and the annual depth of rain falling upon the house, as these two quantities multiplied together would give the amount of water that might be collected, if sufficiently capacious butts or cisterns were provided.

It is on the same principle that the amount of water that can be collected in a reservoir from a large drainage ground is determined. The area of the land in square feet is multiplied by the annual depth of rain that falls in feet, and the result is the number of cubic feet of water that falls on the ground. Of course a portion of the rain that falls on ordinary ground goes to support vegetation, or is taken up by evaporation; the amount of the whole rain-fall thus used is not easily ascertained ; but it varies considerably in different situations and on different soils. In Lancashire and Derbyshire it is found that from retentive land, well covered with grass, as much as two-thirds of the whole depth of the rain falling in a dry year flows off the ground. It is after heavy rains that the great bulk of the water collected in reservoirs flows off the ground. At such times nearly the whole quantity of rain that falls runs off the ground in floods, as I have ascertained by direct experiments on a large scale.

We thus see that a large proportion of the rain falling on a soil resting upon clay, or other impermeable material, flows off the ground in floods as fast as it falls; that another

portion drains through the ground slowly, so as to feed the rivers in dry weather; and that the remainder enters into the composition of animal or vegetable bodies, or is evaporated.

The rain that flows down the river courses in floods, and the water that runs down the rivers in dry weather, may be seen, their course traced by the eye and their quantity measured. When, however, rain falls on a soil resting upon a porous rock, such as chalk, the water that falls upon the ground after heavy rains sinks into the earth, and is not visible to the eye. Nevertheless, by attention, the direction that the rain-water takes, after it disappears from the surface of the ground, and the quantity of water that thus goes down into the earth may be ascertained.

The surface of the ground upon which London, or the district usually termed the metropolis, is built, varies in elevation from the mean level of the sea to about 200 feet above that level.

Geologically speaking, the metropolis is situated upon the London and the plastic clays, and these formations present an exposed area around London of between 2000 and 3000 square miles. At Stanmore, to the north-west of the metropolis, hills of London clay rise as high as 500 feet above Trinity datum, or the mean level of the sea, and at Shooter's-hill, to the south-east, hills of London clay rise to about 400 feet above the sea. These points of the London clay are the highest to the north and to the south of the metropolis.

If in the metropolis we sink a well, or bore down into the earth, the greatest known depth below the level of the sea of the London and the plastic clays combined, is at Pimlico, where they are found to extend 280 feet below this datum; the least depth is at Deptford and New Cross, where they are not more than 40 feet below the same datum. At other parts of the metropolis the depth of the clays below Trinity datum varies between these two extremes.

At Hampstead, the London clay, which is there capped with gravel, rises to an elevation of 440 feet above Trinity datum, and the London and plastic clays go down 158 feet below this datum, so that the London and the plastic clays at Hampstead have a total thickness of 600 feet.

Immediately below the London and plastic clay formations we come to the chalk. Beneath these formations, the chalk extends in every direction, and beyond them rises to the surface of the land at the distance of about 16 miles in a north westerly direction from London-bridge, and about 9 miles in a southerly direction.

The exposed chalk to the north and north-west of London is 16 miles in breadth, and rises in hills known as the Chiltern-ridge, the tops of which vary in level from 400 to 900 feet above the sea.

The exposed chalk to the south of London, is from 6 to 7 miles in breadth, and rises in hills known as the North Downs, the tops of which vary from 600 to 800 feet in elevation. The total area of country in the south-eastern portion of England, in connection with these hills, where the chalk rises to the surface, covered for the most part with only a porous soil, amounts to 5,000 square miles, and the total area of chalk in connection with these hills, that is covered with the London and the plastic clay, and the crag formations, amounts to 6,000 square miles. This area is bounded on the east by the German Ocean, and on the south by the English Channel.

London is usually, though I think not accurately, described as situated in the centre of a chalk basin. Taken, indeed, north and south, the chalk does lie in the form of a basin. Beneath London, the lowest part of the surface is 280 feet below the level of the sea. From this depth, the chalk rises towards the north till it attains an elevation of from 400 to 900 feet, and towards the south to an elevation of from 600 to 800 feet; but taken east and west, the chalk rises to the west to an elevation of 1000 feet, and to the east forms the bed of the river Thames and the sea. To the north-west-by-west of London, the river Thames breaks through the chalk hills, entering this formation at an elevation of about 140 feet above the sea, and then taking a circuitous route flows on through London and joins the sea in an easterly direction; so that, if there be a basin, it is a basin with a gap on its north-west-by-west side, and altogether wanting on its eastern side.

The Thames for about thirty miles from where it enters the chalk, flows towards London on this formation; it then passes on for about 40 miles over the London and the plastic clays, flowing through London on these formations; but, again, from below Woolwich flows on the chalk till it reaches the sea.

London is, therefore, surrounded by chalk hills on the north, on the south, and on the west, and is bounded by the German Ocean on the east.

A glance at the geological map on the wall, or the model on the table, will show more clearly the physical conformation and the geological position of the country surrounding the metropolis. For our present purpose we must bear in mind that the metropolis is built on the London and the plastic clay formations, that these formations rest upon the chalk, the chalk again resting upon the lower green sand and gault, which is a stiff, blue clay, impermeable to water.

The London clay formation will need little description; it is a blue clay, very apt to run when wet; at places it is capped with gravel.

The plastic clay, which is next above the chalk, is composed of sand of various colours, pebbly gravel, and bluish clay; the exposed area of the plastic clay is small compared with the London clay, and for our present purpose these two formations may be considered as one.

The chalk formation is usually divided by geologists into three divisions; the 1st or uppermost division being the soft white chalk with flints; the 2nd division being the hard white chalk without flints; and the 3rd or lowermost division being the chalk marl.

The united thickness of these divisions of the chalk is from 600 to 1,000 feet. The chalk is a stratified formation, the planes of stratification being generally well marked, although at places they are somewhat obscure. The planes of stratification in the upper chalk, however, may generally be determined by the alternating layers of flints, which run in the same direction as those planes, and which are usually from two to four feet distant from each other, and from three to six inches in thickness.

The planes of stratification in the chalk are usually parallel, and vary in the distance apart, from a few inches to a few feet. Where a large extent of chalk is exposed, as in the cliffs by the sea side near Ramsgate and other places, the strata may be seen, as well as numerous fissures or joints usually at right angles to the planes of stratification; some fissures, however, are at right angles to the horizon, others diagonal. These fissures, crossing in various directions, divide the entire mass into irregular portions.

The upper green-sand, which lies immediately below the chalk and next above the gault, varies from 30 to 100 feet in thickness, while the gault, or blue marl, varies from 10 to 150 feet in thickness.

The gault extends, with few known exceptions, in every direction beneath the chalk, and dips conformably with it from the country north to the south of London, and from the country south to the north of London. The elevation of the surface of the gault to the north-west of London, where the Thames crosses this formation, is 150 feet; proceeding northward, near Aylesbury, it is 270 feet; near Dunstable, 250 feet; and near Biggleswade, 140 feet, all above the mean level of the sea. To the south of London the elevation of the gault exposed at the surface of the country varies in elevation from about 150 to 250 feet above the same datum.

Chalk is a marine formation, not crystalline; it is composed almost wholly of pure carbonate of lime. Dr. Mantell says that "a microscopical analysis shows it to be a mere aggregation of shells and corals, so minute that

upwards of a million are contained in a cubic inch of chalk; the amorphous particles appear to be the detritus of similar structures. These organisms, for the most part, are calcareous shields and chambered shells of the animalcules, termed foraminifera, which swarm in inconceivable numbers in our present seas, and are daily and hourly contributing to the amount of sediment now forming in the bed of the ocean."

In landscape the chalk formation, when it is close or very near to the surface of the country, is remarkable for its smooth and undulating outline, forming large basins, and rising into high hills and downs, which are, for the most part, free from trees or hedgerows. No drains or water-courses are required or used to carry off the heaviest falls of rain. On the sides of the steepest hills the rain is absorbed as fast as it falls, and in this respect the chalk formation altogether differs from, and forms a remarkable contrast to, that portion of the country composed of London clay. Very large areas of hills absorb the rain as fast as it falls, so thoroughly that no stream, river, or surface spring is visible any where upon them.

On the Chiltern ridge, which is the name given to the chalk-hills to the north of London,—there is an entire district of more than 200 square miles of country without a stream, river, or surface-spring to be seen anywhere upon it, nor, without sinking a well to a considerable depth, sometimes as much as 260 feet, can water be procured.

Wherever chalk forms the surface of the country, streams and rivers are very scarce compared with almost any other geological formation, as will be seen from a reference to the following table, which gives the area in square miles of the different geological formations in the south-eastern portion of England, the length of river courses in miles upon each separate formation, and the length of stream or river course per square mile :—

| Geological Formation. | Area.* | Absolute Length of Streams and River Courses. | Comparative Length of Streams and River Courses, per Square Mile |
|---|---|---|---|
| | Sq. Miles. | Miles. | Yards. |
| Crag . . . . . . . . . | 2056 | 1996 | 1709 |
| Bagshot Sand . . . . . | 168 | 165 | 1729 |
| London and Plastic Clay . | 4071 | 4741 | 2057 |
| Chalk & Upper Green-Sand | 5353 | 2391 | 782 |
| Wealden Clay . . . . | 763 | 905 | 2087 |
| Hastings Sand. . . . . | 577 | 700 | 2135 |

Thus it is seen that there are only 782 yards of river course, per square mile, upon the chalk formation, while there are 2,057 yards of river course per square mile upon the London clay, or nearly three times as much, besides which there are great lengths of ditches and drains upon the clay formation, altogether absent upon the chalk.

Not only are the river courses much less in length upon the chalk formation, but they are also much smaller in size.

I have here drawings, made to the same scale, of nine pairs of bridges crossing rivers and streams.

One bridge, of each set of drawings, crosses or spans a river course, where the country draining into the river above the bridge has chalk at or near the surface; the other bridge of each set crosses a river that has, as nearly as could be found, the same area or number of square miles draining into the river above the bridge where the country is composed of clay.

The first example commences with a bridge having 11½ square miles of drainage, and the ninth, or last example, having 100 square miles of drainage, the other examples having intermediate quantities of drainage ground.

* The superficial contents, &c., are taken from the Ordnance Map of 1 inch to the mile, and are exclusive of the Isle of Wight and a circle round London of 7¼ miles diameter.

An examination of the drawings, or of the following table, shows (see Table, page 172) that the water-way for a bridge per square mile of chalk drainage is only from one-fifth to one-tenth the relative area or size of the water-way of a bridge with a clay drainage. Besides, in every case it was clearly ascertained that the water-ways for the clay drainage-grounds had been frequently choked with water after heavy rains, while the water-ways for the chalk drainage were always more than ample in size. Before a flood of any magnitude can occur in a chalk country there must be first a soaking rain, immediately followed by a hard frost; then a heavy fall of snow, and all this succeeded by a sudden thaw, acting on the snow. Such a concurrence of circumstances has happened, but it is of rare occurrence.

Here, then, we have ample and positive proof that the rain, falling on a chalk country, does not flow off the land in floods, as it does from a clay country.

Again, as to evaporation, the surface of the ground does not lose so much of the rain that falls in a chalk country as in a clay country. After the heaviest rain, the surface in a chalk country is dried in a few hours by the descent of the rain into the ground, away from the influence of the sun and wind; while in a clay country, the ground after rain is wet at the surface for many days in succession. Accordingly it is matter of notoriety, that the air in a chalk country is drier than in a clay country. Of the rain falling on chalk, then, much less is lost by evaporation.

Notwithstanding that the heavy rains never run off the surface of a chalk country to anything like the extent they do in a clay country, yet the yield of a stream fed from the drainage of any extensive area of chalk country is never larger in volume in dry seasons than the yield of a stream fed from a similar area of clay country, so that there is no compensation from a larger yield in dry weather.

On clay it is found, as before stated, that nearly two-thirds of the water that drains off the ground, runs off after heavy rains in floods, and that large reservoirs are frequently constructed to impound such floods and to store them for use in dry weather.

On the chalk formation such reservoirs are never constructed, for the very good reason that there are no floods to impound. The chalk itself constitutes a natural reservoir.

In illustrating this peculiarity of the chalk formation, when it is near the surface of the ground, the description, before given, is a general one. When speaking of 5000 square miles of country, or 3,200,000 acres of land, it must be understood that there are places where the chalk is covered with gravel; other places where the chalk is covered with sand; other places where the chalk is covered with clay, more or less thick; and almost everywhere the chalk is covered with soil of a greater or less thickness, besides vegetation at least for a great part of the year. In many parts of Hertfordshire, especially to the north of London, and in other places, extensive tracts of clay lie upon the chalk; rain, however, falling on these patches of clay, is now usually drained into the chalk by means of wells sunk through the clay and continued for a short distance into the chalk. These wells are then filled up with flints and stones and the surface drains of all land lying above the wells are carried into the wells. The drainage water, upon reaching the chalk, soaks away as fast as it touches it. These wells are usually termed dumb wells, and of late years have been so extensively made use of, that the amount of water running down the rivers on the chalk formation, has been considerably lessened, and the supply of water to the mass of the chalk increased.

As a whole, however, the chalk formation may be said to absorb almost all the rain that falls upon its surface, giving out again but little to support vegetation, as is made manifest by the scanty herbage on chalk downs.

TABLE shewing the area of the water-way of nine pairs of bridges. One bridge of each pair has a drainage-ground of the chalk formation, and the other, as nearly as could be found, a similar area of drainage-ground of the London-clay formation.

| SITUATION OF BRIDGES. | Area of Water Shed or Drainage Ground. | Geological Formation. | Area of Waterway | OBSERVATIONS. |
|---|---|---|---|---|
| | Sq. Miles. | | Square Ft. | |
| Mountneysing, Essex, River Roding ............... | 11½ | London clay. | 191 | Often filled with flood water. |
| Kimpton Hoo Park, Herts, River Mimram ... | 12¾ | Chalk. | 19 | Never full of water. |
| Chipping Ongar, Essex, River Roding............ | 21 | London clay. | 279 | Often filled with flood water. |
| Welwyn, Herts, River Mimram ................. | 23¼ | Chalk. | 26½ | Never full of water. |
| Colney Street, Herts, River Colne ............... | 39¼ | London clay } 28½<br>Chalk } 10¾ | 267½ | Often filled with flood water. |
| St. Alban's, Herts, River Ver........................ | 38 | Chalk. | 48½ | Never two-thirds filled with water. |
| Near Margaretting, Essex, River Chelmer ...... | 42½ | London clay. | 350 | Bed of river and piers show signs of heavy floods. |
| Park Street, Herts, River Ver .................... | 43 | Chalk. | 65 | Rarely half-filled with water, even after heavy falls of snow. |
| Writtle, Essex, River Chelmer ................ ..... | 49 | London clay. | 358 | Frequently filled with water after floods. |
| Chalfont, St. Peter's, Bucks, River Misbourne. | 49½ | Chalk. | 40 | Never half-filled with water. |
| Coggleshall, Essex, River Blackwater ........... | 58 | London clay } 48<br>Chalk } 10 | 179½ | Often filled with flood water. |
| Denham, Bucks, River Misbourne ............... | 56 | Chalk. | 19 | Never filled. |
| Kelvedon, Essex, River Blackwater ............... | 62 | London clay } 52<br>Chalk } 10 | 390 | Often filled with flood water. |
| Stanborough, Herts, River Lea ..................... | 61 | Chalk. | 50 | Never three-fourths filled with water. |
| Stappleford Abbots, Essex, River Roding ...... | 79½ | London clay } 73½<br>Chalk } 6 | 495 | The water-way not sufficiently large to carry off ordinary floods. The country above is often flooded for miles. |
| Hertford, Herts, River Bean ............ .......... | 72 | Chalk partially covered with impermeable drift. | 173 | Rarely half-filled with water. |
| Loughton, Essex, River Roding ..................... | 99¼ | London clay. | 693 | Often filled with flood water. |
| Winchester, Hants, River Itchen .................. | 102 | Chalk. | 187 | Never two-thirds filled with water. |

A portion, however, of the rain absorbed re-appears at the bottoms or the sides of some valleys as springs, which, together with a portion of the rain-fall drains off the soil lying on the surface of the chalk, and forms rivers, which are generally insignificant compared with the extent or area of country drained by them.

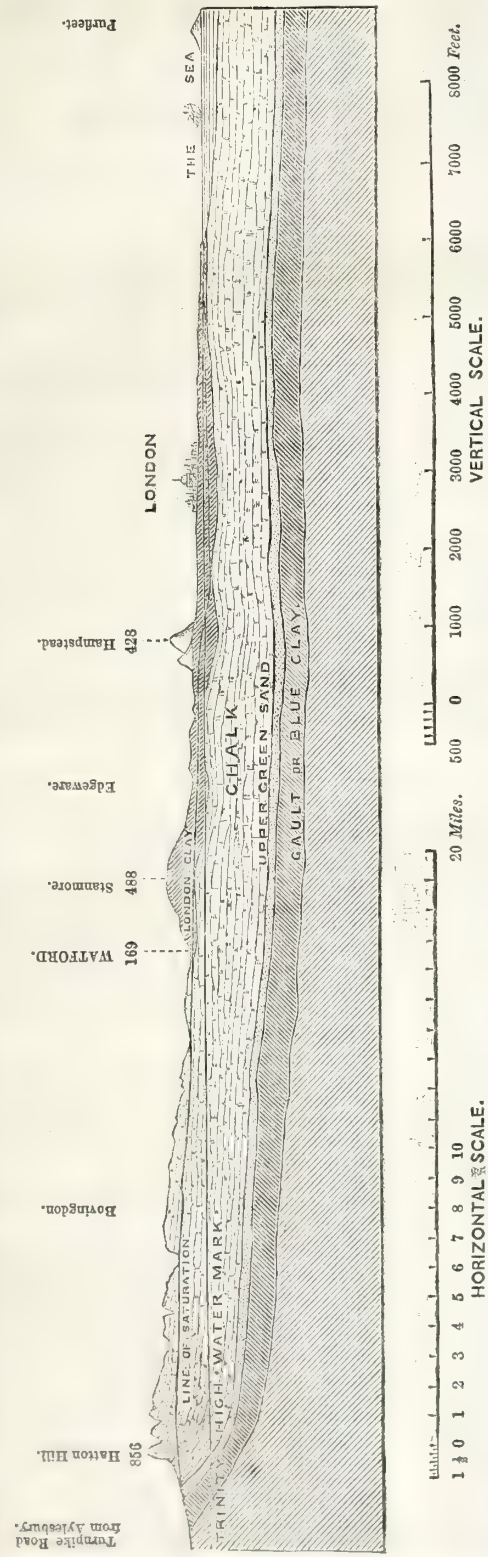
Experiments on a large scale have been made of the quantity of water yielded by the river Lee at Field's Weir, the junction of the river Stort. The area of country draining to this point amounts to 444 square miles, and includes the Lee proper and the Mimram, the Beane, the Rib, the Ash, the Stort, and the surface springs between Ware and Field's Weir; although out of the 444 square miles of drainage ground 50 square miles are covered with the London and the plastic clays; and though the drainage ground of the most easterly streams is covered with extensive patches of clay not yet fully drained into the chalk, it was found that in 1851, out of a rain-fall of 23 inches in depth, only six inches, including the produce of the floods from the clay land, together with the springs, flowed off the ground.

There can be no doubt that even in that year, which was comparatively a dry year, at least ten inches in depth of the rain went down through the surface into the body of the chalk, for, allowing one inch of the six inches that was measured to be the produce of the floods from the clay land, five inches in depth only would flow off the chalk drainage ground; therefore, assuming as much as eight inches in depth of the rain-fall to be taken up by the vegetation and by evaporation, which is a liberal allowance, only 13 inches in depth of the rain-fall would be accounted for in this locality, the rest of the 23 inches, that is, 10 inches, having sunk in the ground. Now it must be remembered that there are very large areas of chalk country of a basin-like form where not a drop of water runs off the surface, either in rivers or springs, so that over the entire chalk area, there can be no doubt, that a larger average quantity than a depth of 10 inches was absorbed even in the year 1851.

The rain-fall, however, over the whole of the chalk formation, and especially about the North Downs to the south of London, and the Chiltern ridge to the north of London, will on an average of years be more than 23 inches. The mean rain-fall at Greenwich is as much as 24 inches in depth per annum, but from the greater elevation of the chalk hills, at least 26 inches in depth must fall, on an average of years, upon the chalk formation.

After making a liberal deduction from the rain-fall for the water carried off from the chalk by the rivers and by the surface springs, and for the amount that enters into the composition of animal and vegetable bodies, and that which is taken up by evaporation, it is certain that on an average of years, at least a foot in depth of the rain that falls per year, sinks through the surface of the land into the great body of the chalk, and remains there till it finds an outlet.

The woodcut, page 173, shows the section of the country from near Aylesbury, 36 miles north-west of London, through the Chiltern-ridge, Watford, Stanmore, London, and the river Thames, to the sea. The form of the surface of the country from London along the line of section is accurately shown, and the thickness of the London clay between the surface of the land and the chalk, has been ascertained from wells sunk along or near the line of section. You will notice that from the Chiltern-ridge to Watford, the chalk itself appears near the surface, and that from Watford through London to below Woolwich, the chalk is covered by the London and the plastic clays, while from below Woolwich, the river Thames runs to the sea upon the chalk. Immediately below the chalk is an impermeable stratum of gault, that is, blue clay. This




SECTION THROUGH THE CHILTERN RIDGE, WATFORD, STANMORE, LONDON, AND THE RIVER THAMES TO THE SEA.

impermeable stratum rises to the north so high, as almost entirely to prevent any water flowing northwards.

The highest portion of the Chiltern-ridge shown on the section is 886 feet above the level of the sea, and the level of the surface of the chalk at Watford is 169 feet above the same datum, as shown by the figures on the section. From Watford the surface of the chalk undulates, and gets lower as it approaches London, till it is at places 276 feet below the sea, when it rises again towards Woolwich, forming the bed of the Thames and of the sea, rising up in hills to the north of the Thames at Gray's Thurrock, and to the south of the Thames at Gravesend. The undulations of the upper surface of the chalk from Watford under London to Woolwich, are filled up with London clay, which at many places, as at Stanmore and at Hampstead, is of considerable thickness.

How the water flows through the chalk formation can be easily explained by the section. The rain falling upon the pervious soil that overlies the almost bare chalk from Watford to the Chiltern-ridge, immediately sinks into the chalk, which near the surface is knobly or broken in small pieces for some feet in depth before the stratified chalk is reached. The heaviest rain is absorbed as fast as it falls, the pores of the chalk acting in the same way as the reservoirs that are used in Derbyshire, Lancashire, and Middlesex, to store flood-water. Chalk is extremely porous, one-third of the bulk of the upper chalk consisting of pores; thus every yard of three feet in depth of the upper chalk, when dry, can receive into its pores a rain-fall of one foot in depth before it is saturated; that is to say, a piece of dry chalk a yard square and a yard thick would absorb, or take into its pores, a yard square of water by $\frac{1}{3}$ of a yard or a foot thick. As the heaviest falls of rain upon the chalk rarely exceed a quarter of a foot in depth over the surface in 12 hours, the facility with which chalk will imbibe the rain as it falls will be easily understood.

If upon the top of an upright pillar of dry chalk, a yard square and 30 yards high, were poured a quantity of water, the water would be gradually disseminated throughout the whole mass of the chalk; but the utmost quantity of water this mass of chalk could take into its pores, would be a quantity equal to one yard square and 30 feet deep, as this amount of water would fill all the pores in the chalk. If, however, the water was continued to be poured upon the top of the chalk, then the water as it descended through the upper portion of the chalk would, by its gravity, in time, fill the pores of the lower part of the chalk, while yet the upper portion would remain comparatively dry; and, as the water slowly percolated through from above, the lower mass of chalk would, when saturated, allow the water to drain hrough, and flow away from it altogether. The percolaion of the water through the mass of the chalk hills takes place in a similar manner.

In those hills, however, the percolation is facilitated by the varying pressure of the atmosphere. When the barometer is low, the air in the chalk, being expanded, is given out of its fissures and pores, and when the barometer rises, the air, being condensed, enters its pores and carries with it any water that may lie between the fissures of the planes of stratification in the chalk. Thus every change of the barometer puts in motion the water in the pores of the chalk, and slowly but surely assists the rain from above in reaching the lowermost beds of chalk, at the same time that it oxidises any organic matter that was taken up by the rain in percolating through the soil at the surface, as will be more particularly alluded to hereafter.

The capillary attraction due to the small pores of the chalk would keep some water disseminated through the whole body of it, but mere capillary attraction would leave some spaces unoccupied with water. If a quantity of water were continued to be poured on the top of the supposed pillar of chalk, it would gradually descend through the upper portion, and in its descent force out

from the lower mass of the chalk some of the water before contained in its pores. Thus the water that would run out at the bottom of the chalk, would not be the identical water immediately before poured upon the top of the chalk; just as would happen if a tube or pipe, one mile long, were laid horizontally, with its two ends turned up, one a little higher than the other; if the whole pipe were filled with water, and a gallon of water were poured in at the higher end, although a gallon would run out of the other end, yet it would not be the same water.

In the same manner the rain that falls and percolates through the surface or top stratum of the chalk hills takes many years to reach the lowermost stratum. Taking the chalk formation to be from 200 to 300 yards thick, and the annual depth of rain percolating through its surface at one foot in depth, it is pretty certain that generation after generation will pass away before the rain that fell during the last year and went down into the chalk, will reach the lowermost stratum.

Turning to the section, page 175, you will notice that the surface of the chalk from the Chiltern ridge slopes towards London and the sea, and that the bed of gault, or blue clay, below the chalk, inclines in the same direction. This bed of gault, and the impervious beds of the lowest chalk, prevent the water from escaping below, so that the whole mass of the lower portion of the chalk becomes saturated. You may observe that the great bulk of the chalk lies below the level of the sea, and even extends far under the sea. There can be no doubt that when the chalk-hills were thrown up to their present elevation, the pores of the whole mass of the chalk were filled with sea-water. The incessant rains of countless years having, however, descended through the chalk, the sea-water has been displaced by the rain-water, the salts originally contained in the chalk have been washed out of it, and the chalk has become saturated with fresh water, not only up to the level of the sea, but as high above the sea as is shown by the line of saturation upon the section. This line shows the height from above the gault that the chalk is saturated with water, as ascertained in May, 1852, from wells that are situated along or near to the line of section. When a well is sunk into the chalk, for some distance from the surface, the chalk is usually found comparatively dry, but upon sinking deep enough, the chalk is at last found saturated with water, which flows out of the chalk so easily, that the bottom of the well is soon filled with water and the workmen are unable to proceed with sinking the well any deeper. For ordinary purposes, a well sunk as deep as the well-sinkers can work in, suffices to yield water for the supply of a large household. When a larger quantity of water is wanted, either a bore hole is sunk through the chalk by means of rods, or else pumps are used to pump water out of the well, to enable the workmen to go deeper into the chalk, or to make small tunnels below the line of saturation. Near the Chiltern ridge some wells are sunk through the chalk from 220 to 250 feet from the surface before the line of saturation is arrived at.

In a straight line 15½ miles north-west of Watford, the chalk is saturated with water to a height of 470 feet above the sea; at Watford the height is only 169 feet, and towards the sea coast it is about the level of high-water, and even varies with the height of the tide; so from the Chiltern ridge through the chalk towards the coast there exists a considerable subterranean sea of water, not level at the surface, like a lake, but declining gradually, being abrupt only where diverted by faults or cavities.

In a straight line about 16 miles south of London-bridge, the line of saturation in the chalk in the North Downs, is also several hundred feet above the level of the sea, and the line of saturation gradually lowers, but in a southerly or south-easterly direction, towards the Thames and the sea coast.

When the surface of the chalk is at a lower level than the sea, and covered, as below London, with impermeable clay, then the surface of the sheet of water is kept down, as it cannot rise through solid clay, but if the chalk have a porous covering, such as gravel or sand, the water will rise so as to maintain the inclination of the surface of the water unbroken, and if a hole be sunk through the clay to the chalk, water will rise from the chalk into the hole, to the same level as it would have stood in the chalk.

This is the condition of the chalk strata at and around London, as determined from careful surveys and levels, and you will now at once perceive how the rain falling on the hills to the north and south of London disappears and is not seen, as it is on clays and clays capped with gravel, in the form of rivers and surface-springs. The rain sinks into the porous chalk at the surface of the ground as fast as it falls; and descending by its gravity, displaces the water in the stratum of chalk immediately below it; this yields the water it before contained to the next descending stratum. Each descending stratum in succession, thus receiving water on its upper surface, and giving water out at its lower surface, until the line of saturation in the chalk is reached.

The rain thus maintains the line of saturation in the chalk hills to such a height or inclination as will suffice to carry the water away through the chalk to the lowest point where it can find a vent and can escape. This is the level of the water in the sea, the sea being in immediate connection with the chalk itself, as at Wells, Erith, Northfleet, Deal, St. Margarets, Dover, Brighton, Weymouth, and other parts along the coast, where the issue of large bodies of fresh water from the chalk direct into the sea can be distinctly traced.

As it frequently happens that a great deal of rain falls in one part of the year, and very little at another, and also that a much larger quantity of rain falls in one year than in another year, so does the line of saturation rise or fall in the chalk hills furthest from the sea. At one season of the year this level is frequently from thirty to forty feet higher than at another, and in one year there is also a different level to another year, at one place different to another place. High up at Dunstable the variation of the level of the water in the wells is about thirty feet annually, the water constantly rising during one portion of the year and falling during another; while lower down, at Watford, the variation is very little in the shallow wells, and is not perceptible in deep borings. At Uxbridge many borings sunk into the chalk constantly overflow above the surface of the ground, and have done so for a great many years past without any variation or diminution in the quantity yielded.

The direction in which the subterranean currents of water most freely flow to the ocean, of course, depends upon the inclination of the planes of stratification, the size of the interstices between them, and the positions in which the more fractured or more permeable chalk may happen to lie. The subterranean water will take the course that offers the least obstruction to its flow, and local investigations are required to ascertain the direction of the greatest flow in any particular place.

The capacity of chalk for holding water varies considerably. Thus a cubic foot of chalk at Boxmoor, weighing, when dry, 82½ lbs., will contain, when saturated, 26¼ lbs. of water, or more than $2\frac{6}{10}$ths of a gallon; while a cubic foot of chalk, when dry, procured at Kentish-town, from below 370 feet of London clay, weighing when dry 106lbs., will contain, when saturated with water, only 19½ lbs., or $1\frac{9}{10}$ of a gallon. And a cubic foot of chalk-rock, frequently encountered in sinking wells and borings in the chalk, which, when dry, weighs 137 lbs. 5¾ ozs., contains, when saturated with water, only 9 lbs. 10½ozs. of water, or little less than a gallon. This is more fully shewn in the table, page 175:—

It is this difference in the capacity and permeability of different strata of chalk, combined with the varying inclination of the strata and the intervention of faults, that produces surface-springs in some

## TABLE SHEWING THE CAPACITY OF DIFFERENT SPECIMENS OF CHALK FOR HOLDING WATER.

| LOCALITY AND DEPTH FROM THE SURFACE OF THE GROUND AT WHICH THE SPECIMENS OF CHALK WERE OBTAINED. | Weight of the chalk per cube foot when thoroughly dry. | | Weight of the chalk per cube foot when saturated with water. | | Weight of water in a cube foot of saturated chalk. | | Measure of water in a cube foot of saturated chalk. | Specific gravity of the chalk irrespective of its porosity; *i.e.* supposing the chalk to be so compressed as to obliterate its pores or cavities. |
|---|---|---|---|---|---|---|---|---|
| | lbs. | oz. | lbs. | oz. | lbs. | oz. | Gallons. | |
| Boxmoor, Herts, 5 feet deep from a cutting | 88 | 9 | 114 | 13¾ | 26 | 4¾ | 2· 63 | 2·460 |
| Boxmoor, Herts, 12 feet deep from a cutting | 85 | 6 | 111 | 13¾ | 26 | 8 | 2·649 | 2·383 |
| Boxmoor, Herts, 30 feet deep from a cutting | 90 | 5 | 116 | 13½ | 26 | 8½ | 2·655 | 2·524 |
| Abbot's Langley, Herts, 5 feet deep from a cutting | 110 | 8 | 130 | 6 | 19 | 14 | 1·988 | 2·601 |
| Abbot's Langley, Herts, 40 feet deep from a cutting | 105 | 11 | 127 | 6 | 21 | 11 | 2·169 | 2·601 |
| St. Alban's, Herts, 29 feet deep, well that supplies the town | 89 | 7 | 117 | 10 | 28 | 3 | 2·823 | 2·620 |
| St. Alban's, Herts, 146 feet deep, well that supplies the town | 94 | 1¾ | 120 | 9½ | 26 | 8 | 2·649 | 2·629 |
| Bushey, Herts, 4 feet deep, from lime kilns | 106 | 15 | 128 | 2 | 21 | 3 | 2·119 | 2·600 |
| Bushey, Herts, 51 feet deep, from lime kilns | 104 | 6 | 126 | 13 | 22 | 6½ | 2·244 | 2·618 |
| Bushey, Herts, 35 feet deep, well near lime kiln | 118 | 13½ | 135 | 12¾ | 16 | 15¼ | 1·695 | 2·621 |
| Loudwater Mill, Herts, chalk rock, frequently met with in boring | 137 | 5¾ | 147 | 0¼ | 9 | 10½ | 0·966 | 2·609 |
| Gravesend, Kent, 3 feet deep, well | 88 | 1 | 116 | 1¾ | 28 | 0¾ | 2·804 | 2·568 |
| Gravesend, Kent, 60 feet deep, well | 93 | 10¾ | 119 | 1½ | 25 | 7¾ | 2·542 | 2·539 |
| SPECIMENS OF CHALK PROCURED FROM BELOW LONDON CLAY— | | | | | | | | |
| Hartsbourne, Bushey Heath, Middlesex, 400 feet deep, well, clay 230 feet deep above the chalk | 142 | 14½ | 151 | 14 | 9 | 0 | 0·897 | 2·679 |
| Kentish Town, Middlesex, 500 feet deep, clay, gravel, and sand, 270 feet deep above the chalk | 106 | 2 | 125 | 10¾ | 19 | 8½ | 1·951 | 2·480 |
| Kentish Town, Middlesex, 538 feet deep, Do. Do. | 111 | 6 | 129 | 10 | 18 | 4 | 1·826 | 2·529 |
| Kentish Town, Middlesex, 500 feet deep, Do. Do. | 111 | 5 | 127 | 4 | 15 | 15 | 1·595 | 2·398 |

The experiments upon the different specimens of Chalk were made in 1851, by John Smith, M.D., then Assistant in the Chemical Laboratory and Fordyce Lecturer in Marischal College, Aberdeen, and now Professor of Chemistry and Experimental Physics in University College, Sydney.

places, and causes in others considerable currents of subterranean water in particular directions. The great weight of the London clay overlying the chalk situated below the metropolis appears to have condensed the chalk; at least it is very much less permeable to water than where the chalk is not so thickly covered with clay. This explains the notorious difficulty of procuring large volumes of water from the chalk under London, after sinking through the London clay, and makes more intelligible the fact, that the water procured from the chalk under many parts of the metropolis is quite different in quality from the water procured from the chalk where it is not covered by London clay; for instance, water from the well that supplies the fountains at Trafalgar-square, contains 70 grains of mineral or saline matter per gallon, 60 grains of which are common salt, potash, and soda; the water from the chalk at Watford contains only 23 grains of mineral matter per gallon, of which there is altogether less than two grains of salt, potash, and soda. It thus appears certain that the compactness of the chalk under London has always prevented sufficient water from the uplands passing through to wash out the salts originally contained in it. It has been said that the lowering of the levels of the water in some of the wells under London is caused from want of water in the great mass of the chalk hills beyond Watford, but as the present level of the water beneath London is artificially lowered by pumping in some wells to 60 or 70 feet below Trinity high-water mark, it would be as reasonable to say that the difficulty of brewers and others in procuring large quantities of water from deep wells sunk into the chalk under London, arises from their having already exhausted the sea, which is quite as near, and not less copious.

Many exaggerated statements have been made relating to the water of the wells sunk under the metropolis into the chalk. Most persons will have heard it stated in general terms that the level of the water in the wells beneath London has been steadily lowering for years past, and, no doubt, certain wells have lowered since they were first sunk, but upon investigation it will be found that the water in many wells—that at Orange-street, to supply the Trafalgar-square fountains, for instance—has never lowered at all *since the well was first sunk*, although larger and larger quantities of water have been pumped from it for the last 10 years.

At places extensive faults (or breaches) are found in the chalk, as, for instance, at Hemel Hempstead, to the north of London. These faults allow the water draining from the chalk hills to get direct down into the lower portions of the strata, and this water, so conducted, meeting with the readiest course through the interstices between the planes of stratification in the lower chalk, takes that course to the sea. The water-level in the chalk at these faults is frequently 250 to 260 feet above the sea, and when holes at a considerable distance towards the sea are bored down through the chalk so as to intercept the planes of stratification leading from these faults, large volumes of water may be intercepted on their passage to the sea, without the possibility of interfering with surface springs or streams. Indeed, if the level of the surface of the ground where a boring is made is low enough, and large fissures be met with in the chalk, overflowing springs may be and frequently are, thus produced. This may be seen exemplified close to Redbourne, in Hertfordshire, where five borings, only 12 inches diameter, sunk through the chalk for 270 feet in depth, overflow, and thus supply the head of the river Ver with 750,000 gallons per day, although the top of the bore hole where the water overflows is 281 feet above the level of the sea at high-water.

Within convenient reach of the metropolis northwards there are at least 1,200 square miles, and southward at least 200 square miles, of chalk hills, the greater portion of the water percolating through which could be easily collected for the supply of the metropolis.

Taking only a foot in depth per annum as the amount of water sinking into 1,400 square miles of chalk, this

would produce more than 660 million gallons per day for the supply of the metropolis.

Almost the whole of this vast amount of water now finds its way underground, silently and unseen, to the sea, without being of any service to man or beast, in town or country.

The judicious interception of the small fraction of this water that would be required for the supply of the metropolis, could no more injure or interfere with the existing wells, or the surface springs, streams, and rivers in the chalk districts, than the raising of a portion of the Thames at Teddington, could dry up the streams in the districts that feed this river.

A heavy shower of rain over the before-mentioned 1400 square miles of chalk country, such as brought down one inch in depth, which often falls in a few hours several times in a year, would produce 54 million gallons per day for every day in the year; this is more than the supply furnished to the metropolis by all the companies put together.

At the present time, the towns of Brighton, Gravesend, Ramsgate, Margate, Dover, Winchester, St. Albans, Woolwich, &c., are supplied with water derived from the chalk. The water is abundantly procured by sinking wells or making borings into the chalk.

Let us now examine the quality of the water.

The rain, when it falls upon the surface of the soil overlying the chalk, carries with it a portion of the manure put upon the land, the decaying plants, leaves, or other organic matter with which it comes in contact. A great part of the water, before reaching the line of saturation in the chalk, is held for a long time in the pores of the chalk by capillary attraction. Now, porous bodies, such as chalk or charcoal, have the remarkable property of absorbing oxygen in their pores, and the oxygen in this state, enters into combination with other bodies with great readiness and force. A remarkable example of this power of porous bodies was first given in this place by Dr. Stenhouse, who found that a dead cat, by being covered with only three inches of charcoal, could be kept in a sitting-room without giving off any sensible offensive smell. The odours resulting from putrefaction were thoroughly oxydized. Porous chalk has a like property; and the natural power of gases to diffuse is aided by the variations in the density of the air, which expands when the barometer falls, and is condensed when the barometer rises.

In this manner the water slowly loses all the organic matter contained in it, it becomes perfectly pellucid or clear, and at the same time unites, or takes in solution, a large proportion of atmospheric air, but absorbing a larger quantity of oxygen from the air than of nitrogen, as is the property of all pure water; so that the water in the lower stratum of the chalk is not only freed from putrescent organic matter, and becomes perfectly bright and clear, but is well aërated and oxygenated, to which the well-known freshness of spring-water is due.

I may here mention, in illustration of the oxydising power of chalk, what is well known in districts where the chalk appears near the surface. When ordinary wooden posts, such as are used in making fences, have their lower ends sunk into the ground, and are rammed up with chalk, the portion of the post in the ground will become completely rotten and decayed in four or five years; while posts, of the same size and material, fixed in the same manner, but rammed up with clay in a clay soil, will last twenty years, or more, and then be sound at their lowest extremity.

The carbonic acid formed in the pores of the chalk, as described, being dissolved in the water, causes it to take in solution a small portion of chalk in the state of bicarbonate of lime, and so thoroughly, that whenever a well or tunnel has been excavated through chalk, and moisture is present, there is no free carbonic acid to be removed, as is necessary in excavations in many other soils.

From a gallon of water taken from the chalk strata at Watford, there may be obtained by evaporation 23 grains of mineral matter, which were in a state of invisible solution; $17\frac{1}{2}$ of those 23 grains consist of chalk, the remaining $5\frac{1}{2}$ grains consist principally of silica and salts of magnesia and soda. The principal mineral or saline matter contained in the water is, therefore, chalk, held in solution by carbonic acid.

Owing to the water passing down through so great a depth into the chalk hills, and to the length of time occupied in passing down, the water assumes about the mean temperature of the air, or 52° Fah., and the water, when first raised, is at all seasons of this agreeable temperature.

The characteristics of the subterranean spring water from the chalk strata are, therefore:—

1st. Its clearness, brightness, and freedom from solid matter in suspension.

2nd. Its being always about the agreeable temperature of 52° Fah.

3rd. Its freedom from putrescent organic matter.

4th. Its holding in solution a large proportion of oxygen gas and atmospheric air.

5th. Its holding in invisible solution about $17\frac{1}{2}$ grains of chalk per gallon.

If it were not for the chalk in the subterranean spring water, it would be impossible to find a water better adapted for domestic use. The chalk, however, held in solution, renders the water, what is popularly called hard, and ill adapted for washing and bathing.

It is easy, however, by a simple and inexpensive process, to withdraw from the water nearly all the chalk it contains, with the exception of $1\frac{1}{2}$ grains per gallon, without leaving anything else in the water in the place of the removed chalk, and without altering any of its other good qualities; so that, after the water has had the chalk withdrawn from it, it still maintains the first four characteristics before named, quite unimpaired.

The following is an analysis by Dr. Thomas Clark and Dr. John Smith, showing the soluble contents obtained by evaporating a gallon of water, procured from the chalk stratum at Watford, before and after the withdrawal of the chalk, where each degree of hardness stands for as much hardness as would be produced by one grain of chalk per gallon:—

Analysis of the Evaporated Residuum of Watford Spring Water.

| | Grains per Gallon. | | Degrees of Hardness. | |
|---|---|---|---|---|
| | Original | Softened | Original | Softened |
| Carbonate of lime | 17·60 | 1·65 | 17°·60 | 1°·65 |
| Nitrate of lime | 0·08 | 0·41 | 0°·05 | 0°·25 |
| Nitrate of magnesia | 1·42 | 1·05 | 0°·95 | 0°·70 |
| Nitrate of soda | — | 0·09 | — | — |
| Sulphate of soda | 0·50 | 0·50 | — | — |
| Chlorides of sodium & potassium | 1·30 | 1·30 | — | — |
| Phosphates (precipitated by ammonia from acid solution) | 0·28 | 0·28 | — | — |
| Silica | 0·82 | 0·57 | — | — |
| Volatile matter, including some nitric acid | 1·00 | 1·15 | — | — |
| Residue on evaporation | 23·00 | 7·00 | 18°·60 | 2°·60 |
| Subtract latent hardness (magnesian salts) | | | 0°·95 | 0°·00 |
| Sensible hardness | | | 17°·65 | 2°.60 |

The principle characteristics of the water when the chalk is withdrawn from it, besides those already named, are: 1st. Its softness being only $2\frac{6}{10}$th of a degree of hardness, or about as soft as ordinary rain water collected from the roof of a house, without any of its impurity.. 2ndly. That the water has no action whatever upon lead, as most soft waters have.

I have before shown, that the area of country having chalk at, or near the surface, in the south-east of England, amounts to 5,000 square miles. Assuming that only 12

inches in depth per annum, of the rain that falls on this surface, percolates down to the lowermost stratum of the chalk, finding its way in subterranean currents to the sea, this depth of rain on this surface would produce the enormous amount of 2,400 million gallons per day, for every day in the year. As every gallon of water thus flowing into the sea carries with it—held in invisible solution as bicarbonate of lime—on an average about 16 grains of chalk per gallon, which is equal to one ton per million gallons, we become aware of the fact that 2,400 tons of chalk are *daily* carried into the sea, by subterranean currents of water, that is to say, 100 tons per hour. When we bear this in mind, it is easy to perceive how the water draining down through the mass of the chalk hills makes an underground passage for its exit; and also, to account for the fact (which is well-known to all practically conversant with the working of chalk wells) that the water-bearing fissures in wells sunk in the chalk, get very much enlarged in a few years. I have known water-bearing fissures in the well sunk in the chalk that supplies the town of Brighton with water, not one-fourth of an inch wide when the well was first sunk, to be enlarged, in four or five years, to many inches in width. This accounts for the fact, that wells sunk in the chalk, continue for several years after they are first sunk, to yield water more and more plentifully.

The method of withdrawing the chalk contained in water was invented and patented by Dr. Clark, of Aberdeen, and the operation of the process has been explained by him in the following words:—

"To understand the nature of the process, it will be necessary to advert, in a general way, to a few long-known chemical properties of the familiar substance, chalk; for chalk at once forms the bulk of the chemical impurity that the process will separate from water, and is the material whence the ingredient for effecting the separation will be obtained.

"In water, chalk is almost or altogether insoluble; but it may be rendered soluble by either of two processes of a very opposite kind. When burned, as in a kiln, chalk loses weight. If dry and pure, only nine ounces will remain out of a pound of sixteen ounces. These nine ounces will be soluble in water, but they will require not less than forty gallons of water for entire solution. Burnt chalk is called quicklime, and water holding quicklime in solution is called lime-water. The solution thus named is perfectly clear and colourless.

"The seven ounces lost by a pound of chalk on being burned consist of carbonic acid gas,—that gas which, being dissolved under compression by water, forms what is called soda-water.

"The other mode of rendering chalk soluble in water is nearly the reverse. In the former mode, a pound of pure chalk comes to be soluble in water in consequence of losing seven ounces of carbonic acid. To dissolve in the second mode, not only must the pound of chalk not lose the seven ounces of that carbonic acid it contains, but it must combine with seven additional ounces of that acid. In such a state of combination chalk exists in the waters of London—dissolved, invisible, and colourless, like salt in water. A pound of chalk, dissolved in 560 gallons of water by seven ounces of carbonic acid, would form a solution not sensibly different in ordinary use from the filtered water of the Thames in the average state of that river. Chalk, which chemists call carbonate of lime, becomes what they call bicarbonate of lime when it is dissolved in water by carbonic acid.

"Any lime-water may be mixed with another, and any solution of bicarbonate of lime with another, without any change being produced: the clearness of the mixed solutions would be undisturbed. Not so, however, if lime-water be mixed with a solution of bicarbonate of lime; very soon a haziness appears, this deepens into a whiteness, and the mixture soon acquires the appearance of a well-mixed whitewash. When the white matter ceases to be produced, it subsides, and in process of time leaves the water above perfectly clear. The subsided matter is nothing but chalk.

"What occurs in this operation will be understood if we suppose that one pound of chalk, after being burned to nine ounces of quicklime, is dissolved so as to form 40 gallons of lime-water; that another pound is dissolved by seven ounces of extra-carbonic acid, so as to form 560 gallons of a solution of bicarbonate of lime; and that the two solutions are mixed, making up together 600 gallons. The nine ounces of quicklime from the pound of burnt chalk unite with the seven extra ounces of carbonic acid that hold the dissolved pound of chalk in solution. These nine ounces of caustic lime and seven ounces of carbonic acid form sixteen ounces—that is, one pound of chalk—which, being insoluble in water, becomes visible immediately on its being formed, at the same time that the other pound of chalk, being deprived of the extra seven ounces of carbonic acid that kept it in solution, reappears. Both pounds of chalk will be found at the bottom after subsidence. The 600 gallons of water will remain above, clear and colourless, without holding in solution any sensible quantity either of quicklime or of bicarbonate of lime."

This will explain the theory of the patented process which I have lately been called upon to apply in some works I have constructed for the purpose of supplying the parishes of Plumstead, Woolwich, and Charlton, with water derived from the chalk strata.

These works were commenced about December, 1852, and they were so far advanced that they were used to supply the spring water from the 1st August last year, afterwards the same water softened since the 1st of November. The wells, pumps, steam-engines, and principal works are situated at the top of Ann-street, Plumstead. The well is sunk into the chalk, which is here met with at about 60 feet from the surface of the ground. I found no difficulty in procuring an abundant supply of the water required by the company,

The water, after being pumped up from the well, is softened according to the process just described, cream of lime being used instead of lime-water. The process is found extremely simple, and very easy to work, and it appears probable that the sale of the chalk taken out of the water, which is similar to, but better in quality than, the best whiting, will repay the whole expense attending the process. I have here some of the chalk taken out of the water for you to examine.

The water at the Plumstead Works, after being softened, is pumped up into a covered reservoir, situated near Plumstead-common, and is furnished through pipes to the houses, on the continuous system, so that the consumers can draw the water at all times from the pipes of the company by merely turning a tap, without the intervention of any butt or cistern. The water is very much liked by the consumers for all purposes—drinking, washing, cooking, &c. Should any of you like to examine the water for yourselves, or to see the process in operation, I shall be glad to afford you the opportunity.

If in the foregoing statements I have been successful in conveying to you the facts and reasonings in my own mind, I think you will agree with me in the important conclusions that there exists within reach of the metropolis a source for the supply of water, abundant in quantity and unexceptional in quality.

## DISCUSSION.

Dr. Hassall, in a letter to the Secretary, whilst regretting that indisposition would prevent his attending the meeting, and so taking part in the discussion, as he had intended, says:—"Water intended for domestic use should possess two characteristics—first, it should be entirely free from organic productions of every kind, dead and living; and, secondly, it should be soft. The waters at present in use in this metropolis fulfil neither of these indications—they abound with living productions, and they are not

of the requisite degree of softness. The water obtained from chalk strata, as proposed by Mr. Homersham, would certainly be free from the greatest and most injurious contamination to which it is liable, viz., that by organic matter, while the quality of hardness is one which admits of remedy, so far as I have hitherto had the opportunity of judging by the adoption of the softening process of Professor Clark (of Aberdeen). Almost any water which fulfils the above two indications, would be suitable for domestic use, no matter what the source might be from which it was procured."

Dr. Glover stated that in his opinion there were no positive data whatever as to what extent organic matter and animalcules might exist in water without being injurious; although, perhaps, a general notion might be formed on the subject.

Mr. Frederick Braithwaite apprehended that the discussion that evening was not so much the purity of the water from the chalk, as the question of the quantity of water to be obtained from that stratum; and, having heard the principal part of the paper read to-night he was surprised that, in the face of the positive evidence of the inefficiency of the supply from the chalk, the author of the paper should still persist in stating that it contained a quantity which did not really exist. The drawings which he saw before him he recognised as having been exhibited in other places where this question had been discussed. He was mistaken if he had not seen them at the House of Commons, and also at the Institution of Civil Engineers, the matter having been discussed by the latter body, he believed, on no fewer than nine nights, on various occasions. Therefore, any remarks he might offer would, perhaps, appear more like a repetition of what he had said before rather than as original to the present occasion. He had at different times combatted the observations of the author of the paper, for unfortunately his facts went against Mr. Homersham's theory. He (Mr. Braithwaite) did not make any pretensions to greater geological knowledge than others present, but when he had been called upon to perforate the chalk in almost every part of London, and when the results had proved that it was a fallacy to hope for any very large supply of water from the chalk, he hoped he should not be considered personally offensive when he said the author of the paper was perfectly in error upon this subject. Localities had been pointed at—such, for instance, as the Orange-street well—as yielding, it was alleged, an inexaustible supply of water from the chalk. He wished to state that that inexhaustible supply was not from the chalk at all, but from the sand overlying the chalk; but even assuming that the well was inexhaustible for its purposes, it was not inexhaustible as to the supply of London with water. They could imagine a great number of wells of which it might be said that the supply of water was inexhaustible, inasmuch as it had perhaps never been known to run short for the purposes to which it was applied; and, for the simple reason that the supply had been equal to the demand, it was alleged to be inexhaustible. For instance, supposing a person having a well in London required 20 gallons of water per minute; if the supply was 30 gallons per minute, and only 20 gallons were required, it was stated to be inexhaustible; but suppose that person wanted 40 gallons per minute, then the reverse would be the order of the day. He had taken infinite pains to look into this question, and there was one fact he would like to mention, although it was not original, referring to the quality of the water, as in many parts of the paper the author had touched upon this branch of the question. When the well was sunk at the Camden-town station of the London and North Western Railway, they found to their surprise that the water which was tapped from the chalk did not rise to within 44 feet of the Trinity high-water mark. The same railway company had also chalk wells at Watford and at Tring, but it was a singular fact that when they filled the boilers with the water from the Camden-town well, they could not keep it in the boilers, because it what was technically termed "primed," and the surprise was, how the water at Watford and Tring should be so good, whilst that at Camden-town could not be used for the locomotives. It was found, upon analysis, that the water at Tring and Watford contained from 17 to 19 grains of carbonate of lime per gallon, and 2¼ grains of saline matter, whilst that at Camden town contained 44 grains of saline matter per gallon, with very little carbonate of lime. This remarkable difference in the chemical conditions of the water formed the subject of a discussion at the Institution of Civil Engineers, and on that occasion he took the liberty of differing very widely from the opinions expressed by several of the speakers as to the cause of this difference. For his own part he attributed it to the infiltration of water from the sea, or the brackish water of the Thames under London. For this reason, the waters under London varied in their chemical condition—for instance, the water of the Orange-street well contained nearly 100 grains of sea salt per gallon; whilst that at Watford contained but 2 grains per gallon. The fair question was, if there was this inexhaustible supply through the chalk, how was it they had this infiltration of salt? The fact was there was no such supply. He would mention the fact, that in a boring made in 1832, the water rose in the well to the Trinity high water mark, and an analysis showed that that water contained nothing like the same amount of salt as was now found under the same circumstances. He had in his hand a table, showing the level of the water in a well situated not more than a quarter of a mile from the Orange-street well, namely, at Combe's brewery. This well was first sunk, he believed, in 1827, and as he had said, the water at that time rose to the level of the Trinity high-water mark. He had no opportunity of taking the gauges of that well until the year 1837, but from that period to the present time he had gauged it accurately and minutely; and the result had been to show the permanent lowering of the water under London, not in one instance only, but in all cases that had come under his notice throughout London. In the year 1832, the water in ten or twelve of the principal wells in London also rose to the Trinity high-water mark. The table to which he had alluded gave the rainfall every month from year to year, and they would see that it showed an abstraction from the basin of some 500,000,000 or 600,000,000 of gallons a year, and it moreover showed the continuous lowering of the water under London. Now he wished to know what became of the argument that so many inches of water flowed into the bowels of the earth to make up the supply. On the contrary, they found that they had much infiltration of salt and sea-water, and in all cases where they had gone a considerable depth into the chalk, and, in some instances, even through the chalk, they had never yet met with what he should call a supply of water. In the case of the well at Reid's brewery, the chalk was bored and tunnelled in every direction, and they got a supply of 190 or 200 gallons per minute, but, at the present time, that supply had fallen to 30 gallons per minute. At Hampstead, again, where they had gone completely through the chalk, and had bored to a depth of 600 or 700 feet, they had found no water in the chalk; and the chalk, as chalk, he contended, did not give out one drop of water. If they got it at all, it was through the fissures, and even those were diminishing in their supply. In the Chiltern Hills there were large fissures, besides a tolerable supply from the surface, and Mr. Homersham had correctly stated that large quantities of fresh water ran into the sea from the chalk formation at Brighton and Ramsgate; but the chalk formation under London was of a different character. He mentioned these as ascertained facts, and he would challenge any one to show him any instance in London of such a supply of water being obtained from the chalk as would be adequate to the requirements of this vast city, though he admitted they might find limited supplies. He regretted that there should be a difference of opinion upon a question of facts. The Rev. Mr. Clutterbuck had

paid great attention to this subject, and he felt sure that that gentleman would corroborate his assertion, that it was a mistake to suppose that, because here and there fissures were met with which yielded a large supply, that therefore the supply was inexhaustible. It had been asserted that there were from eight to ten inches of water flowing under London, but if they went into the calculation he questioned whether there was more than the tenth of an inch at the present time. In 1852 there was a large rain-fall, and if a great proportion of this sank into the chalk strata, how was it they had this constant depression of the water only from a limited abstraction, and yet it was the same in every part of London.

The Rev. J. C. CLUTTERBUCK said, in dealing with the points raised in this paper, he had not much new matter to introduce, considering that this subject had been already so largely discussed at the Institution of Civil Engineers. It was clear that the chalk strata were the sources of the supply of water to the metropolis, and to a certain extent they always would be so, although he had heard of an extraordinary proposition to bring water out of Wales for the supply of London: but, as nature had made the London chalk basin the natural means of supply, so it would continue. Let them look at what was the state of the metropolis before it became inhabited by its present teeming population. They found it to consist of a bed of gravel, resting upon clay, which bed of gravel did, no doubt, to those who first fixed their habitations here, yield to them a tolerable supply of water. Certainly their forefathers would not have built a town where there was no water, and they unquestionably fixed upon London as a proper place because there was a supply of water. It was, in times gone by, obtained from wells, but it might now be said that that supply was pretty well exhausted. No one in the present day thought anything of what were called land-springs, which gave a great deal of trouble perhaps to those who sank wells, though to no one else. It was stated that the metropolis was indebted to a Dutchman for its first supply of water. Then came the project of Sir Hugh Middleton, who, by diverting streams, brought a supply of water to London: his work had outlived him, and the main works were still in existence. That was the natural way of dealing with the question. The supply of water at the New River Head, coming from Hertfordshire, still went on, and was made available for the requirements of the population of a very large portion of the metropolis. There were, in addition, the supplies taken from the Thames, which were still going on; and, with reference to the Thames, he might say, that a great deal of the volume of water of the Thames was derived from the chalk. There was a large drainage of water from the Chiltern Hills into the Thames, which found its way into Berkshire and Oxfordshire. Then, if they went further up the stream, they found it received a great quantity of water from the gap near Pangbourne. Then, going on towards Reading they found the Kennet coming into it, and also the little stream which came by Wycombe, until they got to the Colne—so they might naturally say chalk was the stratum which yielded the principal supplies of the Thames. But now that they were looking for supplies from artificial sources, what was the consequence? At the beginning of the present century it was discovered that, by boring into the sand and chalk, large supplies of water might be obtained by Artesian wells. They acted very well for some time, and there were not wanting persons who declared that the supplies from those sources were inexhaustible. Against such a declaration he would place the statement, derived from actual experience, made by Mr. Frederick Braithwaite. He (Mr. Clutterbuck) was not prepared to say there were no exceptions, but they had the fact before them, that there was a depression of sixty feet in the wells of London, and he had no doubt of the accuracy of Mr. Braithwaite's statement. He had suggested, in a paper which he had read before the Institution of Civil Engineers in the year 1850, that it was in consequence of the back drainage of the Thames, to fill up the vacuum, that the large quantity of salt found in the water was due; and he had no doubt that would be found to increase every year in the deep wells of London. Here was an instance in which they had tried to deal with the supply of water from artificial sources, and not according to the natural mode either by the New River, the Croydon River, or the Thames, and that ought to be a warning as to how far they ought to go in tampering with those supplies. In dealing with the question before them he thought due weight had not been given, in the beginning of the paper to the amount of evaporation of water from the soil. It was quite true that the water which fell upon the surface was, to some extent, immediately evaporated, particularly in hot weather; another portion entered into animal and vegetable life, whilst a further portion either ran off the surface or sank into the ground where the stratum was porous. But they were to remember this, that when the water was evaporated from the soil the first duty of the water which permeated into the stratum would be to replace that which had been so evaporated. People were little aware of the enormous bulk of water that evaporation would consume. He stated before another society, the other day, that, from his own experience and observation, he had found, at the end of a dry season, it would consume at least three inches of continuous rain to replace the water which had been evaporated during the dry season. Now, if they took three inches of water from the whole annual rainfall, and also remembered that during the whole of the summer there was a rapid evaporation going on, they could not look for much supply of water from that source—namely, the rainfall. Sometimes they had as much as two inches of rain in one week, and he had known more than an inch in twenty-four hours, and on one occasion he registered between two and three inches in three or four hours, but such a fall as that would generally occur in the month of July, when the ground was very much heated, and much water was sucked up. Chalk, it had been found, would absorb about one-third of its bulk and one-fourth of its weight of water. The quantity of moisture appropriated by the soil to replace the water evaporated was immense, and, so far from saying that 12 inches of rain sank into the earth, he never knew anything like that quantity, and he would affirm that during the last 15 months not so much as 2 inches of rain had sunk into the soil. He had not brought with him the register of Mr. Dickenson's gauge, but he had gone upon the principle of gauging the wells themselves, which appeared to him the most legitimate mode—and he recollected in a wet season in June, he gauged and found the rise was only about 2½ or 3 inches. Some reference had been made in the paper to the conformation of the strata under London, and the term "basin," as applied to these strata, seemed to be objected to; but when they spoke of the London basin, no one imagined that it was as regular in its form as a washing-basin, for instance. He presumed that what was meant was an indentation filled up with some other strata; but it was not necessary to dwell on that. A great point had been made of the drawings of bridges exhibited. His old friend, Dr. Buckland, used to say with reference to the chalk districts, where floods never occurred, that in Hampshire they built the arches of the bridges so low, that the ducks had to bob their heads when they went under them. It was evident that they had no floods, or they never would have built such bridges. He had no doubt the drawings produced by Mr. Homersham were correct representations of the different bridges in the chalk and in the clay districts, although he thought it did not go to prove very much, inasmuch as if they went to one of these smaller bridges after a heavy thaw, they would find very little difference in the height of the water there, but then in this case the water was running continuously, whereas in the other it was principally at seasons of floods. Not long since, after a considerable fall of rain, he saw a plough at work in a field which turned up complete dust at only

such a depth as the plough would reach, and therefore he was at a loss to know what great point was made by showing that the clay had more evaporation from it than the chalk. That was no proof that all the water went into the chalk, because there was a portion of soil which sucked up the water. He could not agree with Mr. Homersham with reference to the absorption of water by chalk. As far as he could judge, if they took a piece of chalk and saturated it with water, they might hang it up, and he ventured to say it would not part with a drop of the water except by evaporation. He had made an experiment for the purpose of ascertaining how much water chalk would take up by capillary attraction. He filled a glass tube with about thirty pieces of chalk of the size of the top of the finger, with only the bottom piece immersed in water, and it was a considerable length of time before the top pieces became affected by the moisture from below. The conclusion at which he had arrived was, that the chalk would absorb one-third of its bulk and one-fourth of its own weight of water. There were many different qualities of chalk, but he was speaking of the clean, smooth chalk which a carpenter would use, containing 95 per cent. of carbonate of lime, and that description would take up the quantity of water he had stated; and it was not until that quantity had been taken up that any water would pass through the fissures. He did not understand that the water was driven through the chalk, but only passed through it between the cracks and fissures. With reference to the well alluded to by Mr. Homersham as giving 750,000 gallons per day, he begged to ask that gentleman at what period that supply was given?

Mr. Homersham said it was in July, 1853.

Mr. Clutterbuck.—In 1852 they had a very heavy rainfall, and if the supply was 750,000 gallons per day in 1853, he would almost stake his existence that it was not half that quantity at the present time.

Dr. Clark, of Marischal College, Aberdeen, remarked that it had been somewhat authoritatively given out by the two gentlemen who had preceded him, that because, forsooth, this subject had been discussed for nine nights at the Institution of Civil Engineers, there was no scope left for discussing it here, but it did not occur to him from what transpired of the proceedings of the learned Society alluded to, or from what had that evening fallen from the gentlemen who had just addressed the meeting, that the subject had been removed from intelligent discussion in this place. He did not intend to discuss this subject geologically, and he would leave to the author of the paper to answer in detail the objections which had been taken to his theory. One gentleman (Mr. Braithwaite) had met the statements of the author of the paper by saying—such and such was not the fact—which was a style of settling matters that he (Dr. Clark) was not accustomed to. What was the state of the case? A certain portion of clay was here represented whereon London stood, and that gentleman had said he knew there was not to be found under that clay the vast quantity of water described to be readily found, not under that clay, but beyond the limits of the overlying clay. As well might a man say, "I have had much experience in boring for water somewhere in the Isle of Wight, and having been accustomed to find little there, I can assure you there is little to be found in the chalk of Watford." The fact was notorious, that they could not get such large quantities of water from chalk under a load of superincumbent clay. Mr. Homersham had fully admitted that. But did Mr. Braithwaite say, "I went to Watford and I bored there, and I could find no water?" That would have been to the purpose. The inapplicability of the argument was further shown from this circumstance—whether or not the theory of Mr. Braithwaite was right, that the water of the Orange-street well came from the sand; it was known that the water found there was of a totally different quality from that obtained from the chalk beyond the London clay. Still the quality was such as could not be accounted for by the sea-water mixing with the water from chalk not loaded with clay. If they took chalk water and sea water and mixed them together in any proportions, it was physically impossible to make out of the two a water corresponding to the chalk water under London; and therefore that theory was simply a mistake; and it was also a very great mistake, as to the scientific result of chemical analysis, to say that in the water found below London there were something like 100 grains of salt per gallon. There was not 100 grains per gallon of all sorts of things in it. He had a friend sitting near him who told him he had accurately examined these waters, and he said it was no such thing, and moreover that a very small portion of salt only was present. There was this fact also worth stating—if they went to any of the chalk formations not being heavily loaded above with clay, they would find that the quality of the water was singularly uniform; the only difference was, that they would find more water in some places than in others. In some cases it contained 23 grains of saline matter per gallon, and in others only 19 grains, but the dissolved matter was so nearly the same, that you might say the one water had 23 grains in a gallon, and the other had 23 grains in more than a gallon; whereas the waters below London are of a different nature. They would find that the same weight of saline matter evaporated from the water of the Orange-street well and from the water of the well at Combe's brewery, presented considerably different results of analysis, so that all the observations with reference to the water below London, were nothing to the purpose in hand. If the chalk below London was so compressed as that there was not free scope for the water to pass through the interstices towards the sea, it would find its way through places where there was not that compression. With regard to the observations of Mr. Clutterbuck as to evaporation, what struck him (Dr. Clark) most was the loose kind of evidence which the rev. gentleman had produced upon that subject, and how utterly unlike it was to the stern, rigid, and undeniable evidence which belonged to all scientific investigations.

The Rev. J. C. Clutterbuck said he had given the results only, but would be happy to furnish the details if they were required.

Dr. Clark went on to remark, that it had been said the discussion of this paper should have reference to the quantity and not to the quality of the water, as a source of supply to the metropolis. That notion, certainly, did not occur to him; on the contrary, if they obtained a source as ample as the sea, unless the quality of the water was such as to make it fit for use by the inhabitants of the metropolis, the quantity went for nothing. With regard to the presence of organic matter in water, some people hereabouts entertained the idea that all water contained minute living creatures, and that it was an arrangement of nature that every one should patiently submit to. For his own part, he was 28 years of age when he first visited London, but, until then, he had never seen a live insect in water supplied to a town; and in the town where he now resided, although the water came from the river, they could not see an insect in it with the naked eye, and it was difficult to discover any with a microscope. There was no doubt a diversity of tastes as regarded water, as in all other things. Some might not think the presence of organic matter an objection. In some specimens of the Thames water, as recently supplied, he was aware that the microscope discovered traces of the fibre of mutton chop, the source of which it were perhaps too curious to inquire into. For his own part, he prefered to have water free from all organic matter. There was this plain advantage in supplying a town with water free from organic matter, that such persons as were disgusted with this kind of matter would be gratified by its absence, whilst others, that prefered the contamination, might add of it as much as to make the water suitable to their taste. At the same time, it was notorious that water contaminated with organic matter, under certain circumstances—for instance, in very hot weather—became

very offensive, both to the taste and smell, and there could be no doubt, notwithstanding the uncertainty of the history of epidemics, that, somehow or other, corrupted water was connected with the cause of some epidemics. He believed the chalk water which Mr. Homersham referred to—not the water under London, which was of different quality—but taken from favourable positions, could be obtained devoid of organic matters, which would be a prodigious public advantage; for sometimes they found families, who were accustomed to drink water, on coming to London were disgusted with the article they were supplied with; and in preference they drank something else, not so good nor so cheap as wholesome water. He contended that organic matter was the chief pollution of water, but spring water might be obtained from the chalk entirely free from it. He might enumerate a few of the advantages of a supply of water such as was proposed by Mr. Homersham. They would, in the first place, have water free from organic matter, or if any trace of it were detected, the process which Mr. Homersham had described took it away—a fact which he had himself carefully verified. They would, in addition, have water containing only 7 grains of saline matter per gallon, and only one-fifth of the hardness at present supplied. The softness of the water was an advantage in other respects beyond the saving of soap in the operation of washing, and since the supply had been laid on from the New Woolwich Waterworks the laundresses had been able to get up their linen whiter and clearer than they were before enabled to do. He thought Mr. Homersham had made out, in a satisfactory manner, that an enormous quantity of water is dispersed throughthe chalk; and to his mind that gentleman had given a very reasonable account of what became of it. For his own part he would say that he had not yet heard of a proper search for chalk water, in such places as Mr. Homersham had referred to, that had not been attended with success. In this metropolis water might now be got so soft and pure that he did not know a large town which was more highly favoured than this great meropolis *might* now be.

Mr. Evans said he had been an inhabitant of Watford for upwards of 15 years, and was well acquainted with the district, having sunk wells and constructed weirs for manufacturing purposes, the supplies of water to which were derived from streams arising from the chalk. The basis of Mr. Homersham's calculations appeared to be this:—a certain amount of rain-fall took place annually, and a certain quantity of the water was carried off by springs and rivers, and a certain quantity by evaporation. It was about 19 years ago, that, for the sake of gathering information as to the quantity of rain-fall in successive years, he employed a gauge constructed upon the plan of Dr. Dalton, in which the rain which fell upon the surface soil, was collected after percolation through three feet of soil, defended from evaporation. The result showed that the average annual rain-fall of the 19 years was 26 inches, whilst the quantity which had percolated through the soil was less than 9 inches. The soil of Watford was covered with a clay or sand of the beds of the lower tertiary formation, which tended to diminish the amount of the body of water percolating into the chalk. He took the full amount of the flow at London-bridge, and the gathering ground of the river, and he found that the quantity of water taken, as being the amount of the stream at London-bridge, corresponded with his calculations. It showed that the whole of the water which percolated to any depth, was accounted for by the streams and rivers of the districts and if any of the water fell towards the sea it must be a very minute quantity. Mr. Evans went on to mention, that two years ago he constructed another Dalton gauge, and filled it with pure chalk, with nothing on the surface, and during the last year—from February to December, not a drop of water had percolated through that three feet of chalk. He thought that showed that the absorbent powers of chalk had been much over-rated. With reference to the wells sunk in connection with the Woolwich and Plumstead water works, Mr. Evans mentioned that on a property held by a relation of his, the well had been laid dry from the pumping of the company's well; also that a well sunk by the Grand Junction Canal Company, to a depth of 72 feet in the upper and middle chalk, had the effect of laying dry a stream which worked one of his mills, and he obtained an injunction to restrain them from pumping that well, so that it was evident puddling did not prevent the surface water from being abstracted, which was sometimes a matter for which compensation was demanded.

After a few words from Mr. Braithwaite, and Mr. C. May having declined to protact the discussion at the late hour to which it had extended,

Mr. Homersham begged to say a few words in reply to one or two points in the discussion. Mr. Evans spoke of compensation,—very natural to a mill-owner, who sought not for compensation for the value of any damage done, but ten or twelve times the value of a supposed injury. Mr. Braithwaite had stated that at Southampton they had bored in one place 1,000 feet in chalk below the clay, and yet found no water. Granted that was the fact, yet, in the chalk at a few miles out of the town they had got more water than was wanted to supply ten Southamptons. In the well or boring to which Mr. Braithwaite referred, the chalk was hard and impermeable, from a thick body of clay overlying the chalk, and they got no water from it, but on going a few miles out of the town, where there was no clay, an abundant supply was obtained. The New River Company sunk a well at Hampstead, where the chalk was thickly covered with clay, and obtained 600,000 gallons per day; but they went further out of London, and sunk two wells near Ware, where the chalk was not covered with clay, and then got a supply of 4,000,000 gallons per day. He had never said that they could get water in any large quantity from the chalk under thick London clay. It was foreign to the purpose for Mr. Braithwaite to come here and tell them that, and try to argue from it, that they could not get water at Watford. Nor was the water under London of a quality which was desirable for the supply of London. He repeated, that when they went to chalk where the clay did not lie upon it there was a different state of things, and in suitable localities they got, *practically*, an inexhaustible supply of water. He would add one word with regard to the gauge which Mr. Evans stated Mr. Dickenson had used to ascertain the infiltration from the annual rain-fall. When before a Parliamentary Committee he had occasion to learn all about that gauge, and he had prepared evidence to be given before the committee, and had had drawings made of the gauge. It was as unlike the gauge recommended by Dr. Dalton as it was possible to be. There was an overflow pipe attached to it without a bottle to catch the water, and there was a stratum of peat, which was well known to have the property of plugging up pores, and hindering filtration, put on the earth at the top of the chalk, and the body of the gauge was made of wood not tight at the joints, and therefore for the purpose of telling what quantity of rain infiltrated through the chalk, the gauge in question was quite useless. How far the experiment was properly conducted upon the gauge with the bare chalk referred to, he could not say without having all the particulars before him. Mr. Evans had alluded to the beautiful greenness of the vegetation of the Chalk Downs. Now he (Mr. Homersham) could only say, that the land on the Chiltern Hills would not let for more than 10s. or 12s. per acre, but in the neighbourhood of the Brent it let for £3 or £4, where there was five or six times as much grass as upon the chalk downs or the Chiltern Hills, and therefore it was evident that less water must be consumed by vegetation on the chalk downs than on the London clay at the Brent. He would state that there were 270 square miles of chalk country on the Chiltern ridge which contained hardly a

spring or a stream, and the vegetation was of the most scanty description. With regard to the well at the Cow Roost, to which Mr. Evans had alluded, it was not puddled water-tight on the sides, nor was puddle carried down to the bottom of the well; and he had said that if in proper localities they constructed wells lined with impermeable sides, carried into a hard stratum of chalk, they might get a large supply of water without interfering with the springs, rivers, or sources from which other wells in the neighbourhood were supplied. Mr. Evans had argued that if wells were sunk near a river they would obtain water from the river; but, if so, a well 40 feet deep would do this better than one of 80, as the deeper the bottom of the well the farther from the river. He would say that at Watford they did not get, in wells, any very large quantity of water, at a less depth than 120 or 160 feet, and they could not get much water at 40 feet deep. Mr. Homersham then referred to the well at Great Grimsby Dock, as another illustration of the position he had taken. The bore-hole of that well was 24 inches in diameter, and was found capable of supplying 8,000,000 or 9,000,000 gallons per day of the purest water.

The CHAIRMAN, in summing up the discussion, said the practical question to be solved was whether the chalk stratum could be depended upon for obtaining a very large supply of water. According to Mr. Braithwaite, who had had very considerable experience in this matter, they could not depend upon the supply for any length of time, where the chalk was covered with London clay. The question was, the limit of the quantity; and, further, whether in tapping that water they did wrong or not to the present surface supplies of water. It therefore still remained to be established what quantity of water could be depended on for a long period of time from the chalk, which had not as yet been adequately tested.

The Secretary announced that there would be a *Special* Meeting on the evening of Friday, the 2nd of February, when Mr. Leone Levi would read a short Paper, " Observations on the Proposed Congress for the Improvement of International Commercial Law," as introductory to a discussion on that question.

Also, that the Paper to be read at the meeting of Wednesday, February 7th, was " The Commercial Consideration of the Silk Worm, and some of its Uses," by Mr. Thomas Dickins.

## ON THE CONSTRUCTION AND PROPER PROPORTIONS OF BOILERS FOR THE GENERATION OF STEAM.*

BY ANDREW MURRAY, M. INST. C.E., CHIEF ENGINEER OF H.M. DOCKYARD, PORTSMOUTH.

Mr. Muir, in his paper on the Smoke Nuisance, read before the Society on the 17th of January, referred, and other parties have done the same, to a want of definite rules for the relative dimensions for the flues and other parts of steam engine boilers. In 1844, in a paper read before the Institution of Civil Engineers, Mr. Andrew Murray gave the results which he had arrived at, on these points, after long observation and much consideration. As his experience since 1844 has confirmed him in the opinions then expressed, he has enclosed to the Secretary a copy of the paper, from which the following extracts are taken.

" The supply of the requisite quantity of air to the fuel on the bars, being of the utmost importance, it is usual to make the ash-pit, and the entrance to it, as large, and as free, as the situation will allow. In marine boilers, or wherever it is necessary to limit the size of the ash-pit, the area for the entrance of the air into it, should never be less than one-fourth part of the area of the grate, and in order to facilitate the supply to the back part of the grate, the bars should be made to incline downwards to the extent of about 1 inch in a foot. No advantageous results will be obtained from increasing the ash-pit, as is sometimes done in land boilers, to a very great extent, by making it 5 or 6 feet deep; about $2\frac{1}{2}$ feet is sufficiently deep, even supposing that the ashes are not cleared out oftener than once a day.

" The extent of ' dead plate' in front of the furnace is not material, as respects combustion; in marine boilers, it is generally not more than about 6 inches broad, which is the width of the water space between the fire and the front of the boiler; but in land boilers it is frequently required to be very broad, to support the brick-work, especially in those cases where the flue is carried across the front.

" The amount of the opening between the bars, should be about $\frac{7}{16}$ths of an inch, but this must be regulated by the kind of coal to be burnt upon them; but for any kind of coal, it should not be less than $\frac{3}{8}$ths of an inch, nor more than $\frac{1}{2}$ an inch. If the space were made larger, the waste from the amount of cinders, or of small pieces of coke, which would fall through in a state of incandesence, would be considerable; otherwise it would be preferable to have a larger space. In order to facilitate the supply of air, each bar should be as thin as is consistent with the strength required. The bars in general use in this country, are 1 inch or $1\frac{1}{8}$ inch in thickness, but it would be much more advantageous to use them thinner, as in France, where they are frequently used not more than $\frac{1}{2}$ inch thick.

" The advantage of a considerable amount of space in the furnace, over the fire-bars, has been already mentioned, but no very decisive experiments have been made on this subject. Three cubic feet of space to each superficial foot of grate bar surface, may be stated as a good proportion where there is nothing to prevent this amount being obtained. When the space is reduced below one foot and a half to each foot of grate, it will be found to be attended with a marked disadvantage.

" The area of the flue, and subsequently of the chimney through which the products of combustion must pass off, must be regulated by their bulk and their velocity. The quantity of air chemically required for the combustion of one pound of coal, has been shown to be 150·35 cubic feet, of which 44·64 enter into combination with the gases, and 105·71 with the solid portion of the coal. From the chemical changes which take place in the combination of the hydrogen with oxygen, the bulk of the products is found to be to the bulk of the atmospheric air required to furnish the oxygen, as 10 is to 11. The amount is therefore 49·104. This is without taking into account the augmentation of the bulk due to the increase of the temperature. In the combination which takes place between the carbon and the oxygen, the resultant gases (carbonic acid gas and nitrogen gas) are of exactly the same bulk as the amount of air, that is, 105·71 cubic feet, exclusive, as before, of the augmentation of bulk from the increase of temperature. The total amount of the products of combustion in a cool state would therefore be $49·104 + 105·71 = 154·814$ cubic feet.

" The general temperature of a furnace has not been very satisfactorily ascertained, but it may be stated at about 1000° Fahrenheit, and at this temperature, the products of combustion would be increased, according to the laws of the expansion of aëriform bodies, to about three times their original bulk. The bulk, therefore, of the products of combustion which must pass off, must be $154·814 \times 3 = 464·442$ cubic feet. At a velocity of 36 feet per second, the area, to allow this quantity to pass off in an hour, is ·516 square inch. In a furnace in which 13lbs. of coal are burnt on a square foot of grate per hour, the area to every foot of grate would be $·516 \times 13 = 6·708$

*Excerpt Minutes of Proceedings of the Institution of Civil Engineers, for 1844.

square inches; and the proportion to each foot of grate, if the rate of combustion be higher or lower than 13 lbs., may be found in the same way.

"This area having been obtained, on the supposition that no more air is admitted than the quantity chemically required, and that the combustion is complete and perfect in the furnace, it is evident that this area must be much increased in practice, where we know these conditions are not fulfilled, but that a large surplus quantity of air is always admitted. A limit is thus found for the area over the bridge, or the area of the flue immediately behind the furnace, below which it must not be decreased, or the due quantity could not pass off, and consequently the due quantity of air could not enter, and the combustion would be proportionally imperfect. It will be found advantageous in practice to make the area 2 square inches instead of ·516 of a square inch. The imperfection of the combustion in any furnace, when it is less than 1·5 square inch, will be rendered very apparent by the quantity of carbon which will rise unconsumed along with the hydrogen gas, and show itself in a dense black smoke on issuing from the chimney. This would give 26 square inches of area over the bridge to every square foot of grate, in a furnace in which the rate of combustion is 13 lbs. of coal on each square foot per hour, and so in proportion for any other rate. Taking this area as the proportion for the products of combustion, immediately on their leaving the furnace, it may be gradually reduced, as it approaches the chimney, on account of the reduction in the temperature, and consequently in the bulk of the gases. Care must, however, be taken that the flues are nowhere so contracted, nor so constructed as to cause, by awkward bends, or in any other way, any obstruction to the draught, otherwise similar bad consequences will ensue.

"An idea is very prevalent that it is advantageous to make the flame, or hot gases (as they may be termed, because we may look upon flame merely as a stream of gases heated to incandescence) impinge upon, or strike forcibly the plates of a boiler, at any bend or change of direction in the flue. The turn in the flue is, therefore, made with a square end, and with square corners; but it is difficult to see on what rational grounds the idea of advantage can be upheld. The gases, if they are already in contact with the plate, cannot be brought closer to it, and any such violent action is not necessary to alter the arrangement of the particles of the gases and bring the hotter particles to the outside, while there is a great risk of an eddy being formed and of the gases being thrown back and returned upon themselves, when they strike the flat opposing surface; thus impeding the draught and injuring the performance of the boiler. That circulation will take place to a very great extent, among the particles of heated gases, flowing in a stream even in a straight flue, will be apparent from those particles next the surface being retarded by the friction against the sides and by their tendency to sink into a lower position in the stream, from their having been cooled down and become more dense. An easy curve is sufficient to cause great change in the arrangement of the particles, as those which are towards the outside of the bend, have a much longer course to travel and are thus retarded in comparison with the others. From these causes the hotter particles in the centre of the flowing mass, are in their turn brought to the outer surface and made to give out their heat. The worm of a still is never found returning upon itself with square turns, as if the vapour inside would be more rapidly cooled by its impinging on the opposite surface; yet the best form of worm is a subject which has engaged the attention of many able men, and therefore may well be taken by engineers as a guide in the management of a similar process, though carried on at a much higher temperature.

"Another very prevalent practice and which also would seem to be open to serious objections, is, that the flues are frequently made of much greater area in one part than in another. This arises from a desire to obtain a larger amount of heating surface than is consistent with the proper area of the flue, or with the amount of the heated gases which are passing through it. The flue is thus made shorter in its course than it ought to be in proportion to its sectional area. This is even sometimes done, by placing a plate of iron partly across the flue, near the bottom of the chimney, thus suddenly contracting the passage for the gases. The effect of this is evidently to cause a very slow and languid current, in the larger part of the flue, and the consequence is, that a deposition of soot rapidly takes place there. In many marine and land boilers, having one internal flue in them, of too large a size, this will be found to be the case, soot being soon deposited, till the flue is so filled up that the area left is only such as is due to the quantity of heated gases passing through it; the value of those parts of the sides of the flue which are covered with soot is thus lost.

* * * * * * *

"When the gases have reached the foot of the chimney, in a well-proportioned boiler, they will be found to be reduced to a temperature of about 500° Fahrenheit, or below it; their bulk will, in consequence, be reduced by about ⅓rd below their bulk on their first leaving the furnace. The reduction in the area of the flue, ought not to be in the same proportion, because their velocity is no longer so great. The reduction ought to be made gradually, as has been stated before, and not by a sudden contraction at the foot of the chimney, as the effect of this is to cause a slowness of draught in the latter part of the flue and consequently a deposition of soot; and then the surface, so covered, which had been reckoned upon as effective heating surface, is lost. The area of a chimney, to allow the products of the combustion of each pound of coal consumed in an hour, to pass off, should be not less than ¾ths of 2 square inches, this latter being the area given for the flue, immediately behind the fire-place—that is, 1½ square inch; and for a boiler burning 13 lbs. of coal per hour, on each superficial foot of its grate, the area should be ¾ths of 26 square inches, or 19½ square inches.

"Theoretical research not having as yet given us any valuable assistance, in determining the proper height of a chimney, we must again refer to practice as our guide. A good draught may be obtained with a very low chimney, but at a great expenditure of fuel, from the necessity that exists in such a case for allowing the gases to pass off at a much higher temperature than would otherwise be necessary. For a chimney built of brickwork, the height ought not to be less than 20 yards, and may be increased to 30 yards or 40 yards, with advantage in the economy of fuel. When chimneys are carried to a still greater height, it is generally for the purpose of carrying off the smoke, or any deleterious gases, from the immediate neighbourhood, or to create a good draught with gases at a lower temperature, than those from a steam-boiler furnace. On board steam vessels chimneys are limited in their height by the size of the ship, on account of the influence the chimney has on the stability and appearance. It will generally be found advantageous to make the chimney as high as these circumstances will permit."

## LECTURES AT INSTITUTIONS.

Mr. Jelinger Symons has lately given gratuitous lectures on "Education, and How to Adapt it to the Practical Uses of Life," at the Bristol Athenæum, and the Mechanics' and Literary Institutes of Westminster, Ludlow, Shrewsbury, Hereford, Swansea, and Gloucester. At the three latter places very interesting and animated discussions ensued, in which several clergymen, professional men, gentry, and school-teachers took part. At Hereford, where Dean Dawes presided, the discussion was adjourned, and occupied two evenings. It is likely to result in the establishment of an evening institution for class instruction to adults in that city. Mr. Symons touched principally on the chief defects of school in-

struction, and the means of improving it; on the necessity of adapting education in the middle and higher ranks more closely to the individual capacities and social requirements of each class and sex, and on the full development of the moral, and, especially, the industrial faculties. He has also advocated Mechanics' Institutes, and the best manner of assimilating their functions to the tastes and necessities of the working-classes, and he has dwelt forcibly on the influence of individual character in every-day life on national welfare, and the consequent importance of making education tend to leaven society with its influence, and strengthen the energies and moral manhood of the people.

Mr. Symons suggests, that if gentlemen who have occasionally an evening to spare, would give similar lectures in their neighbourhoods on any popular subject with which they are familiar, and especially if they were to invite discussion, they might, at a very small sacrifice of time or trouble, do much to invigorate a class of Institutions which have too generally fallen into a state of comparative somnolency and uselessness, but which might easily be rendered valuable means of popular instruction.

## Home Correspondence.

### LIQUID MANURE.

Sir,—I have observed in the *Journal of the Society of Arts*, of the 19th instant, an account of a lecture given by a Mr. Wilkins, at the London Tavern, furnished by Mr. H. P. Stephenson, of 37, Charing-cross.

Whatever merit may attach to the method of such cultivation therein described, I beg most unequivocally to state the plan or system did not originate with Mr. Wilkins, but with myself (several years past). In confirmation of this statement, I now enclose a pamphlet, published by me in 1850, upwards of six thousand of which have been distributed. If you refer to page 10, you will see my description of the culture of celery, with a woodcut of the plan (this description is appended). I acquainted Mr. Wilkins of the circumstance more than twelve months past, and gave him my card at the Cattle Show in Baker-street, where he was expatiating to many farmers on the subject; he called me aside, and said he would write me on the matter, but I have never heard more of him. I think it but right in self defence that the public should know to whom the merit is due, and as such trust to your sense of justice to insert this in one of your early numbers.

I do not hesitate to state that all root crops and most cereals can be grown finer by the means in question than by any other, on light friable earth, but not on retentive or clayey soil. From experiments I have made, I am warranted in stating, that the fresher and longer (in reason) dung is the better for stiff soil, as the silica of the straw unites with the alumina and makes a better fertilizer than very rotten dung or liquid manure.

In fact I go further, and state that straw cut in lengths of about four inches, and well soaked in liquid manure, (urine from stables or feeding stalls) is the best possible manure for stiff soils; it keeps the soil open to receive all moisture, and likewise carries of all excess. There is no one method alone will answer for every soil; it would be much the same as saying a particular pill will cure all complaints.

I am of opinion that there is abundance of (waste) land which lets for 2s. 6d. per acre in many counties, on which I could grow the finest wheat, barley, turnips, in short, every crop, that would be worth six pounds per acre, with an outlay of ninety to one hundred pounds per acre; it would be a permanent improvement, and give astonishing results. By the plan in question I have raised celery 12lbs. per head; strawberries, seven of which weighed 17 ounces; and asparagus which filled tubes an inch in diameter; these were exhibited in private to editors and sub-editors of various newspapers five years since; therefore, it can be no secret.

I am, sir, yours truly,
JOHN ROBERTS, F.S.A.

Upnor lodge, near Rochester, Jan. 22, 1855.

"On the Improved Culture of Asparagus, with Roberts's Asparagus Tubes.—The secret consists in a rapid growth, and from its situation in a natural state, it is obvious that it should have a light soil, which offers little resistance to the emission of its roots, or the protrusion of its stems: the soil should be capable of receiving and parting with water readily, consequently, when asparagus beds are made, perfect drainage is the first step for consideration; that being ensured, dig out the earth two feet deep, four feet wide, and the length required,—place strong bushes at the bottom, one foot deep, then cover them with good old well-rotted stable dung, fully six inches deep or thick; upon the dung put two pounds of salt to every square yard, then some light friable earth, mixed with river sand, in the proportion of four parts earth one part of sand; these must be well sifted through a sieve, the holes of which must not be larger than ⅝ of an inch square, which will remove every stone of importance; when enough of this mixture is sifted, fill up the remaining six inches of the trench, and the bed is ready for the plants; mark out the spaces, allowing a square foot to each plant, open and spread out the roots each way. When all the plants are put in their respective places, sift over them four inches of the same mixture, soil and sand, as you put under them; the bed will then be finished. Late in March or early in April is the best time for the operation, if the weather is fine and dry, as it should be when the beds are made. Those who require the asparagus very large should plant in single rows, three feet apart, the plants two feet apart. There will be no further care required except to water in dry weather, and keep the beds free from weeds. At the end of October or early in November, when the stems are all ripe and withered, cut them off close to the soil, and put on the bed well-decayed leaves or well-rotted dung, to the depth of two inches, and upon that one pound of salt to each square yard, sift a little soil and sand over it, about an inch deep (more will not be necessary); nothing more need be done till early in March following, when the surface of the bed should be slightly forked over, but not deep, say three inches only; put on one pound of salt to each square yard, and water very frequently with liquid manure till the end of April, but on no account cut any of the asparagus that season, however fine it may appear. In October attend to give the same treatment as last, also again in March. This being the third season, you may cut a few of the finest heads only, but after this season, if the treatment is continued, as before stated, every autumn and spring, you may have fine asparagus for twenty years, of the best flavour, and without the silly plan of earthing up the beds three feet high, as gardeners generally do, merely to show a blanched end, as hard as wood, only about two inches of which can be eaten. All that labour may be saved by placing asparagus tubes over it as soon as it appears above the ground. These will preserve it tender and good, and every particle may be eaten with relish; so that, in fact, your beds may be said to produce three times as much serviceable food as those now generally in use. Those who have asparagus beds made on the old system, will find it much to their advantage to rake off three parts of the soil now heaped on them, when the stems are ripe, and treat them precisely as directed on the plan now set forth, and in spring, as soon as the heads appear above ground, place asparagus tubes over them,—the improvement will be such that I engage to say the old plan will never be tried again by the same person."

### THE COST OF PEAT CHARCOAL.

Sir,—In reply to a letter published in the Journal of the 26th instant, from Mr. Mark Fothergill, I beg to say that I stated distinctly that the cost of my patent peat charcoal would not exceed 10s. to 12s. per ton at the place of manufacture on the bog.

In reference to the statement of this gentleman, of the cost of manufacturing peat charcoal, the item of 6s. 9d. for draining and value of bog, is not applicable to my case, as I am offered thousands of acres of the finest bog at a mere nominal rent, and well *drained*, situate in the best localities for transit, either by rail or water conveyance; again, we neither pile, dry, burn, nor grind the peat previous to saturation with sulphuric acid; thus these items of cost,

amounting to £1 18s. 6d. by the retort method, are entirely avoided. Instead of which we have the following charges, viz.:—

Cutting bog, estimated dry, 1½ tons; carriage from bog to factory per tram, and placing in vats; sulphuric acid to saturate dry peat for fuel, half a ton; labour placing the bog in drying chambers and drawing the charge; over-looker, &c., &c.; wear and tear of plant . . . . . £0 10 0

Produce one ton of charcoal suitable for locomotive engines, smelting iron ore, and the general purposes of fuel. In case the bog is too tender, or not sufficiently compact, there will be a further charge for pressing and shaping (per machine), of about 9d. to 1s. per ton; and for grinding it to a size suitable for sanitary purposes and manure, another shilling must be added; in this way the 10s. to 12s. per ton is made up.

By the old process four tons of dried peat have to be burned in retorts or otherwise to produce one ton of charcoal, whilst by the patented process a sufficient quantity of peat to produce 1½ tons of dried peat will produce 1 ton of charcoal of superior quality, inasmuch as that produced by the old method contains in one ton the impurities of 4 tons of peat, whilst by the new process, one ton contains the impurities of only 1½ tons peat, the difference being in the ratio of 16 parts of impurities of the old to 6 in that produced by the new process.

In endeavouring to take a broad and comprehensive view of this great national question, I have arrived at the conclusion, that wherever a railway traverses a bog, there will the charcoal be made and consumed; wherever rich iron ore of a certain quality be found contiguous to bog, there the charcoal will be manufactured and the ore smelted. Bogs exist in many of the agricultural districts, and in the vicinity of large cities and towns there will the charcoal be made, and consumers supplied direct for sanitary and agricultural purposes, without the intervention of expensive agencies, warehousing, freights, carriage, &c. I think it fair to say in conclusion, I have based all my estimates of cost, calculations, &c., on large transactions. Apologising for occupying so much space on this occasion,

I remain,
Thine faithfully,
WILLIAM LONGMAID.

65, Beaumont-square,
London, Jan. 31, 1855.

## MEETINGS FOR THE ENSUING WEEK.

MON. Royal Inst. 2. General Monthly Meeting.
Architects, 8. Messrs. C. C. Nelson and M. D. Wyatt, "Some Notice of a Work entitled 'Early Christian Monuments of Constantinople, from the Fifth to the Twelfth Century,' by W. Salzenberg."
Chemical, 8.
Entomological, 8.

TUES. Horticultural, 2.
Royal Inst., 3. Professor Tyndall, "On Magnetism."
Civil Engineers, 8. Mr. J. Leslie, "Observations on the Flow of Water through Pipes and Orifices."
Linnæan, 8.
Pathological, 8.

WED. Society of Arts, 8. Mr. Thomas Dickins, "The Commercial Consideration of the Silk-Worm, and its Products."
Pharmaceutical, 8½.

THURS. Royal Inst., 3. Mr. Donne, "On English Literature."
Antiquaries, 8.
Royal, 8½.

FRI. Astronomical, 8. Anniversary.
Philological, 8.
Royal Inst., 8½. Prof. Owen, "On the Orangs and Chimpanzees, and their Structural Relations to Man."

SAT. Royal Inst, 3. Dr. Gladstone, "On the Principles of Chemistry."
Royal Botanic, 3¾.
Medical, 8.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS,

*Delivered on 25th January*, 1855.

Par. No.
18. The Crimea—Copy of Letter from General Canrobert.
6. Bills—Jurors and Juries (Ireland) (No. 2.)
12. Bills—Fairs and Markets (Ireland)
Steam Ship, "Forerunner"—Report.

*Delivered on 26th January*, 1855.

15. Local Boards of Health—Return.
13. Bill—Nuisances Removal and Diseases Prevention Acts, Consolidation and Amendment.
Post-office Arrangements with France—Convention.

*Delivered on 27th and 29th January*, 1855.

23. Coal (Heraclea)—Return.)
26. Naval Receipt and Expenditure—Account.
27. Deficiency Bills, &c.—Statements.
28. Public Income and Expenditure (Balance Sheet), Account.
24. Transports—Return
23. Coal (Heraclea), A Corrected Plan.
2. Bills—Jurors and Juries (Ireland).

*Session* 1854.

463. Metropolitan Parks, &c.—Return.
525. (1.) National Education in Ireland—Index to Lord's Report.

*Delivered on 30th January*, 1855.

19. Population, &c. (Scotland) Abstract Return.
31. Court of Session, (Scotland—Return.

446. Savings Bank—Return.

## PATENT LAW AMENDMENT ACT, 1852.

### APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Jan. 26th*, 1855.]

*Dated 14th October*, 1854.

2202. L. Monzani, Greyhound-place, Old Kent-road, Bedsteads.

*Dated 14th November*, 1854.

2414. G. Bodley, Everhard-street East—Revolving cannon.

*Dated 19th December*, 1854.

2671. W. P. Dreaper, Liverpool—Pianofortes.

*Dated 1st January*, 1855.

3. J. Seguin, Paris—Motive power.
5. S. Giles, Caledonian-road—Ratchet brace.

*Dated 2nd January*, 1855.

7. A. Roullion, Paris—Soap.
9. J. Arnold, Tamworth—Ornamenting bricks.
11. G. Peacock, Gracechurch-street—Propellers.

*Dated 3rd January*, 1855.

13. F. G. C. Dehaynin, Paris—Purification of hydrogen gas.
15. J. Lippurann, Paris—Splitting skins of animals.
17. S. A. Goddard, Birmingham—Fire-arm.
19. J. Gaskell, Manchester—Mortar and cement.
21. A. S. Stocker and S. Darling, 11, Poultry—Bottles, pots, jars, tubes, &c.
23. J. Venables and A. Mann, Burslem—Figures in plastic materials.
25. G. W. Muir, Glasgow—Warming and ventilating.

*Dated 5th January*, 1855.

27. L. J. Martin, Paris—Colours for printing and dyeing.
29. W. H. Bulmer and W. Bailey, Halifax—Combing machinery.
31. R. Ashworth and S. Stott, Rochdale—Spinning machinery.
33. F. Prince, 3, South-parade, Chelsea—Cartridges for fire-arms.

*Dated 6th January*, 1855.

35. J. H. Johnson, 47, Lincoln's-inn-fields—Agricultural machinery and motive power. (A communication.)
37. J. B. E. Ruttre, Paris—Treatment of woollen and vegetable rags.
39. J. Scott, Sunderland—Anchors.
41. C. J. Edwards, jun., Great Sutton-street, Clerkenwell, and F. Frasi, Tavistock-terrace, Holloway—Axle bearings.

*Dated 8th January*, 1855.

43. J. Huggins, Birmingham—Lint.
45. R. McCall, Pallas-Kenry, Limerick—Iron and steel.
47. W. and J. Hay, Glasgow—Motive-power engines.
49. J. Bury, Manchester—Embossing Orleans cloth.

*Dated 9th January*, 1855.

51. E. Hayes, Stony Stratford—Feeding thrashing machines.
53. J. Offord, Wells street, Oxford-street—Carriages.
55. P. E. Thomas, Paris—Obtaining wool from tissues of wool mixed with other fibres.
57. Commander H. J. Hall, R.N., Charlton, and A. Dalgety and E. Ledger, Deptford—Propelling ships.
59. W. Major, Copenhagen—Screw propellers.

*Dated 10th January, 1855.*

61. T. Wilson, Birmingham—Bands for fire-arms.
62. B. Predaval, 106, Great Russell-street—Paper pulp.
63. W. T. Henley, St. John-street-road—Steam boilers.
64. E. Booth, Gorton—Dressing, starching, and finishing textile fabrics.
65. W. C. Fuller, Bucklersbury—India-rubber springs.
66. H. Bessemer, Queen-street-place—Iron and steel.
68. L. P. Lehugeur and M. Uttinger, St. Denis, near Paris—Machinery for printing fabrics.

*Dated 11th January, 1855.*

69. J. Gedge, 4, Wellington-street South, Strand—Metallic flooring. (A communication.)
70. J. L. Hervé, Paris—Preserving meat and fish.
71. J. Norton, Dublin—Draining land.
72. A. Robertson, Upper Holloway—Packages for dry goods.
73. E. Hall, Dartford—Gunpowder
74. R. Oxland, Plymouth—Animal charcoal.
75. E. Townsend, Massachusetts—Stitching machinery. (A communication.)
76. J. Wood, 30, Barbican—Lettering and ornamenting glass.
77. W. L. Thomas, Anderton, Devon—Projectiles and gun wads.
78. S. W. Davids, Carnarvon—Elongating chandeliers and gaseliers.

*Dated 12th January, 1855.*

81. W. Hunt, Tipton—Iron.
82. J. R. Hodgson, Sunderland—Anchors.
83. F. V. Guyard, Gravelines—Electro-telegraphic communications.)
84. E. Miles, Stoke Hammond, Bucks—Coupling joint for tubing.
85. C. Turner, Burnley—Power looms.
86. J. Harrison and J. Oddie, Blackburn—Preparing yarns for weaving.
87. F. Preston, Manchester—Ordnance and projectiles.
88. W. Barningham, Salford—Connecting rails of railways.
89. A. Seithen, Coblenz, and J. H. Lichtenstein, Berlin—Cork machinery.
90. R. A. Brooman, 166, Fleet-street—De-vulcanizing India rubber (A communication.)
91. P. N. Gadol, Bermondsey—Tanning.

*Dated 13th January, 1855.*

93. W. H. Nevill, Llanelly—Reverberatory furnaces.
94. J. Graham, Hartshead Print Works, near Stalybridge—Fixing colours in yarns.
95. G. Warnecke, Frankfort-on-the-Maine—Preserving vegetables and fruits.
96. J. Claudot, Paris—Stucco.
97. M. D. Hollins, Stoke-upon-Trent—Slip kilns for drying clay.
98. E. L. Hayward, Blackfriars-road—Kitchen ranges.
99. J. C. Pearce, Bowling Iron Works—Iron.
100. J. E. Outridge, Constantinople—Transmitting motive-power.
101. J. Greenwood, Irwell-springs, near Bacup—Finishing textile fabrics.

*Dated 15th January, 1855.*

102. F. Burke, Montserrat, West Indies—Obtaining fibres from plantain, banana, aloe, penguin, &c.
103. W. T. Frost, Shottle, near Belper—Machinery for cleaning knives.
104. H. M. Ommaney, Chester—Projectiles.
105. J. P. Lark, Nine-elms-lane—Consumption of smoke.
106. G. Riley, 12, Portland-place North, Clapham-road—False bottom for mash tubs.
107. E. Haynes, jun., Bromley—Smoke-consuming furnace.

*Dated 16th January, 1855.*

108. M. T. Stefani, Paris—Fire-arms.
110. H. Adkins, Edgbaston, Birmingham—Bleaching oily and fatty bodies.
111. J. Yeoman, Walworth—Self-feeding furnaces.
112. G. Jackson, Manchester—Tents.
113. J. Simkin, Bolton-le-Moors—Rifles and fire-arms.
114. J. L. Norton, Holland-street, Blackfriars—Recovering wool from fabrics.
115. J. Saunders, St. John's-wood—Axles and shafting.
117. R. J. Mar'yon, 37, York-road, Lambeth—Steam engines.

*Dated 17th January, 1855.*

118. G. W. Garrood, Burnham—Machinery for raising or lowering weights.
119. S. Lomas, Manchester—Silk machinery.
120. J. Horton, Birmingham—Storing gunpowder.
121. A. Quertinier, Charleroi—Glass furnaces.
122. A. Colles, Millmount, Kilkenny—Sawing marble. (A communication.)
123. Capt. D. Davidson, Meiklewood-by-Stirling, N.B.—Pointing ordnance and restoring the aim.
124. J. Webster, Collingham—Motive power.
125. J. Higgins and T. S. Whitworth, Salford—Moulding for casting shot, shells, &c.
127. E. Hall, Salford—Wire ribbon.
128. L. Flower, 37, Great Russell-street, and G. A. Dixon, Stratford—Sifting and cleansing machinery.

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INVENTION WITH COMPLETE SPECIFICATION FILED.

154. C. Van den Bergh, Lacken, by Brussels—Rotatory steam-engines.—20th January, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed January 26th, 1855.*

1659. Henry Wickens, 4, Tokenhouse-yard—Improvements in the means of giving signals on railways and for other purposes.
1665. Richard Johnson, Manchester—Improvements in coating and insulating wire.
1679. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improved method of engraving.
1689. Edward Gillman, Twickenham—Improvements in the manufacture of paper, papier maché, and other similar articles from certain vegetable substances.
1724. Edouard Alexandre, Paris—Improvements in concertinas.
1738. Antoine Corvi, Paris—Improvements in musical instruments.
1761. Thomas George Taylor, King's Arms Yard, City—The use or application of the stalk of the hop plant in the manufacture of paper, pasteboard and millboard, cordage, rope, and textile fabrics.
1768. Henri Louis Edmond Désiré Hennebutte, Esquermes-lez-Lille (Nord), France—Improvements in the manufacture of varnishes.
1777. John Norton, Cork—Improvements in bolts and projectiles for fire-arms.
1785. Samuel Frankham, Greenland-place—Improved means of consuming smoke and economizing fuel in furnaces.
1788. William Burgess, Newgate-street—Improvement in or addition to reaping and mowing machines.
1789. William Siddons, Birmingham—Improvements in locks for guns and other fire-arms
1796. John Turner Wright, and Edwin Payton Wright, Birmingham—Improvements in the manufacture of ropes, cords, lines, and twines.
1798. Charles Blake, Saint Leonards—Improvement in or addition to doors and door and window frames.
1863. Henry Bessemer, Baxter-house, Old Saint Pancras-road—Improvements in guns for throwing projectiles for naval and military purposes.
1882. John Kirkham, Tonbridge-place, New-road, and Thomas Nesham Kirkham, Edith-grove, West Brompton—Improvements in the process of manufacturing and purifying gases for lighting and heating, and in apparatus to be employed therein.
1956. James Burns, Manchester—Improvements in ventilating ships.
2169. John Kershaw, Brixton—Improvements in the manufacture of wrought-iron railway wheels.
2196. Anthony Bernhard Baron Von Rathen, Wells-street—Improvements in bakers' and confectioners' ovens, and in furnaces or fireplaces connected therewith, parts of which improvements are applicable also to other ovens, furnaces, and stoves.
2311. William Reid, University-street—Improvements in the manufacture of galvanic batteries.
2416. David Davis, Wigmore-street, Cavendish-square—Improvement in roller blinds.
2458. Fisk Russell, Massachusetts, U.S.—Machine for mowing grass.
2459. William Beasley, Smethwick—Improvements in the manufacture of gun-barrels.
2481. Samuel Alfred Carpenter, Birmingham—Improved buckle or substitute for a buckle.
2486. Cyprien Marie Tessié du Motay, Paris—Improvement in treating soap to obtain back the fatty or oily matters in their original state,
2489. Henry Bessemer, Old Saint Pancras-road—Improvements in projectiles and in guns or ordnance used for discharging the same.
2490. Thomas De la Rue, Bunhill-row—Improvement in the manufacture of compositions suitable for printing rollers, printing ink, and flexible moulds.
2496. Joseph Gillott, jun., and Henry Gillott, Birmingham—Improvements in metallic pens, and new or improved machinery for the manufacture of metallic pens.
2510. George Gowland, South Castle-street, Liverpool—Improvements in the mariner's compass.
2512. Sydney Smith, Hyson Green Works, near Nottingham—Improvement in gauges for ascertaining the pressure of steam and other fluids.
2518. Edwin Pettitt, Manchester—Improvements in machinery for drawing cotton and other yarns.
2521. John Sands, 11, Austin Friars—Improvements in the mariner's compass. (A communication.)
2542. Joseph Maudslay, Westminster-road—Improvement in ordnance.

*Sealed January 30th, 1855.*

1713. Commander Alfred Kortright, R.N., James-street, Adelphi—Improvements in marine and surveying compasses.
1745. William Armand Gilbee, 4, South-street, Finsbury—Improvements in hydraulic machines.
1793. William Johnson, 47, Lincoln's Inn Fields—Improvements in furnaces, and in the consumption or prevention of smoke, (A communication.)
1795. Charles Cowper, 20, Southampton-buildings, Chancery-lane,—Improvements in the felting of hats, and in machinery for that purpose.
1815. Frederick Crace Calvert, Manchester—Improvements in the treatment of heating, puddling, and refinery iron slags or cinders.
1879. Thomas Carr, Liverpool—Improvements in steering apparatus.
2539. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improvements in apparatus for the manufacture of combustible gas.

Journal of the Society of Arts.

## *FRIDAY, FEBRUARY* 9, 1855.

## SPECIAL MEETING.

### Friday, February 2, 1855.

A Special Meeting was held on Friday, the 2nd instant, Viscount Ebrington, M.P., Chairman of Council, in the chair, to consider the question of the Congress proposed to be held in Paris during the period of the Industrial Exhibition, as to the Improvement of International Commercial Law.

After the advertisement convening the meeting had been read, the Chairman called on Mr. Levi to read his Paper—

### OBSERVATIONS ON THE PROPOSED CONGRESS FOR THE IMPROVEMENT OF INTERNATIONAL COMMERCIAL LAW.

By Leone Levi.

The expediency of assimilating the Commercial Law of Nations is no more a theoretical assertion, but an acknowledged practical want. The conference held in London in November, 1852, of deputies from our Chambers of Commerce and legal associations for assimilating the mercantile laws of England, Ireland, and Scotland, established the principle that the differences and the discrepancies existing in the mercantile law of nations, tend greatly to restrict and embarrass commerce by producing uncertainty, perplexity, and delay, inasmuch as every element of uncertainty increases the difficulty of calculating consequences, induces doubt and hesitation, and checks legitimate credit. Illustrations of such a principle were produced, and the evil arising therefrom were clearly pointed out in the proceedings of the Conference and in the reports of the several Chambers of Commerce, although the extent of their influence can hardly be appreciated, because such inconveniences are principally of a negative character, preventing the commencement and growth of mercantile transactions.

The observations I shall submit will, I trust, have the effect not only of giving a new impulse to the steps already taken by her Majesty's Government with respect to the United Kingdom, but also of extending the application of the principle among all trading countries. As the words "International Code of Commercial Law," convey ideas perhaps too vague in themselves, it may be desirable at the outset to circumscribe the meaning in which they are used in connection with the subject. First, then, when we speak of assimilating the Laws relating to commerce, we make no distinction as to the sources; they may be statutes, ordinances, or codes, or they may be usages of trade, or customs of place or of markets, sanctioned by law. Thus, for example, the Merchant Shipping Act, and an established custom relating to bills of exchange, come alike under the generic designation of law.

Mercantile Law has a limited sphere. It is a branch of the private law of a nation, but distinct from that portion which regulates the conduct of the individuals of whom the nation is composed in relation to the State or Government, such as public or political law. Hence, Mercantile Law does not include custom-house law, or financial or economical measures; nor do we interfere with these in promoting the assimilation of Commercial Laws. Again, as to the word Code, it is only the form in which the law is often embodied in a set of rules or definitions. So when we speak of codification, no reference is made by it to the value of the law itself, but simply to the mode of expressing, publishing, or applying it. The laws of two countries may be assimilated, yet the modes in which they are stated may continue different. The most important point, therefore, is the assimilation of the law—the codification of it is a secondary consideration.

When we speak of International Commercial Law, it must not be understood in the common acceptation of the term as connected with the law of nations, which has reference to the mutual relations of nations collectively. For example, the law by which Russian property (as being that of an enemy) on board a neutral ship shall be respected by the belligerents, is properly international as between nation and nation. As regards commercial law, however, it is essentially a branch of the international law of the state, and, as such, regulating the mercantile transactions of individuals within it only. Nevertheless, so numerous are the transactions which involve questions of right between different states, and between the subjects of different governments; such is the general nature of the rules observed in common by the inhabitants of different countries, and the similarity and homogeneity in the circumstances of commerce, and of the customs which spring alike in all countries, and of the rights and duties arising from buying and selling, which must be the same all the world over,—that mercantile law is held to be a branch of international law, a *jus maritimum universale*.

Having thus fixed the field of our operations, it is easy now to conceive in how many ways a merchant is affected by the provisions of mercantile law. Whether, in fact, he forms a partnership, purchases or sells, ships goods, effects an insurance, becomes a bankrupt, or sues another for money, —as partner, as debtor, and as creditor, as shipowner, as insurer, as shareholder in national enterprises, and even as an author or an artist,—in all these relations he is touched by the mercantile law of the state wherein he resides or transacts business. But it has been said that commerce is essentially universal and of an international character. A firm may have a house of business in many countries; goods are bought in one country and are shipped to another,—and, perhaps, on account of a merchant residing in a third. Bills may be drawn in this country on some person residing in another, and may circulate through many more. In such cases the individuals, the articles, the instrument and the transaction, are all affected by the law of the place wherein the business originates, by the law of the place through which it passes, and by that of the place wherein the affair is consummated.

Now to illustrate how such circumstances practically come into operation, let us suppose a Scotch merchant contracts with a merchant at Naples for certain English goods. At the very outset a difficulty is experienced in England, from the fact that the contract not having been made in writing, advantage is taken to refuse the shipment. After much disputing the goods are shipped, a vessel is chartered, and she sails. The ship gets damaged; she puts in at Malta, and there arrangements are made for a bottomry-bond. The ship proceeds to her destination to Naples. The purchaser becomes a bankrupt, and the goods are sequestrated by the Neapolitan tribunal. The shipper, ignorant of the mode of procedure in the Neapolitan Courts, loses the whole amount. Here is a transaction which, independent of the mode of payment by bills, becomes subject to the laws of England and Scotland, the law of Malta, a British colony, and the law of the Two Sicilies.

The anomalous state of the mercantile laws of the British empire gives just ground for surprise, for, from the queries issued by the Mercantile Law Commission, it appears that the points of difference between the Mercantile Law of England and Scotland, consisted of 14 points on the law of contract of goods and chattles; 19 points on bills and notes, 9 in the limitation of actions, 1 in shipping, 3 in the law of lien, 2 in the

law of parliament, 5 in mercantile guarantees, 5 in the law of principal debtor and surety, 13 in the law of debtor and creditor, 13 in the law of partnership, and most of the law on joint stock companies.

The Colonies and dependencies still preserve antiquated foreign laws as the bases of their jurisprudence—St. Louis is yet governed by the Coutume de Paris, which half a century ago was abrogated in France by the Code Napoleon. In the Canadas a portion has the French Code, a portion the English, and a portion the Scotch law; Trinidad has the Spanish law, and the Cape of Good Hope and Ceylon, the Roman Dutch law, long ago abolished in Holland by the new Code of Commerce. A communication was some time since made to the Society* as to the state of the Patent Law in the Colonies, which exhibits a complete discordance almost in every one of them, and considerable inconvenience is now felt regarding them as to the Law on Copyright.

The question is even more difficult as regards foreign countries, inasmuch as to the differences in the laws, there are superadded the differences of language. The legal differences are, moreover, in many cases of a very essential nature. Transactions which are perfectly legitimate in one country are illegal in another. Here a merchant would have certain rights arising from a specific trading; there they would not be acknowledged. The tribunals differ materially in their character and procedure. Proceedings commenced in one country are of no use in another. A person commits a fradulent bankruptcy in this country—he crosses the Atlantic and is safe. A bankruptcy is committed abroad; some of the creditors are in England; before these have any notice or any information conveyed to them, the tribunals settle the affairs, and the British creditor is ousted. A bill of exchange may be endorsed in France with the simple signature in blank. An Englishman accustomed to such mode of indorsement, takes it without observation. He finds out afterwards that such indorsement was not valid. These are practical difficulties which are often experienced, although they do not form the subjects of dispute in the British tribunals.

Some illustrations of the defects existing in our commercial treaties respecting the extradition of fraudulent bankrupts were given in the report of the London Committee of Merchants, and I deem it important, for the proper appreciation of the subject, to refer to them, the cases specified having been communicated to that committee by a well-known and highly respectable criminal officer. I will here quote two cases from the report alluded to:—

*Case of a fraudulent Teller in a Scotch Bank, who was set at liberty by the American courts, in consequence of a defect in the treaty between Great Britain and America.*

The first case to which I would draw the attention of the committee, was the case of a teller in one of the Scotch banks, who absconded to one of the United States, carrying with him several thousand pounds belonging to his employers. On the employment of the bank, which this man so defrauded, I followed him to America, and I succeded in apprehending him in one of the far west townships. At the moment I took him into custody, he delivered up to me the whole amount which he had stolen from the bank. Having thus secured the money, I took the fugitive before the mayor of the town, and applied for the interposition of his authority, by indorsation upon the Scotch warrant, to enable me to conduct the prisoner in custody through the American States homewards, for the purpose of taking his trial in Scotland. The magistrate who examined the warrant, and the evidence upon which it proceeded, expressed himself satisfied that the proceedings were regular, and that there was sufficient evidence to show that the person named in the warrant had stolen the bank's money, and that the man in custody was the thief. But, on referring to the treaty between this country and America, the mayor found that it only stipulated as follows: 'That each of the high contracting parties shall deliver up to the constituted authorities all persons fleeing from the respective countries, charged with the crime of murder, or assault with intent to murder, or piracy, or arson, or robbery, or forgery, or the utterance of forged paper,' and upon that magistrate's construction of this article of the treaty, he decided that it did not contemplate the case of *stealing* money, and that, therefore, he had no power to deliver up the prisoner to the British authorities; and to my great disappointment, he set at liberty this most fraudulent bank teller. My mission to America would thus have been entirely unsuccessful, had not the delinquent, at the moment I arrested him, while under the influence of nervous fear, disgorged the whole of the embezzled funds in his possession.

*Case of a fraudulent Teller in a Canadian Bank, who was set at liberty in London owing to a defect in the Act of Parliament which regulates such cases.*

The other case was placed in my hands in America, at the time I was engaged with the case of the Scotch bank teller. It was the case of another fraudulent bank teller, who had held that office in one of the principal banking establishments in Canada. For several years, while enjoying the entire confidence of his employers, he had carried on a systematic deception by falsifying the bank's books of account; and on the appointment of a new chairman of the Board of Directors, who showed an inclination to examine the bank's affairs more strictly than his predecessors, this teller took alarm, and suddenly decamped to the United States, not only carrying with him large sums of money, but leaving the bank's affairs in so entangled a position as to create further loss, the amount of which it was impossible to estimate.

On the employment of the Board of Directors of the Canadian Bank, and armed with a Canadian warrant, and a power of attorney, I travelled several thousand miles through the American States, tracing their teller here and there, until at length, finding himself closely pursued, he betook himself to sea, where, for a time, he was safe from my pursuit. Upon some slight information, and weighing probabilities, my judgment was convinced that he had sailed from Philadelphia for Great Britain. I reported my opinion to the bank, and under their instructions, I embarked for this country; and on my arrival, I found that the object of my pursuit had sailed from Philadelphia for Greenock. I immediately proceeded to Glasgow, where I discovered traces of him, and found that he had departed for London by way of Fleetwood. I followed him to the metropolis, and within a week afterwards, finding himself thus closely pursued, he gave himself up to the police authorities, confessing what he had done, and placed himself in the hands of justice. Possibly he may have done so under legal advice; for the police magistrate declined to detain him, on the ground that he had no jurisdiction, and the prisoner was discharged.

Under these circumstances, the Canadian warrant was instantly verified; and an application was made to the Secretary of State to indorse the warrant, under the Act 6 and 7 Vict., cap. 34, which was passed for the express purpose of meeting such cases. But, like the American treaty, that statute was found defective; the Home Secretary was advised by the crown lawyers that he could not safely detain the prisoner, and he accordingly declined to do so. The teller being in possession of a large sum of money belonging to the Canadian bank, an attempt was made to hold him to bail as a debtor, about to leave England; but this also failed, for want of legal evidence of an intention to quit the country.

Thus, in the very focus of London, within the jurisdiction of our own courts, and upon the admission of the man, in the very presence of the Secretary of State for the Home Department, that he had defrauded the Canadian bank, the directors were denied even the benefit of detaining the defendant to assist them in unravelling their affairs, which he had left in a position so confused and embarrasing.

Had the least violence been used; had either of these two delinquents effected a forcible taking of even a few shillings, which, technically, would have amounted to robbery, they would both have been detained, tried, and transported. But because they did what was far more base and cowardly, namely, steal their employer's money, not only were they set at liberty, but, in the case of the Canadian teller, an *admitted* claim for a large amount of abstracted property was, by reason of the defective state of the law, rendered void; and two flagrant and confessed criminals were enabled to confess their guilt, and, at the same time, to bid defiance to their own confiding employers whom they had robbed.

It is important also to notice that much inconvenience is at present experienced from the fact that in the Canadas

* Vide "Journal of the Society of Arts," Vol. II., page 213.

no bankrupt law exists, and a British creditor has scarcely any means of seizing in that country property in bills of exchange, or other instruments, in the hands of a bankrupt debtor.

It will, therefore, be acknowledged, that it is not a mere theory for the interests of commerce to remove these differences in the mercantile law and practice of nations. Let us remember that trade is elastic and expansive, provided, however, it be left in complete freedom, and that it be founded on firm security. To promote the freedom of trade is the duty of the political economist; to promote its security is the duty of the jurist. To shield the inviolability of credit is one of the best means of promoting the extension of commercial intercourse between individuals, as well as between nations; and, just in proportion as the legislative regulations of different countries tend to introduce confidence and security so the mercantile transactions between them will increase.

With what confidence can a British merchant carry on trade with a foreign country in which, should any quarrel arise, he knows not how, or even whether, he can obtain any redress? Much is truly done in a blind confidence that things will go right, and few anticipate reverses; but commerce will acquire a fresh energy when that which now silently operates as a negative restriction shall give place to open and positive freedom. Railways and telegraphs, improvements in shipping, and the extension of steam navigation—the advancement in the arts and manufactures—the increase of precious metal—the success of mining adventures—and, also, the "Universal Exhibitions"—have lately concurred in bringing nations together, in rendering the capital of all countries available in the spirit of speculation for the furthering of colossal enterprises. It is now demanded, and it becomes important that nations should afford the best support which it is in their power to concede for the security and freedom of this immense international commerce.

The question at present is, how can this be best attained? We answer, first, by removing all unnecessary discrepancies between the mercantile law of different countries; secondly, by promoting, as much as possible, a general knowledge of the laws in force in the respective countries; and, thirdly, by constituting commercial tribunals of an essentially international character. I cannot but think that a code is the best mode of extending the knowledge of mercantile law, and when these needless differences are by degrees removed, may we not look forward to the total realisation of the idea concentrated in an International Code of Commercial law? We re-echo the sublime words of the late learned Mr. Justice Story when he said—"What a magnificent spectacle will it be to witness the establishment of such a beautiful system of juridical ethics: to realise not the oppressive schemes of 'holy alliances' in a general conspiracy against the rights of mankind, but the universal empire of juridical reason, mingling with the concerns of commerce throughout the world, and imparting its beneficent light to the dark regions of the poles and the soft and luxurious climates of the tropics. Then, indeed, would be realised the splendid visions of Cicero, dreaming over the majestic fragments of his perfect republic; and Hooker's sublime personification of the law would stand forth almost as embodied truth, for 'all things in heaven and earth would do her homage, the very least as feeling her care, and the greatest as not exempted from her power.'"

The Society may be aware that, previous to the Great Exhibition in London, in 1851, I had the honour to present an address to his Royal Highness Prince Albert, our illustrious President, suggesting to him to turn to account the vast assemblage which that exhibition would attract by assembling a Congress for the promotion of such an International Code of Commercial Law. His Royal Highness honoured me with a communication on the subject, in which he expressed an opinion that uniformity in the laws by which commerce is regulated in different countries would be, if it could be obtained, of immense advantage to commerce generally; that it was a question for the different governments to effect such changes in their commercial laws as they may think desirable; and that it was of great utility to have the legislative enactments of different countries upon the same subject in juxta-position, so as to afford ready means for comparing their relative merits, which would infallibly lead to a certain degree of assimilation. The subject then was, however, not sufficiently mature for the proposed Congress.

A society having been formed in Edinburgh for the promotion of the object, presided over by the learned Professor More, it was determined, with the concurrence of the most important Chambers of Commerce of the Kingdom, especially the Liverpool, Leeds, Bradford, and Hull Chambers, in the first instance to endeavour to obtain an assimilation of the mercantile law of the United Kingdom, inasmuch as thereafter it would come with better grace to ask the adhesion to it of foreign countries. Hence the great Conference in 1852, the practical result of which was the issuing of a Royal Commission to inquire into and ascertain how far the Mercantile Law in the different parts of the United Kingdom of Great Britain and Ireland might be advantageously assimilated. Meanwhile other agencies were called into action, and by the efficient efforts of the London Committee of Merchants, several Bills were introduced into Parliament, some of which have since passed into law, whilst there is one Bill, re-introduced this session by the learned Lord Brougham, for Extending the Law of Diligence, or summary execution on Bills of Exchange, as it exists in Scotland and in continental countries, into England and Ireland.

In September, 1853, on the occasion of the Statistical Congress held at Brussels, the Edinburgh Society entrusted me with an address, which was also strengthened by communications from the Liverpool and Hull Chambers of Commerce, to M. Quetelet, the president, suggesting the expediency of submitting the subject of Commercial Law for the consideration of that Congress. That Congress was attended by official and other representatives from twenty-three States, and a resolution was passed expressing a wish and trust that the differences now existing in the mercantile legislation of nations might be diminished, if not removed altogether. The address and the resolution passed by the Congress formed the subjects of discussion in the reports of the deputies to the respective governments, whilst a memoir which I prepared was appended to the official report of the Congress, so that the question has been opened and submitted to the consideration of Europe and America.

Another opportunity now presents itself for the further promotion of this noble object in the forthcoming "Exposition Universelle" in Paris next summer, and I had recently the honour of presenting to the French Government an address for his Majesty, the Emperor, from the Edinburgh Society, submitting the desirableness of issuing an Imperial Commission, or of adopting any other step which might be deemed more expedient for ascertaining the most important points of difference between the laws of France and of the United Kingdom, and of the other kingdoms and states of Europe and America, which inquiry would doubtless prove of great value for determining the merits of the respective systems of jurisprudence. And with a view to obtain a comprehensive examination of the state of mercantile law in different countries, and also of merging into one focus the wisdom and practical knowledge of the most eminent jurists of Europe and America, the Society further submitted the expediency of assembling a Congress of jurists and deputies from the Chambers and Tribunals of Commerce of the principal commercial towns in the civilized world during the time of the Great Exhibition in Paris, in 1855, to lay the basis of an International Code of Commercial Law.

The steps suggested by the Edinburgh Society to the French Government are thus twofold—the issuing of an Imperial Commission and the assembling of a Congress.

The first is essential for ascertaining the principal points of difference in the legislation of different countries; the latter for combining the experience of commerce and the learning of the jurist, with a view to establish the basis of a good, sound, and equitable system of commercial laws. The commission suggested, should, like the British commission, if possible, be of an international character, in order that the peculiarities of, and the practical good or evil resulting from each system, may be properly demonstrated. The British Commission for the assimilation of the mercantile law of England, Ireland, and Scotland, is composed of an English, an Irish, and a Scotch Judge, two Queen's Counsel, one of whom is cognisant with Scotch law, and three merchants, two from London, representing two distinct classes of commerce, and one from Manchester, representing the manufacturing interests. The constitution and working of the International Imperial Commission, suggested to his Majesty the Emperor of the French, may be a matter of much difficulty, especially on account of the variety and distance of the countries which may join in the attempt. Another mode may be suggested, that of forming a Central Commission in Paris, exclusively of French jurists and merchants, which shall correspond with similar Royal Commissions, to be issued by the several States, each acting separately, yet upon one common basis.

In answer to the address of the Edinburgh Society, his Excellency, M. Fould, Minister of State, honoured me with a communication to the following effect:—

Paris, 8th November, 1854.

SIR,—I have placed before the Emperor the address of the Edinburgh Society and your work on Commercial Law. His Majesty has taken personal cognisance of these two interesting documents, and has appreciated, as it deserved to be, the proposal to choose the time of the Universal Exhibition in 1855, to assemble at Paris a European Congress, which shall lay down and determine the basis of an International Code of Commercial Law. Nevertheless his Majesty has not yet taken any decision on the subject, and by his orders I have committed the examination of the address of the Edinburgh Society and of your work, to the Legislative Section of the Council of State. When I shall render an account to the Emperor of the result of this examination, I shall have the honour again to submit to his Majesty the proposal of the Edinburgh Society.

Receive, sir, the assurance of my esteem,
The Minister of State,
ACHILLE FOULD.

This despatch reached me too late to admit of its being communicated to our noble Chairman previous to the delivery of his excellent address to the Society at the inaugural meeting of this session. This I regretted, not only on account of a most favourable opportunity having been thus lost of adding this subject to the many schemes of usefulness already included in the programme of the Society's proceedings of the year, but also because our noble Chairman had already taken a personal interest in it, when he attended the Statistical Congress in Brussels, in 1853. In consequence of the correspondence which passed subsequently between Viscount Ebrington and myself,* and after mature consideration of the documents submitted to them, the Council of the Society, at their meeting on the 20th December, passed a resolution, "That the Council considers the holding of the Universal Exhibition at Paris, in 1855, affords a favourable opportunity for discussing the improvement of International Commercial Law, and will forthwith seek the opinion and co-operation of the Chambers of Commerce of the United Kingdom on the subject." It is gratifying to find that the opinion of most of these Chambers has already been expressed as greatly in favour of the proposed Congress.

* Vide "Journal of the Society of Arts," Vol. III., p. 76.

I have, moreover, learnt that instructions have been transmitted to the French Consuls abroad, by the French Government, to ascertain the feeling of the mercantile classes on the subject, and the Chambers of Commerce of this country have, in consequence, framed resolutions of the tenor of those addressed to this Society. There are reasons, therefore, to trust, that the Emperor of the French may be disposed to assemble the proposed Congress. Indeed, when we consider the immense development of commerce in France since 1807, when the Code Napoleon was enacted, it is evident that it is susceptible of considerable improvement. The bankrupt law was entirely reformed in 1838, and many other portions have been considerably altered. Moreover, the Code itself was, in my humble opinion, defective in the distribution of some important branches of commercial law between the Civil and Commercial Codes and the Codes of Civil and Criminal Procedure. For instance, the contract of sale, which is essentially commercial, is scarcely hinted at in the Code de Commerce. The laws of partnership and agency are inconveniently divided between the Civil and Commercial Codes, whilst the law of arbitration is only to be found in the Code of Civil Procedure.

Besides the additions and annotations made by the judgments of the Courts, have already rendered the French Code a very imperfect exponent of the French law. It is fortunate for jurisprudence and commerce that in the great and noble undertaking of framing an International Code of Commercial Law we can appeal to one whose name is associated with the greatest reform ever accomplished in jurisprudence; and I hope that his Imperial Majesty Napoleon III. may be instrumental in effecting what will, doubtless, have a most beneficial influence on the interests of commerce, morals, and justice, throughout the world.

That there are difficulties to be surmounted for the accomplishment of such a design is beyond doubt. We know how wedded each country is to its own system of legislation, and how jealous nations are of introducing new principles. Nevertheless, a more liberal spirit universally prevails; extreme prejudices are abandoned, especially where it is ascertained that a change is likely to be productive of much good. For such a purpose, it is all-important to have in view the only basis upon which any assimilation can proceed, as established in the proposition of the conference in 1852, "That dismissing all local, and even national prejudices, the assimilation and improvement of the mercantile law of countries should be effected by selecting those principles and rules, wherever they may be found, which shall be deemed the best and most beneficial to the commercial classes and to the community at large."

From a Congress such as has been proposed, much mutual advantage may accrue. Great Britain possesses a boundless store of legal learning; France excels in the beauty and perspicuity of exposition of the law; the Spanish and Portuguese Codes are distinguised for their fullness and precision; Germany is rich in learned and philosophical jurisconsults; Italy has in her legislation many institutions in advance of other countries; whilst the United States of America have the greatest experience in international law, owing to their peculiar federative constitution, and the complicated relations consequently arising between their several semi-independent governments. Many kindred questions of a similar international character may also be advantageously considered on such an occasion, as, for instance, international Postage—international Copyright—and international Patents. The Decimalisation of our Coins, Weights, and Measures may also be appropriately discussed here; and the great question of International Maritime Law might be mooted, as regards the rights of commerce in time of war, though the latter can with difficulty be altogether separated from politics. These questions, however, are only incidental to the great object for which the proposed Congress

may be summoned, which is specially the promotion of an INTERNATIONAL CODE OF COMMERCIAL LAW.

## DISCUSSION.

Previous to the discussion, the Secretary stated that the Council had received letters from the Chambers of Commerce in Belfast, Bradford, Bristol, Hanley, Leeds, Liverpool, Newcastle, and Worcester, approving of the suggestion that a Congress should be held in Paris during the occurrence of the Universal Exhibition this year; and from the Blackburn Chamber of Commerce and the Manchester Commercial Association, expressing no opinion for or against the proposal. The following letter, addressed to Mr. Leone Levi, from Professor More, Chairman of the Edinburgh Society for Promoting an International Code of Commercial Law, was read by the Secretary:—

"Edinburgh, January 27, 1855.

"MY DEAR SIR,—I have just received your note of the 26th current, in reference to a meeting of the Society of Arts on Friday next, to consider the steps to be taken for promoting a general international code of commerce. I entirely approve, as I have formerly told you, of the proposed congress for this purpose, to be held at Paris during the time of the Great Exhibition of 1855, and it appears to me that France is the country where such a measure should originate. It has already a remarkably good code of commerce, which might be the foundation on which a general code for all the world might be reared. And if, as the "*Conferences*" in reference to this code hear, that Napoleon took much personal interest in its formation, and made several very useful suggestions, I cannot help thinking that his nephew, the present Emperor, might lay the foundation of a much higher fame, by countenancing such an undertaking as I refer to, than by the most brilliant victories he might achieve in the field. At all events, it is certain that the name of his uncle will descend to posterity (like that of Justinian) rather as the author of the French codes of law, than as the General who, by his matchless talents, overthrew such hosts of foes.

"But, when I speak of France as the country best entitled to take the lead in such an enterprise as that of originating a universal code of commercial law, I have in view chiefly the very high rank of her commercial jurists. When I call to my mind the unrivalled works of Pothier, of Valin, of Emerigon, besides the more recent invaluable works of Tonillier, Duvergier, Pardessus, Troplong, Fœlix, and many other modern jurists, to say nothing of the older jurists, Domat, D'Aguesseau, Cochin, and many others, it is impossible to dispute that the jurists of Europe owe more to France than to any other country in the world, for illustrating and expanding the rules and principles of commercial law.

"I trust, therefore, that something effectual will be done at the meeting of 1855, to promote a general code of international commercial law. To France, indeed, in the valuable "Concordance" of M. St. Joseph, we are indebted for the first attempt to give a general view of the discrepancies which at present exist in the commercial laws of different nations of Europe, and to which you have still more strongly directed attention by your valuable work, which, besides what may be found in St. Joseph's work, gives a view of the American, English, and Scottish law, and of many other nations.

"I am, very faithfully yours,

"J. S. MORE."

"To Leone Levi, Esq."

The noble CHAIRMAN having invited discussion upon the admirable paper with which Mr. Leone Levi had favoured them, in which he said there were ample subjects for discussion and observation,

Mr. HOWELL said he knew of no man more capable of elucidating this subject and laying it clearly before the English mind, than Mr. Leone Levi. Our present close alliance with France appeared to offer a happy opportunity of doing good in this matter, for undeniably France had taken the lead in framing sound laws for commercial purposes. The catalogue of learned men given that evening, in the letter of Professor More, showed that in that country great jurists, eminent thinking men, had considered the subject worthy of their study; and under the patronage of the first Napoleon and other great sovereigns, vast progress had been made in enacting rules of justice applicable to commerce. In England the subject had been comparatively neglected. Probably our colonial system had been adverse to a consistency in or uniformity of national law. In acquiring these possessions, past governments studied rather the means of enforcing and preserving our rule, than of proclaiming and spreading true principles of justice. In the two Canadas, the laws were dissimilar, and in a state highly prejudicial to the advancement of trade. At the Cape of Good Hope he found Dutch law (now obsolete in Holland) still in force. In Jamaica and Barbadoes, English law; in Trinidad, Spanish; in St. Lucia and the Mauritius, French laws prevailed. In Guernsey and Jersey very peculiar laws existed; and he thought the time had arrived when the mother country should review the charters under which such colonies were governed, and reconsider the policy of preserving those alleged principles, which, in his opinion, were as detrimental to the real improvement of a colony as they were to the commercial interests of mankind at large. The great business of the legislator was to discover true principles; and the nearer different countries approached them, the greater was the probability of assimilation being accomplished. He thought, if France and England could bring their laws nearer in character to each other, great good would result from it, but still it could only be done slowly. It was a work of time to break down prejudices in favour of laws to which communities were wedded by education and habit; and he was inclined to think that the success of their efforts would never be strikingly brilliant. He thought it a reproach upon the bar of this country that so little attention had been given by it to the framing of commercial law. He had himself given some attention to the subject, in conjunction with his friend on the right (Mr. Hawes), who was chairman of an active committee of merchants for the amendment of the bankruptcy laws; and it was deplorable to think that from amongst the multitude of able barristers living in this country, none had come forward to assist that committee with their skill and knowledge, in accomplishing a reform of the bankruptcy laws; and until very lately (since the subject had become popular) they had equally neglected that other great question, the partnership law. Mercantile men, who could ill spare the time, and had not the knowledge to do justice to bankruptcy laws, alone accomplished its amelioration. Not so in France—there eminent lawyers had found some attraction in the subject, and had thereby well served their country. He was one of those who thought that the progress of mankind in civilization depended upon the prevalence of free and fair dealing, of truth and the administration of justice. Many of our statute laws were enacted under a system totally different to that which was now recognised as the right system—free trade. In Britain and all her dependencies the opposite system prevailed, and the laws were adapted to it. Even now candidates for the representation of boroughs in Parliament succumbed to the old habit of the people, by promising to uphold their "rights and privileges." He hoped the time was come when the people would see that the general interest was the only true interest. The recent discoveries of science were so grand, and the means of spreading information were now so great and rapid, that it was rational to anticipate a large increase of civilization, education, and trade, and of the dissemination of those better principles which added to the dignity of man, which employed, nourished, and ennobled him; and, believing as he did, that these great objects would be accelerated by the discovery and enforcement of moral truth, he felt great pleasure in recommending the subject so ably put before them by Mr. Leone Levi, to the serious consideration of every public man.

Mr. HEADLAM, M.P., said, although he had not heard the early portion of the paper, yet having been somewhat familiar with the subject, he was in a condition to state his gratification at the manner in which it had been brought forward, and his strong sense of the value of the observations which had been addressed to them; and his

opinion that a wide field had been opened from which they might reap ample fruit. He could say, that amongst all the questions that came before the courts of law, he did not know any more practically difficult, both as to the application of the law and as to the law itself, than cases of international commercial law. For instance, there was the greatest difficulty in deciding, when contracts were made in foreign countries, how they should be construed, and as to the disposition of the property of a person who had died in one country being the subject of another country. The difficulty was scarcely to be explained without going more largely into technicalities than would be agreeable to the meeting; but it was worthy of the serious consideration of any one interested in pursuing the strictness of the law. He was bound to admit that there was much truth in the observation of the gentleman who had just sat down, that there was great lack of attention on the part of the lawyers of this country, to the improvement of the commercial law. Mr. Hawes smiled at the remark, but it could not be applied to him, for he had given great attention to the subject; but nevertheless, it was true that a very small degree of attention had been paid by those interested in the law to the improvement of the commercial law of the country. A far greater degree of attention had been bestowed upon the law relating to real property, although it had not led to any very great result. With respect to the bankruptcy law, there had been a number of acts passed, although he did not believe the general result had been very successful. However, to come to the question before them, he recollected that a few years ago the same subject as that now before the Society, was mooted before the Society for Promoting the Amendment of the Law, and he formed one of the deputation appointed to communicate with Lord Derby upon the subject of the appointment of a commission of inquiry into the working of the commercial laws, and he had hoped that such a commission would have been issued, and made a report, by means of which accurate information could be obtained as to the practical difference in the commercial laws of different countries; but nothing was done in it. He believed that now more attention was being paid to the subject. He had received a letter from the Chamber of Commerce of Newcastle, showing that they were alive to it, and were prepared to give their upport to any measures for improving the present state of the law. Having tried the government on a former occasion, and not obtained any result, (and perhaps it was a thing which could not be done by one country alone, and no measure could be brought before Parliament), he believed the best course was the one now suggested—viz., a congress of the representatives of different countries in Paris, when they might discover what were the real differences of the law, and endeavour to get a united action. From that much might be accomplished. There were, undoubtedly, many laws which had no inherent principle in themselves, on which it were better to have the same rule prevailing in all commercial countries, and it might be that they would have to yield some of their prejudices to obtain uniformity. Coins and weights and measures, and matters of that kind might be regulated on some principle of uniformity. It would be impossible to exaggerate the convenience to the commercial world if such a unity of action could be obtained amongst the nations of the earth.

Mr. Collier, M.P., felt, as a member of the bar, the truth of the reproach which had been thrown (although he was sure not offensively) upon that body, relative to the inattention of the bar to questions of this description, and, he might add, generally to questions of jurisprudence. He would say, as a member of the bar, he thought the profession was in some degree chargeable with attending more to legal technicalities than the principles of jurisprudence, and to the peculiarities of their own law rather than the law of other countries. He thought this arose in a great measure from the extreme intricacies—he might say, the absolute chaos—of the law of this country. They had in this country two systems of administration of justice,—one the common law, which originally was supposed to be all that was required, and to do all that was just, but which, from various circumstances, had turned out to be so unjust and so unequal to the requirements of the country, that another system had been required to modify and improve it, which was called equity. Thus they had a double system, which was unknown in any other country; but not satisfied with that, they had a third, that of the ecclesiastical courts; so that they had in fact three systems of administering justice, proceeding not only by different forms, but also by different principles; and there were also inferior tribunals, with their own modes of procedure, which he would not enter into. The consequence of this subdivision of jurisdictions was, that the attention of the lawyer was sufficiently occupied by attending to one branch only of his profession—one applied himself to Chancery, another to the common law, and another to the ecclesiastical courts—so that scarcely any one man thoroughly comprehended the whole of the law of England; and if he had not time and opportunity for that, it could hardly be expected he should give his attention to the laws of foreign countries. It was a fact to be admitted, that English lawyers generally were more technical, and though not less acute, perhaps more narrow-minded than the lawyers of most other countries. That was a defect which he thought ought to be remedied, and which he also thought was in course of being remedied, but it would necessarily be a slow course. But it seemed to him that they went to some extent to remedy it by calling to the councils of lawyers gentlemen who were not lawyers, but who brought to the consideration of law reform a practical acquaintance with the wants of the community, and other circumstances, and who were not hampered by too great a knowledge of technicalities; and the Society for the Amendment of the Law, being composed of laymen and lawyers, was calculated to promote the object they all had in view. He thought so long as law reform was left entirely to the judges and the older members of the profession, who having obtained for themselves honours and wealth from a long course of practice of the law as it was, were seldom much inclined to alter it; if law reform were left to that body, honourable and learned as it undoubtedly was, there was a danger that while all the rest of the world was moving on, Law Reform might remain stranded. (A laugh.) Under these circumstances he was glad to meet a society like this, who seemed inclined to take a step in advance. The object was to bring together the jurists of this country and the jurists of foreign countries, and he thought it was likely they might derive a good deal of light from their continental neighbours and an acquaintance with the law of other countries adapted to the convenience of mercantile and other transactions. He would mention one subject which it was very desirable should be considered—that was the law of partnership. In this country they were peculiar in that, and it was well that that should be amongst the subjects for consideration, in order that they might be instructed by the manner in which that law was administered in other countries. It seemed to him very desirable that the object contemplated by this society should be carried out, and that some of their body (including, he trusted, Mr. Leone Levi and other gentlemen versed in the commercial laws of other countries as well as this) should meet the foreign jurists and take measures for the assimilation of the mercantile laws of England with those of France and other continental countries. A commission had been appointed by Lord Aberdeen, but no report had yet been made; but they knew that all commissions were tardy. He concurred in the general thanks which they all felt were due to Mr. Leone Levi for his very able paper, and he (Mr. Collier) would be glad to co-operate in any measures which he deemed expedient to assimilate the laws of this and other countries.

Dr. Waddilove said, doubtless this was a question of much interest and importance, particularly at the present moment, inasmuch as an approximation towards legal uniformity would tend to cement that harmony which happily existed between France and England, and also to simplify and thus facilitate commercial relations with other countries. There was no one more competent to speak on this subject than Mr. Leone Levi. He had paid great attention to it; he had received a flattering tribute from the Society for his valuable work, in which he had collected the commercial laws of the world; he, therefore, could point out where they differed, and wherein it was desirable they should conform. At the same time he feared Mr. Levi had become so enamoured of his subject, and so much engrossed with its importance, that he had been tempted to press its claims a little beyond the limits of possibility, if not of nece-sity. The paper which had been read presented two prominent features—one, the structure of an universal commercial code, the other, the establishment of tribunals of commerce. Now a code was supposed to embody within it the whole legal system to which it related, whether of civil, municipal, or commercial law, and thus was of a most comprehensive character. It appeared, then, to him, impossible to reduce the commercial laws of all nations into one uniform system. Laws were interwoven with the national customs, the domestic habits, and the social relations of a people. If you attempted an universal code you would fail. No doubt there were some minor discrepancies in our own and the commercial laws of other nations, which you might remove. For instance, a bill of exchange was not negotiable in France unless it had endorsed on it other particulars besides the name of the indorsee, whereas in this country the name was sufficient; here a similarity of requisites might be secured by an easy process—a simple arrangement, by treaty or convention. But take another case. In this country it was known no married woman could enter into a contract. In France she could do so. Supposing a married woman in England gave an order for silk to a mercer in Paris. The French trader not doubting but that the law in England made the person who ordered the goods liable for their payment, sent the silk over to England. What was the consequence? How was the mercer in Paris to be paid? The married woman was not liable, and the mercer could only bring an action against the husband, and even he would not be responsible unless it could be proved that the articles were necessary, and consistent with the wife's condition in life. To assimilate the law here, you must either remove the disability of the married woman in England or impose it in France; either of which steps would be so subversive of a national and domestic institution, that you could scarcely effect the change in either direction. With regard to tribunals of commerce, he had no great faith in their operation as tribunals of justice, but if they were so desirable, you had them practically in a reference to arbitration. It was competent to merchants and others to submit their disputes to members of their own body for decision; this was frequently done, where the bankruptcy laws were supposed to operate prejudicially, by appointing a committee to arrange a bankrupt's affairs. Again, if you had tribunals of commerce, you must often produce evidence before them. We had established a system of evidence, technical and artificial, he admitted, but one which we looked upon as the safeguard of our liberties and the protection of our property and lives. A very different system prevailed in France. We were careful to prevent a person from criminating himself, or prejudicing his own case; the tribunals of France acted on a contrary principle. Thus, to assimilate modes of procedure between the two countries, would involve a violent change in established rules, and we must either abrogate our system and adopt that of France, or France must abrogate her system and adopt that of England. He made these remarks not to discourage the effort to assimilate the law regulating the commercial transactions of different nations, but to point out the difficulties that lie in the path of those who aimed at framing one universal code, and to caution them against attempting too much, for if they did, he feared they would fail, and, by grasping at the shadow, loose the substance.

Mr. Lyne said he held in his hand letters from men of high standing on the subject of commercial law, and he had come to lend his humble assistance to Mr. Leoni Levi on this occasion, an assistance which he might say upwards one thousand of the principal merchants of the country would be glad to afford. He had the honour to hold the position of Chairman of the Tribunal of Commerce Association, which was supported by upwards of 1000 subscribers, and he had letters from mercantile men in the principal towns of the kingdom, bearing upon this subject, and also one from Mr. Hume. He thought that in pushing forward a principle of this kind it ought, in the first instance, to be shown that in this country there was a wide spread feeling in favour of Tribunals of Commerce. He had been agitating that question for the last four years, and large sums of money had been spent in obtaining the opinions of the mercantile world, and he was now in a position to say that the commercial world was in favour of the principle of Tribunals of Commerce, such as were established in France. Remarkable enough, (the two members of parliament being present), two of the strongest letters he had received were one from the Chamber of Commerce of Newcastle, and the other from Plymouth, and Mr. Collier would know the warmth of feeling in the latter chamber. The Tribunal of Commercial Association now proposed to petition Parliament for an inquiry into this question, and in such towns as had no Chamber of Commerce, he had written to the Mayors to ask how far they went with them, and to request them to add their names to the petition for parliamentary inquiry into this great question. The answer received had been most favourable. They felt that in going to France to solicit co-operation in this movement, the question would be asked them, what court they had that would offer a guarantee that they were in earnest when they said that commercial dispntes ought to be submitted to natural and not to artificial or technical law. He knew there were many difficulties in the way of this, but he agreed with Mr. Hume that when they made the inquiry it would be found that the assimilation of commercial law and free trade must go hand in hand. As he before stated, he had come there to show that the association with which he was connected, were anxious to support Mr. Levi in his great movement, but he thought they should have something like commercial tribunals established in this country before they entered upon the project of the assimilation of the commercial laws of this with other countries.

Mr. H. T. Hope apologised for rising to propose a resolution following out the sentiments which had been delivered this evening, inasmuch as he was not able to bring any practical information or legal knowledge in illustration of the subject which had been so well discussed. He was, however, glad to find, both from the paper they had heard, and from the remarks of the legal gentlemen who had addressed them, that they all concurred in the utility and necessity for some movement being made in the direction proposed; and really, he must say, that any one who had heard the discussion must be led to the same conclusion. He therefore ventured to move the resolution which had been placed in his hands, and he did so with confidence, because he felt that the discussion which had taken place had elucidated the subject in a clear and satisfactory manner. The resolution was as follows:—

"That the Council of the Society of Arts be requested to appoint a Committee to consider the best means to be adopted to further the object of the proposed Congress at Paris, for the promotion of the assimilation of the commercial laws of the great nations of the world."

Mr. Chadwick thought it right, as doubts had been expressed as to the working of an international Congress, to state the precedent of one held on a branch of law affecting commercial intercourse—the law and practice

of quarantine — which had been attended with important success. It was initiated by the French government. They invited each European state affected by quarantine regulations to send one physician, and one consul as a representative of the national interests in international transit, to Paris. The General Board of Health in London had investigated and made a report on the subject of quarantines, and that report, translated into French and Italian, served, to a considerable extent, as the basis of discussion. Nothing could be fairer than the mode in which its propositions, as expounded by Dr. Sutherland, the Inspector of the Board, who attended as the medical delegate from England, were investigated, and its principles adopted by the Congress. The delegates of each state canvassed the facts serving as the foundations of the laws in force in the other. It turned out that the Spanish authorities based their practice on facts supposed to be the recognised results of experience in the British dominions. In reply it was shewn, that these supposed facts had been closely examined in England, and had been proved to be destitute of foundation. The mutual contributions of the state of experience and international information, as well as the points for future observation, made up a large amount of important knowledge to the delegates assembled. The practical result of the congress was, so far as the delegates were concerned, almost unanimous agreement; and, by the governments, the adoption of measures which had extensively mitigated the evils of quarantine—costing this country full two millions per annum,—and the obstructions to commercial intercourse,and the recognition of principles which mustlead to the eventual adoption of important physical improvements, more particularly in Turkey, and the seats of pestilence. From having had a share in the direction of the correspondence with the Congress, he (Mr. Chadwick) could state that the business was ably and impartially conducted by Dr. Melier and the French authorities. So satisfied were the delegates with the results, that they unanimously recommended to their respective governments that the congress should be renewed, at a given period of time, for a comparison of their experience in the several states on important points for observation during the interval. Though conclusions were adopted, as to an amended substantive law, and as to a common procedure for its enforcement, yet as the general result tended to the gradual abolition of the present practice, the circumstances were not such as to require any text as a branch of a code, as for a fixed practice. So satisfied were they with the procedure of the congress itself, that they also unanimously recommended its application, by means of other special delegates, to other points of international interests, such as common coinage, weights and measures, and accounts, and regulations of international transit and rights of way. Without going into the peculiar views of Mr. Levi on the question of an entire assimilation of commercial law, he (Mr. Chadwick) was satisfied, from the successful results in respect to the law and practice of quarantine, that the procedure by a congress similarly composed of special men for a special purpose, was proved to be eminently practical for the determination of sections or defined questions of international law and practice. For such questions, the precedent would suggest a congress composed of one juris consul from each state, and one political economist, or merchant, or consul, competent to represent mercantile and general public interests. For himself, however, he conceived that Great Britain had within itself and the colonies the means, as well as the greatest need, for the largest and most complete assimilation of commercial law, and that, too, upon principles much more simple than was commonly apprehended by professional men. When he was studying jurisprudence, he had proposed to himself, as an exercise, to take a particular case, comprising a set of common and simple circumstances, as a case of common assault, to let it occur in a churchyard, and then take it into an ecclesiastical court as a "brawl," and subject it to the peculiar procedure of that court for the investigation of the question of fact, and the determination of a question of law; next, to take the same case into the court of Queen's Bench upon an indictment, and also upon a civil action for damages; further, to raise some equitable question on which the same set of simple circumstances might be carried into the Court of Chancery. He proposed even to adventure to shew the different mode of trying the same by the procedure in Scotland, and thus to display upon the same common circumstances the needless variations in nomenclature to denote the same things, and of procedure, if not in substantive law, for the attainment of the same ends, and the sham science and craft by which the attainment of justice and the course of legislation, upon the most common and simple facts was beclouded and obstructed, under one and the same sovereign authority. It was a large task, but it would indicate great and clear results as to procedure and nomenclature, as well as to substantive law. The mercantil ecommunity were put to such exercises, to the obstruction of commerce, to great loss and vexation, without any profit in the way of amendment. As intimated, a mercantile house might on a single contract debt, or a bill of exchange, or a bankrupt's effects, be subjected not only to different procedures, nomenclatures, and substantive law, on common facts within these islands, but out of them, to the nomenclatures, procedures, and the different substantive laws, for the attainment of the same ends, of the chief European nations. They might be placed under a cloud of old French law in Canada, or subjected to the New French law, or the *cinq* codes, in the Mauritius, or be waylaid by the old Roman Dutch law in the Cape or at Ceylon, or beset by the procedures, nomenclature, and substantive old Spanish law at Trinidad. His revered friend, Mr. Jeremy Bentham, had propounded two great rules—which were as efficacious as they were simple, for the clearance of the fields of legislation and administration, which rules should never be lost sight of—for the relief of lay communities from the jungles which covered chicane and depredation; the one was, in legislation and jurisprudence always to do the same thing in the same way—choosing the best way; the other was, always to call the same thing by the same name. Now the application of these simple and popular rules within the Queen's own dominions—after a conflict of multiform procedures, to determine by lay assistance which was the best—would involve the assimilation with the chief commercial continental codes, those of France and Holland, and the largest preparation that could be made for a complete international assimilation of those points which most needed assimilation. The measures already adopted, of a commission for the assimilation of the commercal laws of England, Ireland, and Scotland, was valuable so far as it went,which, omitting the colonies was only halfway, for British commercial interests. It was scarcely possible that the work of assimilation for Great Britain would not have been largely improved by confronting the French commercial jurisprudence and legislation, not to speak of that of Holland. In respect to codification it was often assumed against it, that those who have paid attention to the subject, expect that it will supersede future legislation, whether judicial or popular. Members of a legal hierarchy ridiculed and held up to scorn, as examples of inherent and insuperable difficulty, the failures arising from the want of knowledge of the science of jurisprudence displayed in the first attempts at codification. Those authorities often manifested feelings of aversion to the construction of codes, to popularising the text of the law, and raised objections, not dissimilar to those of the Papal hierarchy against rendering the scriptures popularly accessible in the vulgar tongue. But, although in France there had been a large overgrowth of judicial interpretation, on the text of the written law, in which there were larger defects, there was, on the part of

the laity, a high Protestant feeling for their codes—a liking to having the rights and duties of the chief social relations, and the broad landmarks of the law, brought within their own view. Prussia would have endangered her possession of the Rhenish provinces if she had ventured to take away from the people the Code Napoleon. The institution of that code in Belgium had given France a hold upon that country of greater strength than might have been expected. It might have been well for the improvement of the people of the Peninsula if France had not been prevented implanting it there. At this time Great Britain, with her conflicting provincial laws and customs in her various colonies, was in a condition not dissimilar to that of France, before her provincial laws and customs and legislation were reduced to one common national procedure, and one common text by the Code Napoleon. Viewing the hold obtained by one common, cheap, and accessible procedure, and popularly cognoscible text and body of law; looking to our colonial and commercial interests, it was surely a serious political oversight to allow such questions as the one brought before them to remain unnoticed, and in the state in which they then were.

Colonel Sykes apprehended that the "practical vitality" alluded to in the paper which had been forwarded with the invitations to attend this meeting, consisted in the appointment of a committee for the purpose of discussing the question at the meeting in Paris in May next. The thing to look to was—what would be the practical results unless the parties came to some common consent as to what they were to do. They had had some experience in matters of this kind from the Congress at Brussels. Questions were discussed with ability, ardour, and sincerity, but what were the practical results? None! The present was quite a distinct question from that of a national tribunal for deciding commercial questions by our own laws, amongst our own merchants, which had been referred to by Mr. Lyne. What they had in view now was that they should have such a code of laws—(for it must come to that)—that all nations should be content in commercial questions—between the French and English, between the Portuguese and the American, and between the Italian and the German—that all disputes should be decided by one common code, agreed to amongst them all. No doubt the difficulty of the thing was enormous, and Dr. Waddilove had very properly warned the meeting of the difficulty of overcoming national feelings and ancient laws and prejudices, but the object of the meeting was to induce nations to give up their prejudices, and to adopt such a system as would be acceptable to all. The practical results of their exertions might, he admitted, be doubtful; the chance of failure should not deter them from making the attempt, for what enormous prejudices had ere now been prostrated by the perseverance of man, or by the combinations of men. With regard to the advantage of the project, it was universal. They were called upon to give "practical vitality" to it. Would the meeting of a Congress in Paris to bandy words produce "practical vitality?" If they went with a code already drawn up, and said, "Will this be acceptable to you?" the French might say, "Our system is so and so." Then the English might say, "That is opposed to our's;" and there must be a compromise before they could make a law acceptable to both parties. If they talked with a code before them it might be pulled to pieces, but they might be able to amalgamate the fragments; but without that, he thought there was very little hope of useful results. Mr. Levi, from the great attention he had given to this subject, was, perhaps, of all others, the most competent man to draw up the rough draft of such a code, and, with that in their hands, they might go and say—"Here is something to debate upon: take from it, or add to it, as you like."

Mr. W. Hawes remarked that for his own part he felt much obliged to Mr. Waddilove for calling their attention to the difficulties of this subject, and he did not think that Mr. Levi himself was so sanguine as to believe that one meeting in Paris would introduce a universal system of commercial law for the whole world; but he (Mr. Hawes) believed that a discussion such as would take place at the proposed Congress would be the means of extending the subject over a larger field than was at present the case, and would tend to remove prejudices, which perhaps existed in this country as strongly as in any other; for they would recollect the attempt to assimilate the commercial laws even of the United Kingdom was attended with greater difficulty than any one had any idea of. But whilst this change was in progress he thought it was a fitting time to take a wider range of the subject, for in so doing we might derive much benefit by consulting with the lawyers of other countries. Dr. Waddilove, in the illustrations he had given, had selected instances perhaps of the least interest in commercial law—a mere nothing.

Dr. Waddilove—I contrasted the two cases. One could be easily arranged, whilst there would be considerable difficulty as regards the other.

Mr. Hawes—It was admitted that the practice as to bills of exchange in France and England might easily be assimilated, and if that alone were effected in 1855, it would be something gained. But do not let them drop the project because there were difficulties in the way. He did not agree with Col. Sykes, that the proposed congress on this subject would result similarly to that at Brussels.

Col. Sykes—I say, unless you go with the draft of a code to be submitted.

Mr. Hawes—But there was only a programme at Brussels, though it was a very good one, and he presumed some similar course would be adopted in this instance. Considering the lateness of the hour, he would not detain the meeting longer than to second the resolution which Mr. Hope had proposed.

Mr. Campin said there was one division of this subject which was particularly deserving of consideration, and that was with regard to the patent laws. Mr. Levi had mentioned the dissimilarity of the law of patents in England and in the colonies; and the difficulty of the patent laws in the colonies was even greater than in foreign countries, inasmuch as they could ascertain the state of the law in the latter, whilst they did not know what was going on in that respect in the colonies. With regard to patents in foreign parts, he would mention this fact. If a foreigner took out a patent in England, he could manufacture the object in his own country and import them here, and his patent remained valid; but not so if an Englishman took out a foreign patent. With reference to France and almost all the other continental countries, the article must be manufactured in the countries in which the patent was taken out, otherwise the patent was rendered invalid.

Mr. Elihu Burritt, having been invited by the noble chairman to express his opinions, said, he confessed up to that evening he had not paid much consideration to this subject, but he felt interested in supporting the object and tendency of this proposition. He had been engaged in endeavouring to promote the holding of a congress of nations, which might possibly improve the condition of the whole system of international law, and the objects proposed in the able paper which had been read, had been embraced somewhat in that proposition of holding a general congress of nations. He earnestly hoped that it might be held, and that all the benefits anticipated from it might be fully realised. He was sure no circumstance could be more favourable for holding such a congress, and he trusted that the opening of the exhibition in Paris would be the opening of a new era in the commercial world, and that everything which tended to embarrass the commercial intercourse of the world would be abolished.

The Noble Chairman said, before putting the resolution he would say a few words. In the first place, having at-

tended two Congresses in Brussels, he could speak from experience as to the great benefit derived by the individuals attending them from having the points which they had been accustomed to view with eyes tinged with the particular habits of thought belonging to their respective countries, presented in quite a different light. That was peculiarly the case with the Sanitary Congress, and it was curious what a large number of persons arrived with different habits of thought, who, after they were engaged some time in amicable discussion, were brought to call things by the same name, and very much to agree as to the best thing to be done. It was curious to observe what unanimity, after a time, attended the moving and passing of the resolutions, on which, when they first came together, hardly two persons had the same opinion. A great deal depended upon the thing being clearly stated, and the propositions being properly drawn up: and never were they better drawn up than at these two Congresses, by the eminent men of that small, but well-governed country—Belgium—everything being put not so as to bind the Congress to particular view, but rather to elicit opinions on successive points He could not agree with the opinion expressed that the direct effect of the Sanitary Congress had not been considerable. He knew that, since his return, he and his friends had been in correspondence with a number of gentlemen in different parts of Europe upon sanitary matters, and that undertakings had been commenced in different parts of Europe, particularly having for their object the benefit of the labouring classes, which would, probably, not have been thought of if they had not been suggested by the details of the benefits brought about—some in this country, and some in Belgium. So also, in the Statistical Congress, which he attended as a humble member of the Statistical Society, considerable results were brought about. There was a hope of getting many facts recorded upon some basis to be agreed upon. There were hopes of an assimilation of the scale of maps, and of the registration of disease, &c.; but, with regard to that of crime, they found that the difference of the laws created an insuperable difficulty. It was difficult to make them understand why the picking of apples *from* a tree should be treated as one offence, and the picking of the apples from the ground *under* the tree as another, and how it was that felony was reckoned more heinous than a misdemeanor, although the moral guilt might be less. When they spoke of the term "codification" he could not do better than quote the words of Mr. Levi upon it:—"As to the word Code, it is only the form in which the law is often embodied in a set of rules or definitions. So when we speak of codification, no reference is made by it to the value of the law itself, but simply to the mode of expressing, publishing, or applying it. The laws of two countries may be assimilated, yet the modes in which they are stated may continue different. The most important point, therefore is the assimilation of the law—the codification of it is a secondary consideration." It was obvious (continued his lordship) that the codification of the same regulation with regard to bills of exchange, might be different in different countries. The expression of the law might be different, and yet a great boon be conferred by the assimilation of the subject of the law itself. He agreed with Colonel Sykes, that if they did not make a beginning, nothing at all would be done. It was for them to sow the seed, and if they only got a small advantage in trifling points of commercial law, something would be gained; and they might hope that future generations might reap the advantages of further assimilations of laws, as well as coins, and weights, and measures with the increasing intercourse, which would bring different governments and states into closer union, and more intimate connection than was the case with the different parts of the same country a few centuries ago. His lordship then put the resolution, which having been unaminously approved, he added that it only now remained for him to express the best thanks of the meeting to Mr. Levi for the very lucid and interesting paper with which he had favoured them; and to express a hope that on this committee they might have the valuable—he might say the indispensable, benefit of that gentleman's services.

Mr. Levi, in returning thanks for the vote which had been passed, expressed his great gratification at the manner in which the subject had been discussed, and hoped that the members of the Society would keep steadily in view the point to be attained, even though they might, perhaps, think that the proposed Congress would but partially aid its accomplishment. He then read a petition to the Right Honourable the President of the Board of Trade, which had been signed by the Earl of Harrowby, Viscount Ebrington, M.P., Sir George Goodman, M.P., Mr. R. P. Collier, M.P., Q.C., Mr. W. Hawes, Dr. John Lee, Mr. F. Bennoch, Colonel Sykes, F.R.S., Mr. T. Winkworth, Mr. H. T. Hope, Mr. F. Lyne, Mr. E. Chadwick, C.B., Rev. W. Elliott, M.A., Mr. Charles Boyle, and others, to the following effect:—"The undersigned having learnt that his Majesty the Emperor of the French has graciously taken a personal interest in an address transmitted by the Edinburgh Society, for promoting an International Code of Commercial Law, suggesting to his Majesty the expediency of seizing the occasion of the Great Exhibition in Paris, in 1855, for the holding of a Congress of Deputies from all civilized nations, for establishing the basis of an International Code of Commercial Law, take leave to express their conviction that the proposed Congress would be of the highest importance for ascertaining the practical working of many important and controverted principles of Mercantile Law in different countries; and also for laying the foundation of measures of a comprehensive character, and of great utility to the commercial world. The undersigned, therefore, respectfully suggest, that her Majesty's goverment should represent to the government of his Majesty the Emperor of the French, the interest with which the proposed Congress would be regarded in Great Britain, and their readiness to send representatives to take part in a Congress which is calculated to produce much benefit to jurisprudence and commerce, strengthen the amity now happily existing between France and Great Britain, and assist the extension of commercial relations between all civilized nations." This petition would remain with the Secretary for signature for a few days.

Mr. Collier, M.P., proposed a vote of thanks to the noble chairman, for the ability with which he had presided over the proceedings, which having been accorded by acclamation, the meeting adjourned.

## TENTH ORDINARY MEETING.

Wednesday, February, 7, 1855.

The Tenth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 7th inst., Thomas Field Gibson, Esq., F.G.S., in the chair.

The following Candidates were balloted for and duly elected ordinary members:—

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| Colman, Jeremiah James. | Pennell, Edmund, C.E. |
| Gwynne, James Egleson Anderson. | Roden, William Sergeant. |
| Longstaff, G. Dixon, M.D. | Staley, Rev. Thomas Nettleship, M.A. |

The following Institution has been taken into Union since the last announcement:—

385. Shotley Bridge, Mechanics' Institution.

The Paper read was

## THE COMMERCIAL CONSIDERATION OF THE SILK WORM AND ITS PRODUCTS.

By Thomas Dickins.

Having been honoured by your Council with an invitation to prepare a paper on some branch of the Silk Manufacture, I have selected for your consideration this evening "The Silk Worm and its Products," as viewed in their commercial aspect. This part of the subject is both primary in interest and illustrative of the first process of the silk manufacture.

I make no pretensions to literary composition, and therefore have ventured upon my task not without some diffidence, yet with the hope that an honest tale will tell well though plainly told.

I doubt not you are familiar with the source whence all silk is derived, viz., the silk worm, the *Bombyx Mori.* Its natural history I will not presume to enter upon, but will confine my remarks chiefly to the beautiful results and commercial value of this, perhaps, the most interesting of the insect tribe of animated nature.

Though we are all conversant with and highly appreciate the costly material we obtain from this little insect; though it engages, perhaps, 50 millions of our capital, and employs and supports about one million of our population, yet we know but little of its habits, and still less of the nature and mode of obtaining its valuable productions. All this has hitherto escaped the penetrating eye of English interest, which has visited, searched, and valued almost all corners and productions of the globe.

Our merchants import cotton, wool, and flax, in their raw or primitive condition. The manufacturers operating on those fibrous materials, aided by the progressive skill and ingenuity of our mechanists, have so greatly improved the quality of their productions, that they now bear no resemblance to the imperfect goods made, say, 50 years since. They have improved in quality and immensely increased in quantity, and though they have diminished the price of their manufactures, they have added enormously to their own wealth, and to that of the kingdom in general. As evidence I refer you to the palatial edifices of Manchester, Leeds, Bradford, and Glasgow, and their not less important, though tributary friends, such as Liverpool and Birmingham.

We can receive the short fibrous materials of the antipodes, and return them in goods at less cost to the natives than their own clumsy manufactures.

During this golden age, how has the silk trade fared? The worm has given us the most perfect and the most beautiful of all fibres,—for none yield such a continuous length,—each worm affording about 500 or 600 yards of usable quality, but owing to the defective process of the first operation, we have had a raw material so comparatively imperfect, that no industry or skill could well remedy the defects. Such as our raw material was fifty years ago, such (for any improvement is scarcely to be recognised) is it now, and as a natural consequence, our silk manufactures, excepting in artistic beauty, remain equally stagnant; indeed, in intrinsic value, they have deteriorated.

Silk manufacturers, with a view of cheapening their productions and extending their trade, have resorted to many ingenious expedients, but their efforts, I consider, have been directed to the wrong points. The basis of their manufacture, the raw material, should have had their first attention towards improvement, whereas, the pressure of their economy has weighed chiefly and heavily upon the operatives, especially the poor weavers. You cannot visit the wretched habitations in Spitalfields, and notice the joyless and pallid faces of their inmates, without a conviction that there must exist some wrong principle in the very nature of the industry which doles out to them so scanty a subsistence, and retains them in the slough of so much despondent poverty. Although they operate upon a very valuable article of luxury, their remuneration and position among the working classes, is far below the average of that of other artizans, and yet the beautiful productions from their miserable garrets, adorn chiefly those to whom want is never known.

I venture to assert, that the average weekly earnings of the silk weavers of this country do not amount to 10s. each. I do not, however, believe that manufacturers can afford to pay more. I know of no other remedy than an extension of the silk trade, and, consequently, an increased demand for labour. No wonder, then, that the silk trade has made less progress than any other branch of British industry, and that it continues so unhealthy as compared with the other staple manufactures.

Let us now consider the entire process of manufacturing the raw material. Commencing with the worm, our young people can claim the most acquaintance; with them it has always been an especial favourite; they have had a delight in rearing it, and their reward for so much care and attention has been a few small skeins of golden-coloured silk, deposited generally between the leaves of some valued book, or among the archives of their curiosities. In fact, no practical result has hitherto attended the rearing of silk-worms in this country. They have been no other than a child's toy from Covent-garden. I will invite your attention presently to a more promising result of silk culture here; but we will first examine its nature and operations abroad,

Silk is chiefly produced in France, Italy, China, Turkey, Spain, Greece, India, Persia, and in all countries where the mulberry tree thrives. The eggs are invariably of about the same size—that of a pin's head; but the worm prospers according to its good and healthy living, climate, and education.

As soon as it has emerged from its shell it eagerly seeks its food, and, except during its periods of torpor and changes of garment, is continually feeding, and rapidly progressing in growth, until it reaches maturity. From infancy to its old age, it enjoys but about five or six weeks, when it will have attained a length exceeding three inches. It then commences the shroud, to serve it as a living sepulchre until the period of its second transformation,—that shroud is the cocoon, the money-value of the worm, and the source of so much wealth to all nations who cultivate it.

When prepared to spin, the worm appears impatient and restless for a day or two, and then seeks some favourable position whereon it may securely construct its habitation. In the reeling establishments in France and Italy, called filatures, the rooms are lofty and well-ventilated, and the temperature kept at a moderate and uniform degree. The worms are hatched simultaneously with the foliation of the mulberry, whose leaves, as frequently as needed, are supplied to the young cormorants, the refuse leaves and matter being at the same time removed. At this early period of their growth extreme care is necessary, so much so that attendance is bestowed upon them night and day, cleanliness and a pure atmosphere being most essential; any serious neglect of the sanitary arrangements would probably be fatal. They are reared—educated is the technical term—in trays placed on shelves, of which there are various ranges, and there they remain, passing through their several periods of rest and change, until they cease feeding altogether, and evince an inclination to spin, or, as the cultivators say, "to mount."

The facilities for spinning are afforded by dry thorns and rushes being interlaced and arranged in arches over the trays, so that the worm may easily ascend. Each selects its resting-place, and there commences and completes its costly domicile.

It frequently happens that two worms will decide upon one and the same spot, and begin spinning *dos-a-dos*, until they find themselves enveloped in their joint web; they, however, proceed with their labours, and work with such regular speed, not over-running each other, that the two threads will, in the subsequent reeling, wind off to-

gether. Such cocoons are termed *doubles*, and are of less value than those composed only of a single filament. I have here a specimen of cocoons "*au naturel*," obligingly furnished me by a gentleman in Cornwall, Mr. J. Hodson, who, imbued with the spirit of Mrs. Whitby, has most perseveringly for years cultivated the worm and its food. These are a portion of his productions of last year, when he was so successful that he did not lose one worm out of about 1,200. I have reeled a considerable number of his cocoons, similar to these, and pronounce them equal to the average good quality grown on the Continent. Mr. Hodson has thus practically demonstrated that very excellent silk may be produced in this country,—a result entirely confirmed by an opinion given me by Sir J. Bowring, just previous to his departure for China, that nature has been so considerate and bountiful with regard to the silk culture, that she has provided a mulberry tree for every moderate clime, and that the entire temperate zones have mulberry trees indigenous to their respective localities.

Mr. Hodson has tried various kinds, but, after all his experiments, he is, I believe, very favourably disposed to our common black, as being the most hardy, and therefore the most suitable for our climate. His opinion is, that it may, in favourable localities, be very advantageously and profitably cultivated. The subject is under consideration at present, and I am sure you will agree with me in wishing every success to its promoters.

One or two attempts were, many years since, made by public companies, and the royalty of England has at times afforded its special patronage, but the results were unfavourable, owing to the subject not then being well understood. They planted the wrong trees in the wrong places, had too expensive a management, so that their finances became exhausted before they could realise any of their efforts. I recently asked Mr. Hodson for his opinions on this head, and I beg to relate them in *extenso.*

"The results of experiments in this country, prove that an attempt on a limited but sufficient scale, need not be a failure—and, if only as a means of bringing the subject practically under the notice of the emigrating classes to our colonies, and thus eventually furnishing a larger amount of the raw material to our manufactures, the undertaking would acquire a national importance. That our climate generally suits the healthy organisation of the silk worm, admits of no doubt, the only difficulty has been the ready supply of food. The white species of mulberry adopted here, in consequence of the preference given to it in France and Italy, has not yet a fair trial. In suitable soils and aspects, and receiving similar fostering care and attention as abroad, the plant would thrive well, and though in rapidity of growth it might not rival that nurtured under a more fervid sun—its nourishing and silk assimilating qualities may equal, whilst its durability of existence may surpass, its southern congener.

"Respecting the black species of mulberry, eschewed by our neighbours as a coarser-leaved kind, and, on that supposition, neglected by us, we have everything to hope from. The principal drawback apparently—and this may prove unfounded in a great measure—is its tardy propagation and growth. For the space which its head of branches occupies, there is such a concentration of leaves, as to make it highly probable that in a few years, an acre of land planted with this kind would yield 3 or 4 tons weight of leaves; and the quantity would annually increase. A ton of leaves would produce, with tolerable management, fifteen pounds worth of silk. A single tree in France, of large size, will sometimes pay its owner 100 francs. Labour would form a prominent, but in this country, not an undesirable item of expense. The greatest part could be accomplished by girls and women. The net profit per acre realised by continental culture, after many inquiries, has not yet been ascertained by the writer—nor does he think it can be easily obtained, except by personal and careful investigation. It cannot but strike any who read the reports on the subject, and know the proceedings in practice, what little progress has been made by the main body of cultivators, during the century or two in which it has formed a part of their agriculture."

I have rather disgressed from my subject,—but Mr. Hodson's success has been so meritorious that I could not hesitate to bring it prominently before you.

We left the untiring artisans constructing their cocoons, which they managed thus:—A silken filament, coated with gummy saliva, exudes from each of two orifices, one at each side of the mouth; these unite immediately and are attached to some part of the twig; the insect then inclines its head to another part, and again attaches its web, and so forms a line; this is repeated from corner to corner, and round and about, and back again, until sufficient outwork be made to support the builder upon its own structure—it then commences the continuous thread, which is placed, not in revolutions, but in a repeated series of the figure 8—the whole being systematically and beautifully arranged by aid of its soft fore-feet, which smooth and regulate the progress of the web. This continues until the worm has formed one entire round of its oval vault—the outer course; it then proceeds in a similar way for another, and for three or four more, according to its material and vigour—when, having exhausted its strength and inward treasures, it weaves its inner lining, which is so very fine and soft that, though a continuous thread like the outer envelope it cannot profitably be drawn off in reeling. Having completed this process, which occupies three or four days, the worm, then being shrivelled up to one-fourth its former size, ceases all labour, shuffles off its caterpillar coil, and becomes an aurelia, in its silken bed, suspended in its natural bower.

It is then the rude hand of man commences operations —ruthlessly are the cocoons removed and eagerly examined. A portion of the finest are laid aside for reproduction, the remainder are exposed to a heat, by steam or otherwise, sufficient to destroy the vitality of the chrysalis, after which they are ready for being reeled. Such as were laid aside for reproduction wait the metamorphosis of the grub into the butterfly, which, naturally furnished with a solvent for softening its hitherto protective casing, is thereby enabled to escape from its grave —but only for a short period. It flutters about for a few days, during which the female deposits several hundred eggs for the reappearance of its species during the ensuing season; and then, all duties being fulfilled, it droops and dies at last.

Such, in almost all countries, is the general progress and development of the silkworm.

In China and India the silk cultivators have two or three broods in the course of the year, which is the reason, I think, why their cocoons yield so much less than do those of Europe—the species, probably, is reproduced too quickly. The quantity of silk that may be obtained in any country depends upon the comparative supply of food. A few ounces of eggs suffice for a very large yield of silk, but the supply of leaves regulates the quantity, and consequently the value.

It would be of great importance if the worm could be reared upon other than its natural food. I was much pleased with reading in your Journal that success is attending the introduction at Malta of the castor oil plant, and that a silkworm—the *Bombyx Cynthia*—thrives well upon it. Within these few days I have received from the Secretary to the Society of Arts at Malta a small box of cocoons spun by these worms—here is a sample of them. I regret having to declare that I consider the reeling of them quite impracticable. I have made a very careful attempt, but, owing to the perforation and malformation of the cocoon, the filaments broke so frequently, that any remunerative result was out of the question. I, however, hope that some difference in treatment and education may induce the worms to produce a more perfect cocoon. I shall continue my attention to the subject.

Port Natal promises soon to become a silk-growing district. I received, a few weeks since, a sample reeled there. The quality, or, rather, the nature, is excellent; but the reeling is very defective, the result of inexperience. I am informed that the mulberry takes so kindly to the locality that small plants, of a few inches, attain in twelve months a length of five or six feet. This valuable introduction will soon augment the riches of the colonists. Thus there is every prospect of the silkworm considerably extending its race; in fact, it will naturalise itself in any country where well and properly nourished and carefully educated.

Having considered the nature of the worm, we will now scrutinise its products, especially the methods of reeling and spinning the silk threads required by the manufacturer.

Here are specimens of cocoons from various countries—the Bengalese are very poor and degenerated—the culture must be very much neglected; the Chinese are small, but of very good and firm texture; the French are very fine, and so are some of the Syrian, which present a mixture of very good and inferior, proving what cultivation may effect there; the English are equal to any. The mode of reeling generally practised is about the same in all foreign countries, varying only with the care and the machinery employed, which is more or less primitive and imperfect—the only object apparently the reelers have had in view being the production of silk in skeins, leaving all subsequent processes to the manufacturer.

The cocoons having been properly sorted, *i.e.*, the doubles, the perforated, the diseased, and inferior, laid aside for separate treatment, the sound ones are proceeded with. The object of the first process is to unwind the thread so systematically and ably arranged. The worm is a perfect spinner; our comparatively clumsy treatment mars much of its natural and intrinsic value.

The reeling commences:—A handful of cocoons are placed in a basin of nearly boiling water, and briskly agitated with a few twigs formed as a wisp. In a few minutes the exterior fibres become loosened, and adhere to the wisp. The agitation is continued until the waste is all detached, and the ends of the continuous threads are attained. By these the cocoons are drawn to the edge of the basin, excepting so many as are required to form the intended thread of raw silk. The finest and best thread (as Italian or French) will be composed of 3, 4, or 5 cocoon filaments, other threads of 10 or 12 such, up to 20 or more, according to the purposed size and quality; the greater difficulty being to reel a fine thread, the very best cocoons are employed for such, hence the finer the silk the more valuable it is. We will suppose a thread to be formed of 4-5 cocoons, *i.e.*, 4 cocoons yielding good firm filaments, or occasionally a 5th added where the remaining four are weak or nearly run off, the inner filaments of the cocoons being finer than the outer ones. An average size is therefore obtained by using occasionally one more or less. The four filaments being united into one thread, two such threads are reeled simultaneously, and occupy the attention of one person, (usually a young woman). She passes them through separate eyes, and then twists them together, usually by means of a simple self-acting apparatus, so as to give about 100 revolutions; the ends are again separated, and each is conducted by a guider to the reel behind, the attendant sitting between the basin of cocoons and the reel to which the threads pass over her head. The partial twist is not permanent, but is necessary to combine and consolidate the filaments into one thread. The reels (for several are attached to one shaft) then being put in motion, either by hand or steam power, the threads are rapidly drawn off, and each cocoon, as it becomes exhausted, is replaced by a fresh one. This process is continued until sufficient silk is wound on to form a hank, which, on being removed from the reel, is made up into a skein. A quantity of such is packed into bales, in which state it is imported by our merchants and manufacturers as raw silk.

In China, and almost all silk countries—Italy and France excepted—the reeling is very negligently accomplished. Ten cocoons, or more, will be taken as the commencement for a thread. The reeler will work away without heeding the rupture of a few filaments, and will then piece up several in a lump; the result of which is that all our China silk varies in places 50 per cent. in size, and instead of being of the finest and best quality, as the cocoons would permit, is seldom worth more than two-thirds the value of good French or Italian.

The size or substance of a silk thread is usually estimated by deniers, an Italian weight, equal to about a grain. The standard of measure is about 400 yards—that length of a single filament will weigh two deniers from China cocoons, and $2\frac{1}{2}$ from French or Italian. A 10-denier silk will thus be the combined thread of 4 or 5 cocoons.

A proof of the defective reeling in China is evident from the fact that, though they possess the finest cocoons, they do not produce fine silk.

The silks reeled in Greece, Asia Minor, and Syria, were, until recently, only known as very inferior in quality; but during the last few years the cocoons of those countries have been reeled there by experienced reelers from France, or have been imported by the French. As evidence that Chinese cocoons, which hitherto have only produced us a coarse and uneven thread, will yield the best and finest silk, I have here, for your inspection, a specimen equal to the best and most costly Italian silk. It has been reeled and spun in one operation, direct from Chinese cocoons, on to bobbins (of which this is one) at my own works, on an improved and patent process, to which I will presently allude. Any good cocoons, from whatever country they may come, may be made to produce good silk, and of the same quality, whether reeled in the country in which they were produced, or imported and reeled in another—the machinery and care being, of course, equal in both. It is, therefore, indisputable that silk reeling may be considerably improved, and that extra skill and attention will amply repay the reeler. When the cocoons are exported very great care is requisite that they may be thoroughly dessicated, in which state they may be press-packed without injury; for, however flattened and deformed, they, like sponges, will resume their original form on immersion in hot water. In drying they lose about two-thirds their original weight, so that 4 lbs. of dry cocoons will yield about 1 lb. of silk, whereas 12 lbs. of the undried would be required.

The waste made in reeling is taken up by another branch; it forms the raw material for silk shawls, spun silk handkerchiefs, stockings, mixed goods, &c. It is carded, spun, and manufactured into threads, on the same principle as raw cotton is converted into yarn. Here are a few specimens of the several processes, kindly furnished by Mr. Briggs, of the Castleton Mills, near Rochdale.

A great fact here will, perhaps, be new to many of you, that from the waste silk made by the reeler, the spinner in this country will first chop it into lengths of about three-quarters of an inch, and will produce a more even-sized thread therefrom than will the reeler from his continuous fibre of 500 yards.

The remaining product is the chrysalis itself. Even that is of some value, for it forms an excellent manure, and, I expect, will not be bad feeding for ducks and geese, for I have tried them at my farm, and have found them not objected to. I do not know but that they may be a luxury. Thus, the silk worm and its products have all a remunerative value.

The question now most seriously presents itself, why cannot we reel silk in this country? My immediate and practical answer is—there is no real difficulty to prevent us. Because it never has been done, we have accustomed ourselves to believe the object unattainable. Almost all persons engaged in the silk trade had deemed it impossible, simply because they did not see how to place the egg the right end upwards.

The title whereby raw silk was known, as French, Italian, or China silk, implied that such silk was the produce of such country.

I have passed through many of the reeling districts of France and Italy, and when I have inquired why we could not reel here, have invariably been told that the cocoons could not be transported from one country to another; that a southern climate was most essential; that reeling could not properly be carried on in wet or damp weather, and that even a cloudy day affected the quality of the silk. Such were the objections so universally given and believed, that no silk merchant or manufacturer in this country (with one exception, I believe,) ever thought of silk being otherwise produced. The French reelers, however, partially solved the question. Wanting more silk than they were producing, they directed their attention to the rich and beautiful plantations of Greece and Syria. Commercial and profitable considerations soon taught them how to dry and pack the cocoons without injury. In a very short time they established houses in those countries, and imported thence immense quantities of cocoons, and reeled them in their own filatures, so that our manufacturers have been using many thousand pounds of so-called French silk, reeled from Greek or Turkish cocoons.

So much for one objection. We will now dispose of others. A southern climate is not at all essential, inasmuch as all silk is reeled in water, and that we can prepare soft or hard, as required. We can likewise create any climate in our factories—moist, dry, hot, or cold. All this I have proved at my own works, where silk-reeling is now practically in operation, on a new system, promising unusual advantages.

We are indebted to Mr. John Chadwick, of Manchester, silk manufacturer, for the invention. He originated the principle of this new process, and confided it to me for development into practice. We have jointly patented the system for this country and elsewhere.

I should here state that your Council invited Mr. Chadwick, as well as myself, to read a paper before you on the silk manufacture. Had he done so he would have explained the process, and the reasoning by which he had arrived at it, but circumstances having occurred to prevent him, I have assumed the pleasure and the responsibility of bringing the invention before you. I would add that whatever merit may be ascribed to me for carrying out the invention of producing thrown silk direct from the cocoons at one operation, from its primitive form to its present practical efficiency, the far greater merit of having originated it is due to my colleague.

I will premise my explanation of our improvements with a cursory view of the usual silk-throwing operations.

We have seen that the first process of silk thread making, is the reeling into a hank such a number of combined filaments as will produce the required thread. The next process, which is the first in the throwster's hands, is to again place the hank upon a reel and rewind it on to a bobbin. So much waste, as you may expect is therein made, that the cost including waste is at least from 1s. 6d. to 3s. per pound. The third process is to clear the thread from all superfluous knots and imperfections made in reeling; this is usually managed by rewinding the thread through a groove, or cleaners, so adjusted as to stop any lumps or gouts that would otherwise pass on. The fourth process spins the thread, if intended for organzine, which is the warp or longitudinal threads of silk goods; this spin is, on an average, of about 15 turns per inch, and the object is to bind up and consolidate the filaments composing the thread. The fifth process doubles the threads so spun. The sixth spins the doubled threads the reverse way of the single ones; this induces the threads to hold more firmly together and not to untwist. The seventh process (sometimes united with the sixth) winds off the skeins ready for the dyer. These operations of reeling and throwing cost altogether 8s. to 9s. per lb., thereby considerably enhancing the cost of our silk manufactures. When the thread is not intended for organzine, but is required for tram, *i.e.*, the cross threads of silk goods, the fourth process is omitted, no spin being required in the single thread.

Our new process dispenses with two or three of the operations I have enumerated. We soften and prepare the cocoons nearly as usual, and reel together any required quantity; but instead of winding the silk at excessive speed, and consequently with much tension, into hanks, we wind it direct and slowly on to bobbins, and in its course thither impart by suitable means any amount of spin required, whether to form a tram or an organzine thread. The combined thread very seldom breaks in its progress to the bobbin, the separate filaments only occasionally, but as the cocoons successively fail or are wound off, they are replaced, the filament of the new cocoon attaching directly to the others, and being at the same time incorporated with them by the continuous spin. The thread, being thus maintained in its strength and size by splicing in the new filaments as needed, is free from all the knots at present inevitable in raw silk winding.

Herein is the leading feature of our improvements, that we dispense altogether with the loose hank of raw silk, and spin the thread at the same time that we reel it. Here is a model showing partly the process whereby a single thread may be reeled and spun simultaneously; it is somewhat rude in construction, but is sufficiently correct to exhibit the principle, though of course wanting in much that is indispensably necessary for working it practically on large frames, such as the means of sliding the bobbin up and down the spindle, so that the thread in winding on may be equally distributed; likewise a disengaging motion attached to each spindle, whereby any bobbin may be shunted in or out of gear without stopping the remainder. This motion is absolutely requisite, as it is of the utmost importance that the machine be stopped as seldom as possible. There are likewise various other appliances for economising labour, and conducing to profitable results. When duly at work the bobbins revolve at a speed of 3,000 revolutions per minute. You will at once perceive that we are much indebted to the cotton spinning machinery, and you will recognise the ordinary spindle and flyer, though differently adapted. It is very simple, and yet a most effectual and complete method of winding and spinning simultaneously.

The bobbin and flyer revolve in the same direction, but the former at a given ratio, quicker than the latter. The difference of speed gives the required quantity of spin to the thread.

I should mention that reeling and spinning direct from the cocoon may be effected by other methods under our patent, but we prefer and recommend that which I have endeavoured to explain. We thus, in one operation, produce either a tram thread complete, or we at one step reach the third or fourth process at present required for organzine.

As I am so personally interested in the success of our new process it scarcely becomes me to dwell much upon its merits. My opinions, however, being subject to your discussion and criticism, I will not hesitate to enumerate some of the advantages over the usual method, I contemplate may be derived—*ex. gr.*—

1. A more complete extraction of silk from the cocoon, by reason of a more steady process of unwinding.
2. A regularity almost mathematical.
3. A greater amount of tenacity and elasticity in the thread.
4. The almost total abstraction of "gouts and knots."
5. Saving of cost of winding and of all waste made therein, producing in the aggregate an economy of several shillings per pound, with a superior quality. Instead of requiring experienced women as reelers, young children between 11 and 13 can with ease manage the whole process. A few days' tuition renders them quite *au fait* at the business.

So steady is the working of the system that we can reel and spin with facility a thread of organzine nearly one-half the size of any, I believe, hitherto produced, one

lb. of which will extend in length about 200 miles. Such a thread will open a new field to the manufacturers of lace and gossamer fabrics. I have stated that we prepare the cocoons nearly as usual,—the difference is, that to facilitate the reeling, we add a little soap to the water, whereby we detract from the brightness or polish of the gum of the silk. Very great, though undue, importance has been attached to the lustre of raw silk. On reflection and examination it will be evident that such outside varnish does not in the slightest degree affect the silk within, for it is merely a resinous gum which entirely leaves the silk when subjected to the necessary boiling off in dyeing. This gum forms 25 per cent. of the gross weight of the thread. Its colour is yellow or white, but all silk when deprived of such gum is beautifully brilliant and white. One of the chief advantages this new system offers to the manufacturer is the control of his raw material, the means whereby he may produce regularly any size and quality of silk he may require, the cocoon being his raw material, as cotton wool is to the cotton-spinner, —whereas, at present the raw material of our silk manufacture is a thread produced at the caprice of the foreign reeler, without any consideration or even knowledge of the purpose to which it is destined. So keenly has this anomaly been experienced, that several of our first manufacturers now buy their cocoons, and have them reeled in France or Italy to their own special order. We all acknowledge the world-wide celebrity of many manufactures, where a certain degree of excellence having been once attained, the reputation has been maintained by a careful adherence to the quality which produced such universal approbation. Now, however talented and skilful the silk manufacturer, he has not had the same opportunity of "letting well alone." One bale of silk may have worked to his satisfaction, and have produced exactly the desired result, the next might be quite the reverse.

The continental reelers are very sensible of the imperfect condition of their business and need of improvement. A silk journal, *Le Commerce Sericicole*, so abounds weekly with suggestions on the most trivial detail, that any stranger reading it would suppose silk-reeling to be quite a modern invention. As evidence of the extreme importance attached to a very trifling advantage, a patent was, taken out in France, in 1853, by Mons. Alcan, a distinguished professor, and director of the Conservatoire des Arts et Metiers, for improvements in softening and preparing the cocoons. M. Alcan told me that he had studied the subject for years.

I believe our system will prove a great national advantage, that it will revolutionize the silk trade, and considerably extend its operations, but as in all other revolutions, and this is one of matter, time is necessary for development in proportion to its magnitude.

One great problem to be solved lay in the question of a supply of cocoons. That apparent difficulty is quickly disappearing. I have received them from China, India, Syria, Greece, and Spain, and am in correspondence with some of the principal houses either in, or connected with, those countries, from whom I receive the assurance that any quantity may be procured, and laid down here at a price that will compete with the French reeler. One merchant in Manchester has already imported them on his own account. The silk producing countries of the world far exceed in extent the cotton growing districts, so that encouragement alone is needed to increase the supply of cocoons, and in course of time render silk not only a luxury, but a comfort, within the reach of all classes, a probability not at all visionary, considering that the period is not so remote when a pound of raw cotton cost more than does now a pound of cocoons. But prior to the realisation of these desiderata, much prejudice has to be overcome. The fallacious theory of centuries must vanish, the reeler and the manufacturer must no longer be strangers to each other, as they now are. The cocoon producers generally have yet to hear of and learn the value of this new market. Existing defective systems have gradually to give way to the improvement. The interests of some are opposed, and therefore will not recognise it, but its onward course, however slowly, must surely continue, because interest and desire of gain, which governs all commercial transactions, will never abandon the pursuit of a profitable occupation.

If labour form the wealth of nations, the political economist would favourably regard our innovations, for, as we consume in this country about six million pounds of silk annually, much of which may in course of time be reeled here, additional employment might thereby be found for at least 10,000 children. A laconic remark, made by an eminent French reeler, may be interesting to you. After minutely inspecting the operation and expressing his satisfaction, he compared the present position of the silk trade to that of France on the 27th February, the eve of the revolution.

There are other pleasing reflections in the fact that Syria may become the chief market for our raw material. One of the first merchants of Beyrout, writes me that about 2 million pounds of cocoons are annually produced within 10 hours' distance, *i.e.*, between Sidon and Tripoli. A very pleasing writer, the author of the "Thistle and Cedar of Lebanon," confirms this opinion, and recommends emigration thither; and he adds that the silk culture will be found far more profitable and certain than gold seeking. Thus the Holy Land, the birth-place and the cradle of the most important events yet known to the world, may be again enriched, and so recall and gather together her long-lost people—all under the inscrutable providence of the Almighty, working by the humble instrumentality of the Silkworm and its Products. Truly, man proposes, and God disposes.

## DISCUSSION.

Mr. Le Neve Foster (Secretary) stated, that as Mr. Dickins had referred in his paper to the accounts published in the Journal of the Society, relative to the *Bombyx Cynthia*, or Eria silk worm of Assam, and to its introduction into Malta and Italy, it might be useful to give a short notice of the information which had reached the Society from his Excellency Sir William Reid, the Governor of Malta. It appeared, then, that through the laudable efforts of Mr. Piddington, of Calcutta, aided by the directors of the Peninsular and Oriental Company, his Excellency the Governor had succeeded in obtaining, after many unsuccessful efforts, sound eggs of the Assam silk worm, called in that country the Arrindy, Aria, or Eria, and by naturalists the *Bombyx Cynthia* and also *Phalæna Cynthia*. These eggs arrived in Malta on the 2nd of December, 1853, and were placed under the care of Dr. Frendo, at St. Antonio, who obtained from them upwards of 600 worms. The first which were hatched died apparently from cold. But after a fire was kept in the room—so as to preserve a temperature of from 58° to 68° Fahrenheit, very few died, and ultimately none. These worms were fed exclusively on the leaves of the castor oil plant, (Palma Christi), the *ricinus communis* of botanists. The worms having thus passed through all their mutations in Malta in a healthy state, a second generation, from eggs laid there, was hatched. Cocoons sent from Malta to the Agricultural Society of Turin, also produced moths. Eggs were likewise sent to Rome and other parts of Italy. Thus this insect could be transported to, and successfully reared in, latitudes differing as widely as those of Turin and Assam. The Palma Christi (*ricinus communis*) was said to take well in Piedmont. In the province of Nice, in the Island of Sardinia, and in the other more northern provinces of Italy, it also grew luxuriantly. Considerable progress had been made in the art of reducing the cocoons into thread. Mootas, very similar to those received from Calcutta, had been produced from Malta cocoons, and these had been spun, by means of distaff and spindle, into thread of a very superior quality, which had been converted into specimens of

knitting, netting, and crotchet. A specimen of the latter work was exhibited. The French Government had applied, through their Consul in Malta, for a quantity of eggs both for France and Algeria; and through the statements published in the Society's Journal, an application had likewise been received by his Excellency the Governor, from the Agricultural and Horticultural Society of Grenada, in the West Indies. Both of these applications had been complied with. Only that morning he had received a communication from Grenada, stating that the silk worms had gone successfully through their several stages, and eggs laid there were now hatching. The first supply was received there on the 22nd of November last. From these 1,200 worms were raised. They began to spin on the twenty-third day after hatching, and the cocoons being kept undisturbed, the moths came from them, laid, and were now dying (10th January). The Grenada Society was particularly anxious to receive information as to the mode of treating the cocoons, so as to render them fit for sale or shipment to England. He had also just received from his Excellency Sir William Reid, through the Colonial-office, a further despatch, accompanied by a box of specimens of the silk prepared in Malta from the Assam silkworm, by Mr. Frederick Lotteri, an Italian gentleman, together with a letter, report, and memorandum, collectively embodying the results of that gentleman's experience on the subject. The object which Mr. Lotteri had in view, and which he hoped to attain, was not precisely the cultivation of the new insect, considered in its phases, its developments, and its transformations (points which were for the most part well known), but rather to study carefully and investigate the important producing powers of so valuable an insect. According to communications which appeared in the *Official Gazette* of Turin, 30th December, it seemed that he had resolved to endeavour to coerce the worm into forming its cocoon hermetically closed, like that of the mulberry worm. By this method he hoped to obtain a continuous perfect thread, unmixed with portions of waste caused by the unequal action of the worm in spinning. Mr. Lotteri's report was as follows :—

"I am indebted to the kindness of his Excellency Sir W. Reid, the Governor of this island, and the warm promoter of any undertaking which tends to the development of the industrial and commercial prosperity of his country, for the many opportunities which I have enjoyed of pursuing my investigations in reference to this new species of silkworm, which is being reared at his villa of St. Antoine, and which, since its introduction into Europe, has given rise to many scientific researches. I have studied these insects in all their phases and transformations, and, after careful observation, I have endeavoured, by treating the cocoons according to the old method, to test the productive powers of this silkworm.

"I sought the end of the thread so as to unwind the cocoon—for I have always considered it as unsatisfactory, looking at the value of the insect, to follow the method pursued in India, of soaking and rubbing the cocoon in order afterwards to spin it, like flax, cotton, and other vegetable substances. After much labour I succeeded in obtaining a little silk from the cocoons, and I forwarded the product to London. I had tried several times to obtain the silk with less trouble, but was unsuccessful, and for a time I considered that my efforts must end here, as I felt persuaded that the results, up to this period, were not proportionate to the expenses, loss of time, &c. My method for procuring silk from the cocoon is as follows :—

"1st. I stripped the cocoon of its outer covering, considering the latter to be merely a tissue of coarse waste, intended simply as a support for the other portion. After having analysed the resinous and viscous substance of the new cocoon, which is much harder than that of the mulberry worm, I thought it best to lay aside the use of chemical preparations, being convinced that the unreeling of the thread could be facilitated by the simple means of water heated to two different degrees of temperature, using it first in a boiling state, and afterwards of a heat not too great to admit of the hand being immersed. This system I found preferable to any other. I then took two flat dishes or basins; one, containing boiling water, I made use of to cleanse the cocoons and to enable me to get hold of the thread; in the other I afterwards placed them for the purpose of reeling. As these cocoons have an aperture, in which respect they differ from other kinds, I took the precaution to have flat dishes or basins made expressly for the purpose, one inch deep, so as to avoid the possibility of the cocoons sinking to the bottom of the vessel in case of the thread breaking, an accident which would otherwise have caused some difficulty.

"Up to this time, I was tolerably satisfied with my manipulation, and I anticipated further and better results, when I perceived that the thread never broke on the edge of the aperture in the cocoon, where the worm began to deposit waste; but I was discouraged on finding that the lengths of thread were continually coming to an end, only to begin others equally short, and that at frequent intervals a quantity of waste was given out by the worm, interfering with the continuity of the true thread.

"However, I do not despair that hereafter, by some new method of treating the worm when arrived at maturity, I shall succeed in causing it to form its cocoon hermetically closed, like that of the ordinary silkworm; for although the closed cocoon has not yet been accomplished, I have reason to hope for success on future trials. One advantage certainly would be gained—in reeling the silk thread, the cocoon would be treated in the same way as that of the old species, which is now naturalised in Europe.

"I hope that my first success will be crowned by another, —viz., the improvement of the silk-thread. All my efforts tend to the accomplishment of this object, and I cannot doubt but that ultimately I shall obtain a cocoon with a continuous thread, and not subject to breaks, as at present. A new species of silkworm will have been introduced, which will breed five or six times in the course of the year, and is capable of deriving its nourishment from five kinds of vegetable substances—the castor-oil plant, the mulberry, the willow, the lettuce, and the wild chicory—and will add a new source of wealth to the vast and fertile possessions of Great Britain."

Mr. Foster then proceeded to state, that a short time back he had received a communication from the Secretary to the Malta Society of Arts, Manufactures, and Commerce, in which it was stated that, "With a view of encouraging and promoting the introduction of manufactories in these islands, and thereby augmenting the limited resources of this population—a people naturally of an industrious and laborious character, and susceptible of instruction in the Arts—the Committee of Management of this Society have offered to aid, as far as in their power, a Signor Lotteri (a gentleman lately arrived amongst us from the north of Italy), in developing a project for establishing in our island, by means of a Joint-Stock Company, a "Silk Mill," viz., a factory for spinning (winding off) Smyrna and other Levant cocoons—a scheme which would not only give employment to a large number of women, but likewise, according to Signor Lotteri's showing, offer an excellent inducement to capitalists, and open to the British silk merchants a *new* market for raw silks at prices infinitely more advantageous than those of Italy and France." Four hanks, viz., two of white and two of yellow silk, wound off Smyrna cocoons of inferior quality, were forwarded with this communication, for the purpose of being tested and reported upon. Messrs. Durant and Co. had, at the request of the Society, kindly undertaken this task, their opinion being as follows :—

"We have examined the sample of silk reeled from Smyrna cocoons, and find it to be of very middling quality. The thread is well laid on the reel, but badly made,—being uneven, flat, and wanting in compactness; it is also endy, and has many weak threads, which cause

waste in the processes of winding and throwing,—these imperfections exist in a greater degree in the yellow than in the white sample. The value of the former is about 16s. 6d., and of the latter 17s. 6d. per lb. As regards the desirableness of establishing a factory in Malta for reeling Syrian and other Levant cocoons, we are not sufficiently informed as to the capabilities of that island for such an object, but it may assist the Society in determining this point, when they are informed that Syrian silk of good quality, reeled in the country, is much esteemed here for certain manufactures, and realises a comparatively high price, while silk reeled in France from Syrian cocoons—a practice now adopted to a considerable extent—commands a price nearly equal to some of the "raws" of the Ardèche and the Drôme. There are four things essential to the proper reeling of silk, namely, climate, good fresh water, skill, and cheap labour. Malta, we believe, affords ample facilities in the first two of these requirements; if it is equally well off as regards the last two, there can be little doubt but that silk reeling might be turned to good account." Mr. Foster said that he had thought it right to lay this summary of information, recently received by the Society, before the meeting, as he felt that it was desirable, on all occasions, whenever any subject was under discussion, that it should, as far as possible, be exhausted. He was aware that the points he had noticed were but briefly alluded to in Mr. Dickins's paper, which he trusted would be as critically and minutely examined as the author wished.

The Chairman said his duty was now to invite observations on the paper, and he could not avoid that opportunity of saying how much importance he attached to the subject, and not only so, but to the able manner in which it had been laid before them. A more lucid and intelligent paper he had never heard read; and supposing that anything like the results contemplated were arrived at, he believed the revolution in the silk trade would be as great as those the inventions of Arkwright had effected in cotton spinning. The paper presented several subjects for discussion, and the first, which was a very inviting one, was as to the possibility of reeling silk in England. That was far from being a settled question, and it would be very desirable if they had still further information on that subject. The grand point—the leading feature of Mr. Dickins's plan—was the importation of cocoons; the whole rested upon that simple fact, and Mr. Dickins had well said that it was not enough to say, because they had never done it they could not do it. They imported cotton and wool, and for his own part he saw no reason why the same should not be the case with cocoons. The great question was as to the cost, and whether the improvement in the reeling would compensate for the additional expense of importing the cocoons into this country. He might be allowed to state, that some years ago he had an opportunity of superintending some filatures in Italy for two seasons. It was in the best reeling district, but the carelessness of the peasantry there could not be exceeded in any country, and therefore everything was in favour of introducing the operation into this country; and they knew from experience that where the machinery was good, although the silk might be produced in inferior districts, and fed upon leaves in an unhealthy spot, still where it was well reeled, depending upon the evenness or the speed, the article would be preferred to that of higher districts where but little attention was paid to that operation. There was one other point upon which he would like to hear the opinions of those conversant with the subject. Mr. Dickins had said that the brilliancy of the silk was not a matter of consequence. It had been the habit to attach some consideration to the brilliancy of the article, and he would like to hear whether there was anything inherent in the brilliancy of the silk which gave an advantage in the subsequent operations to which it was submitted.

Mr. P. L. Simmonds said that he was sure all present would heartily concur in the encomium of the chairman on the valuable paper which had just been read, which, from the magnitude of the subject discussed, the clearness and popularity of its details, the important improvements noticed, and the vast amount of practical information furnished, was in its general interest second to none which had ever previously been delivered in that hall. Having been called upon by the chairman to make a few observations, he might, from having bestowed some careful study and investigation on the subject, supplement a few facts in corroboration of the observations made by Mr. Dickins, especially as to the variety of worms furnishing silk, their food, and the wide area over which the production of cocoons for import might be extended. We might form some faint idea of the magnitude of the silk trade of this country alone—to say nothing of the manufacture of other countries—from the fact that the declared value of our exports of silk manufactures exceeded 1½ millions sterling; and we import about 5,000 tons of this costly material, of which 5 million pounds are raw silk, 2 million waste knobs and husks, and ½ million pounds thrown silk—employing 1¼ million spindles, and 6,000 power looms. Our chief imports were about 10,000 or 12,000 bales from India, and 36,000 bales annually from China. Last year the imports were 1,600,000 pounds (or 24 per cent.) in excess of 1853. The demand for silk everywhere was on the increase. The continental countries now consume nearly all they produce. The United States take foreign silks to the amount of 5½ million sterling, and almost all classes of society are large consumers of silk in some shape or form. Unlike the time when stringent laws regulated the dress of various classes, when velvets and fine silks were restricted to peculiar ranks, every one may now indulge in those superior luxuries if they have the means. In nothing is the goodness and wisdom of Providence more manifest than in the numerous animal and vegetable substances furnished so liberally for the comfort and convenience of man, so that even the most minute portion of the insect tribe, which might seem insignificant in their products, furnish some of the most valuable articles of commerce, of which we have instances in silk, the cochineal dye, the wax and honey furnished by the bee, the lac resin and dye, and the gall nut. For clothing, man avails himself of the down or wool of the cotton plant, the pliable barks and fibres of various trees and plants, and the fleece of the sheep; but certainly the most elegant and generally esteemed is the rich product of the tiny silk worm. Mr. Dickins had already alluded to the principal silk producing countries, but the following observations might be added:—Portugal could easily become one of the richest silk countries of the world, her soil and climate being most admirably adapted to its culture; and some attention was given to it at Oporto a few years ago, by Mr. Tinelli, the American consul, who carried out several improvements in the Piedmontese reel. The three Algerian provinces of France are taking a distinguished position among those countries which are indebted for their wealth to the cultivation of silk. The award of two medals at the Great Exhibition of 1851 had stimulated exertions, and in the single department of Algiers 14,000 kilogrammes of cocoons were produced by a few hundred individuals. In Egypt the cultivation of silk has received considerable attention, and plantations of the mulberry have been extended. In an extensive continent like that of Africa there must be various localities well adapted to the growth of the mulberry; and on the banks of the Nile, or in some of the rainless regions of that quarter, silk will yet, no doubt, be grown to a great extent. Passing from the silk of the domesticated moth to that of the wild species found in Africa, there is reason to think that many unknown species will be there found to produce silk nearly as valuable as that with which we are at present acquainted. Capt. Downes brought with him, from Fernando Po, a few years ago, a considerable number of large white cocoons of a Bombyx, which produces a strong and durable white silk. These

cocoons might, with very little trouble, be collected and imported into England, as they were found in considerable abundance. A few years ago there was exhibited, at the Entomological Society, a large quantity of rough silk, collected at the Cape Coast; apparently it belonged to a species of Cossus. It is exceedingly abundant there, and, although of a quality inferior to other silks, it might, with proper management, become a useful import, similar to the Kollisurra, Tussah, Arindi, and Bughy moths of Asia. Various others are found in Africa, yielding silk quite equal, if not in some respects superior, to them. And to the Bombyces of this continent may be added various species of Cossus, offering a great variety of raw material. It is singular that experiments have not been more directed to the African continent. Among the wild moths which spin their cocoons among the shrubbyplants of India is a species nearly as large as the Atlas, whose food is the leaves of the *Protea Argentea*. This worm might be turned to some account, as it resembles the insect of India which spins the strong silk known by the name of Tussah. Allusion has been made to Natal silk. Experiments were for some time successfully carried on in the Cape Colony and Mauritius. The large island of Madagascar also affords silk, and a large quantity of cocoons might doubtless in time be obtained from thence. A butterfly, differing far from the *Bombyx Mori*, but which produces an excellent silk, is common in French Guiana. The caterpillar feeds on a species of mangrove, which, from its growth in the water, serves in a great measure to keep off the ants and other predacious insects. The silk is stronger than that in common use, of the colour of nankeen, but readily bleached, and receives the most delicate dyes. The manufactures from it resemble the better kind of Malaga serges, usually the strongest of silk textures. The cultivation is much encouraged by the French Government, who consider it as giving additional importance to the colony of Cayenne. The whole continent of Asia, from Scinde to China and the Eastern Archipelago, might produce silk. It has been occasionally tried and experimentalised on in various quarters—in the West India Islands, the United States, the Sandwich Islands, Australia, &c.; but the difficulty of reeling, the want of proper food for the worm, and the absence of a due knowledge of the habits of the insect, combined with a demand for more immediately remunerative staples, has caused it generally to be given up. Now, however, that the cocoons are marketable, more attention will, doubtless, again be given to it. Vast quantities could doubtless be obtained in the Neilgherry hills, in Assam, Bokhara, and Affghanistan. The dry and equable climate of Scinde is especially favourable to silk culture, and it is somewhat singular that though there are about 1,000 silk shops in Lahore, the capital of the Punjaub, and 2,200 at Umritsir, little or no raw silk is produced there, the material for their extensive manufactures being drawn from contiguous states. The coarse silk called Tussur could be obtained in large quantities in the wild tract of country to the eastward of the Godavery River. The breeding worms in cocoons are preserved in the houses. At the proper season the young caterpillars are taken to the jungle, and placed on wild trees, where in time the cocoons are formed. Demand would encourage supply to an unlimited extent. If this coarse kind of silk would sell in Europe, and he had heard that a kind of cloth could be made of it, mixed with cotton, the whole jungle would unfold its treasures, and a very large quantity might be brought into the market annually. Six species of silk worm are found in the province of Assam. 1. The mulberry silk worm (*Bombyx Mori.*) 2. The Tussah silk worm (*Saturnia* [*Phalæna*] *Paphia.*) 3. The Eria, or Arindy silk worm, to which allusion has been specially made this evening, (*Phalæna* [*Bombyx*] *Cynthia.*) These species were previously known, but the following are described and named by Dr. Helfer. 4. Mooga silk worm (*Saturnia* ***Assamensis***, Helfer). 5. Joree silk worm (*Bombyx religiosa*, Helfer,) found on the Peepul tree (*Ficus religiosa*), which is said to yield a silk equal to that produced by the mulberry silk worm. 6. *Saturnia silhitica*, Helfer. There are probably other wild species in different parts of India, which may be found to yield useful products. The wild worms feed upon different trees, such as the Jujube (*Ficus religiosa*), castor oil plant, some of the laurel tribe, and others which are found in almost all the forests of India. The large or annual cocoon of India is principally reared in the district of Cossimbuzar, but is also produced at Bauleah, Harripaul, Jungypore, Radnagore, Soonamooky, and other of the East India Company's filatures. It is one of the most valuable species of cocoon, and yields the best silk, which is of fine fibre, and strong, and ought to be very mellow to the feel, of clear yellow colour, with some white. In favourable seasons it yields a very abundant and profitable return, producing (if the cocoons are good) in the proportion of at least two to one of the other species. The small or indigenous cocoon (*Dessee worm*) is the native silkworm of Bengal, and is produced throughout the year—that is, there are four or five collections annually—but it varies in estimation and value according to the season of produce, and the more nutritious food afforded by the mulberry plant at one season of the year rather than another. Of this species there are no less than five harvests produced at Commercolly, viz., in October, November, March, April, and in June and July. There appears at Cossimbuzar and elsewhere to have been an intermixture of the *dessee* or native worm with the China insect. The Chinese cocoon since its introduction appears to have degenerated greatly in many parts of Bengal. It is of both the white and yellow sorts, and yields silk generally of very fair quality. It is produced in almost every month of the year except March. The quality of the silk it produces is said to be in every respect inferior. The Nistry tribe of cocoons appear to be composed of three species, the Madrassie, Soonamooky, and Cramee, which are peculiar to the Commercolly district, except the Madrassie worm, which is more generally distributed. Of those varieties the Soonamooky is considered the best. The Madrassie ranks next; it is distinguished from the Dessee by a black mark under the throat. It is preferable in produce, &c., during the hot weather and the rains, from May to October. Its great comparative defect is, that it cannot be kept in store longer than a few days without total destruction, whereas the *dessee* may be kept in well-aired cocooneries even twelve months without material injury. This worm, like the Soonamooky, is very hardy, requiring little care, and is not at all choice in its food. The wild or Tussah silkworms are reared in all the western forests from Rhangur to Midnapore, with some degree of variety as to the quality of the *gootte* (as the cocoon is locally called). There are three different kinds of wild silkworms collected in August and September, viz., the mooga, teerah, and bonbunda, with some varieties known as dabba, buggoy, and tarroy by the native collectors. The bonbunda is the largest of the wild silkworms, and of a greater size than any cultivated species. It is sometimes found in considerable quantities in the woods. If other and useful varieties of worm, producing good silk, can be fed upon different substances than the mulberry, a great point will be gained. Signor Griseri has placed the common Indian worm, the *Bombyx cynthia*, on the castor oil plants in Piedmont, and has also succeeded in feeding them exclusively upon willow and lettuce leaves, and is trying to rear the native grubs, *Pavonia major* and *minor*, which feed upon various wild plants. Thus the Tussah worm feeds on a species of Terminalia in India, and the Mooga, or *Bombyx saturnia*, as we have seen, on the *Zizyphus jujuba*. A M. Bonafons proved the efficacy of the Chinese method of feeding silk worms on rice flour, and he also discovered that the caterpillar would eat various kinds of farina, and even the fecula of potatoes. Although there may be moths which will thrive on different plants, still the mulberry appears to be

the only food available generally for promoting silk culture on an extended scale. The Rev. Mr. Savage, who tried the lettuce, found the worms grew more rapidly, but were weaker and yielded a diminished quantity of an inferior silk. Miss Rhodes, Mrs. Williams, and other experimentalists, have tried other substitutes, with only very partial success, and the results have shown that the mulberry is the natural food; from it the best silk is eliminated, and as it is not more difficult to rear than any of the proposed substitutes, it follows that to neglect planting it for the sake of hardly probable success with other things, were but a waste of time. It is a singular fact that no other caterpillar will, however, live upon the mulberry, and that even the aphides, forming so tiresome and fatal a blight to other plants, never invades this. He had thrown out these hints and suggestions in the hope that they might lead to further inquiry and investigation into this important subject, connected with our second great textile manufacture, an interest in which, as had been stated, a capital of some fifty millions was invested, and which was fraught with important interest to the manufacturing districts and large classes of our labouring and industrial population.

Mr. J. G. Frith presented to the Society, for the Trade Museum (Animal Collection), a skein of silk, the produce of a few worms reared in the island of Ceylon—a place which, he believed, had not been mentioned by Mr. Simmonds. This had been sent to him by a friend, to be valued and reported upon, with the view of ascertaining whether the culture of the silkworm in that island was likely to be attended with success. The reeling had been defective, owing to the rude tools possessed by the inhabitants. The mulberry tree grew there most readily, and an abundant supply of food might therefore always be relied upon; but the point to be decided by experiment was, whether the climate of that island was not too damp for the favourable rearing of the worm. This his friend had determined to test very carefully—the eggs he possessed for the purpose being the Maltese and Madras varieties. Messrs. Durant and Co., the eminent silk brokers, had kindly favoured him with their opinion on the skein of silk alluded to. They stated that, "as regarded quality it possessed all the requisites of a superior kind. The cocoons were round, and of good fibre, free from wooliness, and consequently capable of producing a clean thread; and, if such were properly reeled, the thread would have sufficient strength and elasticity. The colour and general appearance of the sample indicated all this, and it had, besides, the advantage of being light in weight proportioned to its bulk—in this respect resembling the silk of Italy more than that of Bengal or China. Provided the worms were reared, and the cocoons produced under ordinary circumstances, there could be no doubt but that the local peculiarities were favourable for the culture. With reference to the reeling, it was evident that the cocoons had simply been run off on to a reel, without any attention being paid to the details or mechanism of the process. The chief defects were the want of 'torsion' on the thread (to cause cohesion of the fibres, compactness, and roundness), and of a 'guider' to regulate the motion of the 'layer.' It had been suggested by a practical Italian reeler, who had seen the samples, that it would be well to regard the cocoons as a primary article, and as such send them to Europe (France or Italy), where they could be reeled, thereby avoiding the embarrassment, trouble, and expense consequent upon all attempts to introduce the art of silk-reeling; as it would only be after long experience and perseverance that there would be the remotest prospect of success in Ceylon, so as to be able to compete with countries where the art might be said to be traditionary."

Mr. Winkworth said, that having been engaged in the manufacture of silk goods in Spitalfields during all his early life, and indeed until more mature age, it might be expected of him to say a few words on this occasion. He therefore, had risen, not so much to controvert the principles and propositions involved in the very able and interesting paper of his friend Mr. Dickens, as to bear his cheerful testimony to its substantial merits. A manufacture which absorbed a capital of fifty millions in machinery, and an annual expenditure of six millions in the raw material and labour, and which gave employment, at the lowest estimate, to a million of persons, was one of great national importance. Any plan or discovery, therefore, which had for its object the economical breeding of the worm and the improvement of the silk it produced, was a desideratum, the full value of which it would be difficult to estimate, for in proportion to that extra production must be the extra number of persons employed. Assuming, then, the correctness of all the facts upon which Mr. Dickins had based his calculations, the system or plan to which he had that evening given publicity, must be hailed as worthy of all encouragement. With his (Mr. Winkworth's) known opinions on the subject of what was erroneously called "Patent Right," he could not but feel regret that his friend had deemed it for his interest to have recourse to that questionable species of protection. With his knowledge, however, of that gentleman's liberality and patriotism, he could scarcely doubt that he would readily disengage himself from that incubus upon improvement, and give to the silk trade at large the benefit of his investigations and improvements. He did not know how far in these remarks he had been anticipated, if at all, by the previous speaker, Mr. Simmonds, as he heard him very imperfectly, and which he regretted the more, as he never rose in that room or favoured the Society with a paper but to communicate valuable and original information. There were, however, one or two matters of opinion contained in the paper of Mr. Dickins to which he must venture to take exception. The first of these related to the present condition of the goods produced by the silk manufacturers, which he described as "deteriorated in intrinsic value," and, except as to "artistic beauty," absolutely "stagnant." Now he, Mr. Winkworth, could not subscribe to this doctrine, and he would, therefore, trouble the meeting with a short historic narrative, that would serve to illustrate his views on that point. It would be in the recollection of the Society, and probably of some members now present, that in the month of June, 1849, when their illustrious President occupied the chair now so worthily filled by his friend Mr. Gibson, for the purpose of distributing the prizes awarded by the Council, he (Mr. Winkworth) was called upon to say something respecting the silk department of the Exhibition of British Manufactures which had recently been held at the Society's Rooms; on which occasion, after paying a tribute due to their excellence as a whole, he ventured to add, "that if it were possible to have an Exhibition at which the manufactures of other countries could be placed in juxta-position with our own, the silk trade need not fear the result of the ordeal." That which was only a possibility in 1849 became a certainty in 1851; and he had the opportunity, as one of the jury of the silk department (Class 13) on that memorable occasion, to collect the opinions of his co-jurors on the relative merits of the goods made in England, and those which were the products of foreign countries, and to embody them in a report, an extract from which he would now read to the Society:—"A very slight glance at the goods exhibited by the English manufacturers will enable those who have attended to the state of the silk trade of this country, to observe the great progress which has been made in quality, design, and cheapness during the last twenty years. Until within that period this branch of manufacture was comparatively inconsiderable, but it is now one of great importance, both as regards the quantity and value of the goods produced, and the extent of the markets opened for their sale and consumption. It is remarkable that though the raw material is, like cotton, an exotic, the judicious application of skill and capital has overcome that natural impediment; and articles of

extensive consumption, for the supply of which England was a few years since almost entirely dependent on foreign producers, are now nearly exclusively manufactured in Spitalfields, Lancashire, and other favourable districts. Of this fact the Exhibition furnishes many examples. The jury do not allude to this as depreciatory of similar goods of foreign production, which are equally well made, but as illustrative of the beneficial effect of the policy by which the incubus of heavy duties on the raw and thrown material was removed, and that which operated as a practical prohibition on the foreign manufactured article was reduced to an almost nominal impost. Goods are now made, both for the home and foreign markets, which were heretofore exclusively supplied by continental manufacturers." Now, when we bore in mind that this jury was composed of some of the best judges of silks, M. Arlés Dufour, for instance, of Lyons, and now the secretary of the "Exposition Universelle" of 1855, and of other gentlemen from Switzerland and Italy, besides English manufacturers, this dictum might be taken as conclusive evidence up to that time. He must also question the accuracy of the broad assertion that the quality of British silk goods had suffered by extreme competition, while the woollen manufactures of Leeds, Bradford, and Glasgow, had improved. This opinion he would fortify by another short extract from the Report, for the language only of which was he responsible, the conclusions being those of the jury:—"It may be doubtful whether excess of competition is not rather calculated to lower the standard of perfection than otherwise; but where, as in the silk manufacture, the market is the world, and the consumption unlimited, the scope for the exercise of taste and skill in all producing countries, is proportionately extensive and profitable." He would not further encroach on the time of the meeting, but would conclude by again expressing his opinion that the Society ought to feel much obliged to Mr. Dickins for his important contribution to the scanty information hitherto possessed respecting "the commercial consideration of the silk worm and its products." Mr. Winkworth, in conclusion, stated that his friend, Mons. Delarbre, of Lyons, then sitting at his left hand, and who had come over to this country for the purpose of introducing the process of "conditioning" silk, as practised in Italy, France, and elsewhere on the Continent, had requested him to inform the meeting, that he, Mons. Delarbre, could fully confirm, from his own experience in France and England, the opinions expressed by Mr. Dickins, as to the possibility of successfully and profitably introducing the process of reeling from the cocoon in this country.

Mr. PEARSALL said it would be interesting to learn what were the received opinions of the trade relative to the properties of the gum of silk—whether it contained any peculiar properties, or, when dissolved in water, whether it had any poisonous or prejudicial effects upon the constitution. He recollected having heard Mr. Felkin, of Nottingham, state, that appropriate means were taken to try the experiment of reeling in England on a large scale, when it was found that the young persons employed became subject to such an amount of illness that the capitalists felt it to be humane to abandon the experiment. In France and Italy the reelers, working with plenty of pure dry air, seemed to be affected by no particular disorder—while the exposure of the young in this country to constant damp induced painful suffering.

The CHAIRMAN said, as he believed he was the only actual reeler present, he could give the best answer to the inquiry which had just been made. He had the management of two filatures in the North of Italy, and he could state, from his own observation, that there was no appearance of unhealthiness in the establishment. The silk was not reeled out of doors, but there was a plentiful supply of air. He did not think climate was a sufficient reason to account for it.

Mr. FEUILLADE, on the part of M. Delarbre, remarked that, during the prevalence of cholera, the silk reelers in Italy were singularly exempt from that disease.

Mr. R. R. R. MOORE wished to ask Mr. Pearsall whether Mr. Felkin, and those who made the experiment with him, came to the conclusion that the disease was the result of the reeling; whether they took pains to have the gum chemically examined; and whether it was found to contain any properties deleterious to health?—because the mode of ascertaining the fact was in itself so simple that one might expect such a course would be taken before an opinion was expressed of the nature stated by Mr. Pearsall. A different cause for the sickness might, perhaps, have been discovered.

Mr. VAVASOUR bore testimony to the value of Mr. Dickins's process, which he believed would cause a great revolution in the silk trade of this country, and he could encourage his friend as to one of the difficulties he apprehended, that was as to the supply of cocoons. He thought there would be no difficulty as to that. A gentlemen of his acquaintance, who traded largely with China, was at present in communication with his representatives abroad, on the subject of the importation of cocoons, and no doubt was entertained that they could be procured in sufficient quantities.

Mr. GRAHAM said, having formerly been engaged in the silk trade, he had made a point of attending the meeting. The subject resolved itself into one point, viz., could they import cocoons in a sufficiently healthy state and with such economy, as with the clever appliances of his friend Mr. Dickins, to produce a more even or level thread. They all knew the quality of China silk to be good, and if they could produce a good even thread from it, there was no doubt it would obtain the preference, and then the difference of cost would vanish in a great degree. He thought there could be no doubt of having a sufficient supply of cocoons. The next point was, whether his friend's plan would produce a better thread. They were aware of the negligent way in which the silk was reeled abroad, and he hoped to see it remedied by the indefatigable exertions of Mr. Dickins.

The CHAIRMAN said there was one point which had not been alluded to by Mr. Dickins—that was—the effect which such a change as this would have upon the condition of the operative. All who had been engaged in silk-weaving knew that a great deal of the unhappiness of the weaver was caused by the bad nature of the material he had to work upon; and those were called good masters who used good silk, and bad masters who used bad silk; and they knew that numbers of people tried to make the best of a bad article, but very much fell upon the poor weaver. If by Mr. Dickins's plan a clean, good, and strong thread could be produced, he would be one of the greatest benefactors to the working classes in the silk business that ever existed. The Secretary had read a summary of information received from his Excellency Sir William Reid, and he (the chairman) must say how much this country was indebted to that gentleman. He knew the pains which his Excellency took three or four years ago at the Great Exhibition, as chairman of the Executive Committee. Since that he had been employed as Governor of Malta, which they could conceive was a most difficult and responsible position at the present moment, and yet they found him giving leisure to the cultivation of a material of this kind, which was calculated to confer very large benefits upon the inhabitants of the island over which he presided. He had received several letters from Sir William, from which it appeared that he had a great idea of introducing extensively the Assam worm into Malta. The castor-oil plant would grow well in Malta, but the mulberry tree, it seemed, could not be produced there in sufficient quantity to encourage the introduction of the common silkworm. It was no less a duty to perform the very pleasing task of proposing a vote of thanks to his friend, Mr. Dickins, for his very able paper. He had stated, in the early portion of his paper, that he made no pretension to excellency of composition, but he thought they had all found out that when a man knew what he meant to say, and said nothing

more, he arrived at the best style of composition, because it was the most simple. Independently of the style, they had had most important matter, and he was sure the meeting would go with him in saying that it was a paper which did the author great credit, and that, by the way in which he had treated the subject, he had conferred immense services upon the important trade in which he was engaged. He ventured to say they all felt very much obliged to him for the paper he had read that evening.

Mr. Dickins having thanked the meeting for the kind manner in which he had been received, said he would refer to one or two points mentioned in the course of the discussion. The chairman had referred to the freight of the cocoon. That was a most important consideration, certainly. Within the last fortnight he had received bales of cocoons from Syria and China, press-packed, —perhaps the first time they were imported in that way; they were equally perfect, and reeled equally well with those imported in their natural form. Provided the cocoons were thoroughly dessicated previous to packing, no harm could happen to them. The cost of freight would not be much in a pound of silk; even at £30 a ton, it would only be 3d. per lb., which could very well be afforded if they had the advantage in the quality of the article. With reference to the lustre of the raw silk, the remarks of the chairman were correct as to the silk at present reeled on the Continent, because it was supposed that all such was reeled on one uniform plan, and hence any difference in the appearance would denote some imperfection in the reeling, but in his own works he had tried the silk treated both ways, *i.e.*, with and without soap, and he had found no difference in the lustre when boiled off and the gum extracted. He was much delighted by the remarks of Mr. Simmonds upon the new worms he had mentioned, and he agreed with him that the mulberry leaf was the natural food of the silkworm, and it was proved that it only required to be cultivated to obtain as much of it as they required. A gentleman made some remarks about reeling in Nottingham, and that the result was injurious to the health of the children. He could not understand why it should be so, unless the reeling was performed with very hot water, so that the children were exposed to the steam; but in his process tepid water only was required in the reeling, so that in this process the children were not exposed to any injurious results whatever. Mr. Graham had put the question, whether we could produce a more perfect thread. He desired to press upon the attention of the meeting that the worm was a perfect spinner, and from one end of the thread to the other there would not be found a practical imperfection—consequently it was only an improved method of reeling that could improve the quality of the thread. The experience of the mechanical world, and all manufactures to which machinery was applied, would justify him in saying that the steady motion which attended this method of reeling must produce a superior thread. He would give an evidence of this in the bobbin of China silk which he held in his hand, the thread of which did not exceed eight deniers.

The Secretary announced that the papers to be read on Wednesday evening next, the 14th inst., were: 1. "On the Expediency of at once Decimalising English Moneys and Weights," by Mr. J. A. Franklin. 2. "On the Basis of a Decimal System of Money for the United Kingdom," by Mr. F. J. Minasi; and 3. "On Decimal Coinage," by Mr. Hugo Reid.

## EXAMINATION OF STUDENTS IN CLASSES IN INSTITUTES.

The Institutions are reminded that the time for the proposed examination is drawing near. The Council is making preparations for conducting these examinations during next month (March), as stated in the original memorandum. In the meantime, such Institutions as contemplate having candidates for examination, are requested to communicate as early as possible with the Secretary of the Society, stating the probable number of the candidates, and the subjects in which they desire to be examined.

# Home Correspondence.

## THE F.S.A. QUESTION.

Sir,—This subject has now had some discussion in the Society's Journal, and, from the contents of the various letters on the subject, it appears to be the general, and I might say *unanimous* opinion, that there should be some settled rule for the government of the members *and the guidance of the public.*

You say that, neither by charter, bye-laws, nor custom, is there any authority for members to use *any* letters denoting membership. All I can say is, that during the time of the Great Exhibition, I noticed that *several* members used the letters "M.S.A," and that on Sir Joseph Paxton being gazetted knight, the notice had, after the name of the worthy knight, "*Fellow* of the Society of Arts," and of another society also, I think; that many members have at various other times been in the habit of using some letters denoting fellowship or membership; that various works on such subjects have given initials and stated them to be those distinguishing members of this society, and in consequence, doubtless, many have erroneously used and permitted the use of such.

I quite agree with the remarks of "M.S.A." and "C.B." that the question is a fit one for the Council to deliberate upon, in its present unsettled state causing much confusion and many mistakes, and might lead the public to suppose that we love to "strut in the borrowed plumes" of members of other societies; and as there appears to be a general desire that there should be *some affix*, it will be for them to consider, and, after due deliberation, to bring the question before the members according to the bye-laws, by which they have the power, either at an ordinary general meeting of the Society, or a special general meeting for the purpose, or they may convene a general meeting for this special purpose, upon a requisition to that effect, signed by not less than ten members of the Society. (See bye-laws, 1854—Nos. 79, 80, 81, 82, 91, and 92.)

I am, sir,
Yours faithfully,
W. H.

Blackburn, Jan. 29, 1855.

Sir,—After the virtual settlement of the F.S.A. question by the authorised statement of our Secretary, that "neither by the Charter, by the Bye-Laws, nor by custom, for upwards of one hundred years, is there any authority for members of the Society of Arts to place any letters after their names denoting membership" it may be considered somewhat superfluous that I should again trouble you on the subject. A Gosport correspondent has, however, in your last number, quoted Maunder's "Treasury of Knowledge" as an authority for the use of the initials F.S.A. by the Members of the Society of Arts, and I would just wish to make a remark upon it. The explanation of Maunder is ingenious, but palpably erroneous, for, setting aside the point of *Fellowship* as opposed to *Membership*, to which I before adverted, Mr. Maunder makes, by his own showing, the Fellows of the Society of Antiquaries, as well as the Members of the Society of Arts, entitled to the initials F.A.S., and neither of them to the already disputed ones F.S.A.

I believe Dr. Hume, in his account of the learned societies, to be more correct in his statement, when he says (page 10), "the Fellows of the Society of Antiquaries sign indiscriminately F.S.A. and F.A.S.; but the latter is

incorrect, or less correct." Why the Fellows of the Society of Antiquaries make use of the initials indiscriminately, has probably arisen from this circumstance: In the early days of the Society, when its Fellows or Members met at the Young Devil Tavern, and Peter Le Neve, the ancestor of our Secretary, was one of them—it was designated as the "Antiquarian Society." The initials F.A.S. were consequently the most appropriate initials of Fellowship at that time, and, as title-pages of works by Fellows of the period inform us, were universally adopted. In 1751, however, George II. granted them a Charter, with, for the first time, the style of the "Society of Antiquaries of London," which it has subsequently retained. After that period F.S.A., as the more correct initials, were gradually adopted by Fellows—although the affection of some for the old style is still apparent. *Grose*, in his *Antiquities*, I perceive, is styled *F.A.S.*, (edition 1790.) Strictly speaking, as this was after the Charter of George II., it should have been *F.S.A.* I will now conclude by signing myself, as before, for the sake of identity merely, and with no desire to infringe the custom of one hundred years,

Your very obedient servant,
F.S.A. *et* M.S.A.

London, January 30.

## Proceedings of Institutions.

Leeds.—The annual meeting of the members and subscribers of the Mechanics' Institution and Literary Society, was held on Wednesday the 31st ult. The chair was taken by the President, W. St. James Wheelhouse, Esq., and the attendance was fully an average, including many of the influential members of the Institution. Previous to the reading of the report, some discussion arose as to the relative number of members and subscribers eligible to election on the committee, when it was decided that there should be twelve of each class. The President then proceeded to read the report, from which the following summary is drawn. The tabular statement of the number of members and others connected with the Institution during the years 1853 and 1854, shows an increase of 39 in the one just closed, making the total number of supporters of all classes 2,219. The greatest increase had taken place in the elementary improvement class. The lecture course for the year has been more than usually copious in extent, and agreeably varied in character, embracing a wide range of interesting topics in history, philosophy, science and art, general literature (including the drama), and also in music. The classified catalogue has now been in the hands of the members and subscribers for some time. Its preparation for and superintendence in passing through the press is entirely due to our late assistant secretary, Mr. Traice. In the appointment of Mr. Traice's successor, Mr. Mc Ivor, the directors feel that they have an efficient teacher in that extremely useful branch of education—natural philosophy. The Committee has deemed it necessary to introduce several changes into the library arrangements, affecting the freedom of personal access to the book shelves on the part of the members and subscribers. These changes have been long in contemplation; and the necessity for introducing them became more apparent at each successive scrutiny the library underwent. Many books were damaged or soiled, not merely by rough handling, but some were found to have been purposely spoilt by being scribbled in, or otherwise marked; whole leaves and many valuable plates were torn out, or had been defaced; no less than three hundred volumes, forming entire works, were unaccountably missing; nearly one hundred books, consisting each of several volumes, were abstracted, thereby rendering the whole series comparatively, if not absolutely useless; and about one hundred and seventy volumes had to be withdrawn from circulation, many of which were permaturely worn or damaged, and these losses were incurred during a period of only seven or eight years. To prevent as much as possible any inconvenience arising from the alteration, it was arranged that the new practice should come into force simultaneously with the issue of the classified catalogue, by a reference to which any required work, if upon the shelves at all, may be found immediately. The Committee has also thought it right to make some further restriction of the privileges granted to the pupils of the day schools. The additions to the library during the year have been as follows:—465 vols. by purchase, 60 vols. by binding periodicals, nine vols. by donation, and six papers by donation. There have been 35,936 issues of bound books, and 7,110 of unbound periodicals, being about 10,500 less than in the previous year—a diminution due doubtless to the great interest felt in those momentous events upon which the eyes of Europe are at present fixed. The recent introduction of the telegraphic despatches into the Institution has given a new and interesting feature to the reading room, and the Committee has the satisfaction of believing that this arrangement has met with the decided and almost unanimous approbation of the members and subscribers. Important changes in the boys' school connected with the Institution have now been in operation for a period of twelve months. The object sought in the remodelling of the school was to render the course of instruction varied and useful. Under Mr. Mc Ivor, the pupils have commenced a course of study, in which every step has been clearly demonstrated by actual experiment. These changes and additions have not been introduced without materially increasing the expenses of the schools, and as they were, in the judgment of your Committee, imperatively called for, they have involved an increase in the fees. From this cause the attendance has fallen from 219 to 170, but gratifying evidence has been afforded that the new system is working well. During the past year the committee has added an important department to the Institution, by opening a school for the education of girls. The progress of the School of Art has been for some time unsatisfactory, but the committee can now speak of its position and prospects with confidence and satisfaction. One of the pupils was fortunate enough to receive a prize medal at the late exhibition at Marlborough-house. The elementary drawing classes are also most numerously attended, and most successful. The aggregate income amounted to £2,277 3s. 8d. Mr. C. Goodall proposed, and Mr. R. Frost seconded, the adoption of the report, when Mr. Kershaw proposed, and Mr. Gore seconded an amendment that it be not adopted, Mr. Gore remarking that there was almost an entire absence of sterling scientific lectures, and that the restriction in regard to access to the library had had a most discouraging effect. Mr. Hole, the secretary of the Yorkshire Union, defended the conduct of the committee in placing some restriction on the free admission of the members to the bookshelves of the Institution. He had himself a book at home from which a dozen fine engravings had been torn out by some person. He also commended the finance and building management, the committee having done all they could to render the place comfortable, and even elegant; but he regretted that he could not extend the same praise to their management of the classes, which seemed to receive too small a portion of the funds and of the attention of the committee. Leeds boasted that it contained the largest Institute in the kingdom, having now about 2,200 members; but, in practical utility, it fell far below Institutions making much less pretensions. He was frequently written to for information as to the best method of conducting an Institute, but he and his fellow secretary, Mr. Dixon, never referred to Leeds as a model, but to Huddersfield. Now it should be remembered that Huddersfield was a small town, containing 30,000 people, while Leeds contained 172,000, or nearly six times as many; yet the Huddersfield Institute boasted of having 576 young men receiving practical instruction in its classes, and Leeds had about 200 out of its 2,200. Huddersfield had 45 teachers, and Leeds 9, and while there was an actual at-

tendance at classes in the Huddersfield Institute of about 1,200 per week, Leeds had not 350. As a proof of the value of the Huddersfield Institute the inhabitants subscribed £150 per year towards it. They felt that it was raising the young men, that it was educating them, and that, therefore, it was a public benefit. Would the inhabitants of Leeds give £150 per year to their Institution? What for? That they might have newspapers, the electric telegraph, and novels? He did not object to these things in their right place and due proportion, but surely the classes —the educative part—were entitled to the first place in the attention of the committee. He was happy to state that the Society of Arts were prepared to offer examinations and certificates of merit to pupils receiving proper instruction in the classes of Mechanics' Institutions. What was Leeds doing to respond to this excellent proposal? Nothing. He contended that it was the first duty of the committee to render their Institution practical and useful in the class department, and the young men who would proceed from *such* an Institution would exercise an important influence on the many thousands in their suburbs, now destitute of any intellectual or educational machinery. After pointing out that they had several large rooms, scarcely, if at all, occupied in the evening, that they had a man—Mr. McIvor —who, if not overloaded with clerking duties, could well undertake the superintendence of the evening classes, he concluded by moving the following resolution:—"That the members and subscribers request the earnest and energetic action of the new committee in the extension of the evening classes, and in increasing their efficiency, regarding this as a most important branch of the Institution, and also as most in harmony with the objects for which these Institutions were formed." Mr. T. CLAPHAM seconded the proposition After some further conversation, it was proposed by Mr. HAWKSWORTH, that the report be approved, excepting that part relating to the library. This was seconded by Mr. N. TILNEY, and supported by Mr. SIMPSON. Ultimately the report was unanimously approved, Mr. Hole's resolution being made a substantive motion, with the addition at the commencement of the following words:—"That this meeting, while it acknowledges the services rendered by the classes committee during the past year, would recommend, &c." The following was the result of the election:—*President*—The Rev. G. W. Conder; *Vice-President*—W. St. J. Wheelhouse, Esq.; *Treasurer*—Henry Oxley, Esq.; *Hon. Sec.*—Mr. John Taylor; *Committee*—Mr. John Bingley, Mr. R. M. Carter, Mr. H. Chorley, Mr. F. Danby, Mr. Thomas Dawson, Mr. E. C. Dray, Mr. W. Hewgill, Mr. Henry Wardman, Mr. T. Wilson; *Auditors*—Mr. Saml. Rayner and Mr. Jos. Redfearn.

## MEETINGS FOR THE ENSUING WEEK.

MON. Geographical, 8½. 1. Mr. C. B. Markham, R.N., "On the Sources of the Purus, a great tributary of the Amazon." 2. "Report on the Arrival of the Chadda Expedition under Dr. Baikie, at Fernando." 3. Dr. Vogel, "Accounts from the Central African Mission,"

TUES. Royal Inst., 3. Professor Tyndall, "On Electricity."
Syro-Egyptian, 7½, Mr. Ainsworth, "On the Yezidis or Devil Worshippers."
Civil Engineers, 8. Discussion upon Mr. Leslie's paper "On the Flow of Water through Pipes and Orifices."
Med. and Chirurg., 8½.
Zoological, 9.

WED. Literary Fund, 3.
Royal Soc. Literature, 4½.
London Inst. 7.
Society of Arts, 8. 1. Mr. J. A. Franklin, "On the Expediency of at once Decimalising English Moneys and Weights." 2. Mr. F. G. Minasi "On the Basis of a Decimal System of Money for the United Kingdom." 3. Mr. Hugo Reid, "On Decimal Coinage."
Graphic, 8.
Ethnological, 8½.

THURS. Royal Inst., 3. Mr. Donne, "On English Literature."
Antiquaries, 8.
Royal, 8½.

FRI. Royal Inst., 8½. Mr. Edward Jekyll, "On Siege Operations."

SAT. Asiatic, 2.
Medical, 8.

## To Correspondents.

Letters from Mr. F. Braithwaite and Mr. John Evans, in reference to the discussion on Mr. Homersham's paper on "The Chalk Strata," and from Mr. Roberts and Mr. Wilkins as to "The Application of Liquid Manure to the Roots of Plants," as well as several others, stand over for want of space.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS,

*Delivered on 31st January, and 1st February,* 1855.

Par. No.
21. Tower of London, &c.—Return.
29. Government Prisons, (Ireland)—Return.
30. Poor in Knogdart—Return.
33. Clergy Reserves, &c., (Canada), Despatch.
20. Criminal Prosecutions, (Scotland)—Return.
32. Public Revenue and Consolidated Fund Charges Act, Rules, &c.
35. Navy, (Excess of Expenditure for 1853-4, and 1854-55), Statement.
37. Ordnance—Supplementary Estimate for 1854-55.
16. Bills—Fisheries, (North America).
17. Bills—Passengers Act Amendment.
Civil Service—Papers relating to the Re-organisation of.
War with Russia; Despatches from Governors of British Colonies.

*Delivered on 2nd February,* 1855.

38. Coffee—Return.
15. Bill—Public Health.
Statistical Tables relating to Foreign Countries—Part I.

*Delivered on 3rd and 5th February,* 1855

34. Assistant Surgeons, (East India), Civil Service, (East India)—Report.
39. National Debt—Account.
14. Bills—Friendly Society.
North American Colonies—Copies of Acts.
International Copyright (Belgium)—Convention.

*Delivered on 6th February,* 1855.

18. Bill—Bills of Exchange and Promissory Notes.
Steam-ship "Erin's Queen"—Report
Ship "Golden Era"—Papers.

*Session* 1854.

495. Railways (Persons Employed)—Return.

*Delivered on 7th February,* 1855.

41. Metropolitan Statistics (Scotland)—Report.
Metropolitan Improvements—Statement.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Feb. 2nd,* 1855.]

*Dated 10th November,* 1854.

2389. E. W. K. Turner, 31, Praed-street, Paddington—Separating fluids from substances.

*Dated 20th November,* 1854.

2451. H. Diaper, St. Michael's-terrace, Pimlico—New material for paper.

*Dated 25th November,* 1854.

2495. J. S. Holland, Woolwich—Fire-arms.

*Dated 29th November,* 1854.

2513. J. M. Hyde, Bristol—Iron steam ships, their boilers and machinery.

*Dated 30th November,* 1854.

2519. J. Mason and L. Kaberry, Rochdale—Spinning machinery.

*Dated 21st December,* 1854.

2695. A. Smith, Princes-street, and J. T. Mackenzie, Lombard-street—Application of high pressure steam to ordnance and small-arms.

*Dated 23rd December,* 1854.

2717. T. Heppleston, Manchester—Finishing machinery for silk, &c.

*Dated 26th December,* 1854.

2723. P. P. Blyth, 23, Upper Wimpole-street—Screw propellers.

*Dated 12th January,* 1855.

80. J. Onions, 44, Wellington-place, Blackfriars—Tobacco pipes, &c.

*Dated 18th January,* 1855.

129. C. J. Dumery, Paris—Smoke-preventing apparatus.
130. J. B. Surgey, Lidlington-place, St. Pancras—Carriages.
131. T. Blackwood and A. Gordon, Paisley—Motive-power engines.
132. W. Lancaster, Preston—"Temples."
133. E. Leigh, Collyhurst—Preparing fibrous substances for spinning.
134. H. Partridge and J. B. Broome, Birmingham—Wrought-iron ordnance.
135. W. Johnson, 47, Lincoln's-inn-fields—Application, treatment, cleansing and dyeing of fibrous substances. (A communication.)
136. W. Pidding, Putney—Hair combs.
137. W. Pidding, Putney—Building materials.
138. W. Pidding, Putney—Coverings for the feet of bipeds and quadrupeds.
139. J. G. Lawrie, Glasgow—Sights of fire-arms and cannon.
140. M. J. Nyclassy, 13, Chandos-street—Wind musical instruments.
141. S. A. Bell and J. Black, Bow-lane, Cheapside—Lucifer matches.

*Dated 19th January, 1855.*

142. C. F. Stansbury, 17, Cornhill—Self-acting railway breaks. (A communication.)
143. S. J. Paris, Manchester—Embossing.
144. R. Martin, High-street, Marylebone, and J. Hyams, Union-street, Bishopsgate—Goloshes.
145. S. Isaacs, 22, Newman-street—Artificial coral.
146. J. I. Clarke, Windsor-court, Monkwell-street—Applying colour to edges of leather gloves. (A communication.)
147. J. Abbott and H. Holland, Birmingham—Preventing sinking of vessels, and raising when sunken.
149. T. C. Hill, Stanton, Lacy—Drain pipes and tiles.
150. P. C. P. Laurent, Prefontaine, Paris—Hydraulic sling for raising weights.
151. W. Smith and T. Phillips, Snow-hill—Taps and floats.
153. M. B. Rennie, 21, Whitehall-place—Preserving food. (A communication.)

*Dated 20th January, 1855.*

155. W. Douglas and J. Carswell, Manchester—Dyeing woven fabrics.
156. S. Salaville, Paris—Preserving and purifying grain and seed.
157. W. G. Pearce, Grosvenor-street, Camberwell—Projecting shot, &c., and exploding by electricity.
158. A. E. L. Bellford, 32, Essex-street, Strand—Paddle wheels. (A communication.)
159. F. Margueritte, Paris—Soda and potash.
160. W. Eisenmann, Berlin—Hearth.

*Dated 22nd January, 1855.*

162. J. Gedge, 4, Wellington-street South, Strand—Laminating metals either in relief or bas relief. (A communication.)
164. H. Carr, Peterborough—Railway crossings.
165. J. H. Pape, Paris—Pianofortes.
167. J. J. Van Camp, Paris—Pistons.
168. F. A. Vasiner, Paris—Fire-places.
169. P. H. G. B. Touzelin, Paris—Artificial flowers.
170. W. Kilgour, Liverpool—Naptha, paraffine and paraffine oil.
171. P. Arkell, Stockwell—Purifying whale and seal oils.

*Dated 23rd January, 1855.*

173. F. Prince, 3, South-parade, Chelsea—Cartridges for fire-arms.
175. W. Sellwood, Cheapside—Spatterdashes.
177. G. B. Pettit and H. F. Smith, New Oxford-street—Gas stoves.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

196. J. Lamacraft, Westbourne-grove—Envelopes, or means for securing letters, notes, and similar documents —26th January, 1855.
208. S. Mayer and W. Bush, Bristol—Reducing flint and other substances, rendering them suitable for the manufacture of porcelain and other earthenware articles.—27th January, 1855.
213. A. L. Lenoir, Paris—Breach-loading fire-arms.—27th January, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed February 2nd, 1855.*

1708. Edward Hallen, Cornwall-road, Lambeth—Improvements in chairs, chair bedsteads, and other seats and bedsteads.
1716. Charles Frederick Stansbury, 17, Cornhill—Improvements in machinery for making rope. (A communication.)
1717. Charles Frederick Stansbury, 17, Cornhill—Improvements in locomotive and steam-boiler furnaces. (A communication.)
1718. Charles Frederick Stansbury, 17, Cornhill—Improvements in cut nail machines. (A communication.)
1719. Charles Frederick Stansbury, 17, Cornhill—Improved air-tight vessels. (A communication.)
1749. John Hackett, Derby—Improvements in the manufacture of garments, or of parts of garments, or of appendages or appliances to garments
1803. Edward Trenery, Stourbridge—Improved machine for driving piles.
1901. William Symington, King William-street, City—Improvements in apparatus for heating air by means of steam.
2117. James Hammond, 9, Brunswick-street, Stamford-street—Holding a book in such a position that it may be read with ease and comfort in an erect, reclining, or completely recumbent position, to be called "Hammond's suspension reading desk."
2259. James Scott, M.D., Argyle-square, Edinburgh—Improvements in apparatus for facilitating surgical operations and teaching anatomy.
2457. Richard Knight, 9, Charterhouse-square—Improvements in apparatus for testing iron as to its capacity for receiving magnetism and in magnetic apparatus.
2485. James Hartley, Sunderland—Improvement in the manufacture of perforated glass.
2487. William Eley, 38, Broad-street, Golden-square—Improvement in the manufacture of ball cartridges.
2523. Frederick Le Mesurier, Guernsey—Improvement in the manufacture of ball and shot cartridges.
2531. William James Cantelo, 4, Leicester-square—Improvement in the construction of barrels of ordnance and small arms, and in balls or projectiles used therewith.
2533. Charles Iles, Peel Works, Birmingham—Improvements in metal bedsteads.
2557. George Fergusson Wilson, and John Chase Craddock, Belmont, Vauxhall—Improvements in the manufacture of candles and night lights.
2575. Nathaniel B. Carney, New York—Circular power loom for weaving circular, cylindrical, and irregular shaped fabrics.

*Sealed February 3rd, 1854.*

1458. Alexander Southwood Stocker, Hall-street, City-road—Improvements appertaining to match boxes, and in the fitting, stoppering, and covering of tubes and other vessels of glass, porcelain, and other materials.

*Sealed February 6th, 1855.*

1734. Joseph Hulme, Manchester—Improvements in apparatus for preventing the explosion of steam-boilers, for measuring the pressure of steam and other fluids, and in heating water for the supply of steam-boilers.
1735. Henry Turner, Leeds—Improvements in preparing hides, and in cutting them into straps for driving machinery.
1736. Henry Moorhouse, Denton—Improvements in certain parts of machinery or apparatus used in preparing cotton, wool, or other fibrous materials to be spun.
1742. William Charles Pitt, Pimlico—Improvements in the construction of knobs and roses used with locks, latches, and such like fastenings as are constructed with spindles.
1744. Plato Oulton, Dublin—Improvements in obtaining motive power.
1750. William Houghton Clabburn, Pitt-street, Norwich—Improvements in the manufacture of shawls and scarfs.
1753. Samuel Bickerton, Oldham—Improved gas-light governor or regulator, which invention is also applicable to regulating the supply of water and other fluids.
1754. Joseph Reimann and Friedrich Sauermann, Breslaw, Prussia—Improvements in fire-arms.
1766. John Petrie, junior, Rochdale—Improvements in machinery or apparatus for drying wool.
1772. William Crosland, Hulme—Improvements in machinery or apparatus for governing or regulating the speed of steam engines or other motive-power engines.
1776. Earl of Aldborough, Stratford-lodge, Wicklow—Improvements in projectiles.
1790. John Lamb and Thomas Lamb, Kidderminster—Improvements in jacquard machinery, and in the apparatus connected therewith.
1802. Sara Spaldin, Hull—Improvements in apparatus for preventing loss of life at sea.
1812. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in preserving corn and other dry seed.
1814. William Ker and Matthew Ker, Tottenham-court-road—Improvement in the frames of expanding tables.
1837. John Grist, Islington—Improvements in machinery for the manufacture of casks, barrels, and other similar articles.
1840. Augustin Jacquelain, Paris—Improvements in the manufacture of gas for illumination and heat.
1851. John Norton, Cork—Igniter or apparatus for igniting explosive and combustible materials.
1858. William Brooke, 5, Martin's-lane, Cannon-street—Consuming smoke and condensing noxious and other gases and vapours, and converting the products thereof to valuable purposes, which now escape to the injury of the animal and vegetable life.
1943. Isaac Pim Trimble, M.D., New York—Improvements in regulating the temperature in conservatories and other apartments, or in ventilating the same.
2306. Pierre Benoit Chapuis, 3, Place des Repentirs, Guillotière, Lyons—Improvement in the harness used for weaving. (Partly a communication.)
2318. Thomas Osborne and William Eldred, Leicester—Improvements in apparatus for retarding and stopping railway carriages.
2336. William Charles Theodore Schaeffer, 11, Stanhope-terrace, Hyde-park-gardens—Improvements in treating the waste washwaters of woollen and other mills.
2361. George Davis, Southampton—Improvements in taps or cocks.
2582. William Hawthorn, Newcastle-upon-Tyne—Improvements in safety-valves.
2594. Nathaniel Johnston, Bordeaux—Improvements in arranging buildings and apparatus for breeding, rearing, preserving, and carrying leeches.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address |
|---|---|---|---|---|
| 3679 | Jan. 25. | The People's Sofa Bed | William Schnell | 12, Denmark-street, Soho. |
| 3680 | " 26. | Perforated Polisher and Sharpener | Richard Edwards | 12, Fanfield-place, Bow. |
| 3681 | Feb. 5. | The Crimean Cloak | Frederick William Lee | 82, Fetter-lane. |
| 3682 | " 7. | Camp Stove and Cooking Apparatus | Thomas Coombs Williams. | 3, London-street, Reading. |

Journal of the Society of Arts.

*FRIDAY, FEBRUARY* 16, 1855.

## NOTICE TO INSTITUTIONS.

The Council have the pleasure to announce that at their request, the Lords Commissioners of her Majesty's Treasury have kindly given directions for the presentation and distribution to the Institutions in Union with the Society, of a Report, lately issued, "On the Re-organisation of the Civil Service," being a continuation or sequel to that issued on the same subject some months since, which was in like manner presented to the Institutions.

## ELEVENTH ORDINARY MEETING.

Wednesday, February 14, 1855.

The Eleventh Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 14th inst., the Astronomer Royal in the Chair.

The following Candidates were balloted for and duly elected Ordinary Members :—

| | |
|---|---|
| Bowditch, Rev. William Renwick, B.A. | Douglas, Robert |
| Browning, Richard, Jun. | Homersham, Sam. Collett |
| Chantrell, George Frederick | Tayler, John George |

On the table was exhibited by Mr. Webster, the numismatist, a series of silver pennies, from Anglo-Saxon times down to the present day, including the Maunday penny, showing the progressive variations in weights as given in the Table, (page 213.) There was also a series beginning with the silver penny and halfpenny of the time of Charles I. and the Commonwealth, followed by copper tokens of one farthing, and through successive reigns farthings and halfpennies ; the first penny occurring in the time of George III., and terminating with copper fractions of a penny of the later reigns, of the value of 1-8th, 1-12th, 1-16th, and 1-24th of a penny. Messrs. Samuel and Montagu exhibited a series of illustrations of the moneys of the greater part of the world, including the unit coin of each country, its multiples and subdivisions, both gold and silver.

The first Paper read was

### ON THE EXPEDIENCY OF AT ONCE DECIMALISING ENGLISH MONEYS AND WEIGHTS.

By J. A. Franklin.

It is due to this distinguished auditory that I explain and bespeak indulgence for the somewhat fragmentary character of what I am about to read. When honoured with a request to treat this important subject here, I strung together materials considerably more abundant than can now be used, and there has been invited to the discussion certain writers who are at issue with me and with the Decimal Association, with which I have the honour to be connected. On their behalf it has been arranged that two other papers shall be read this evening, and, in order to afford every facility to them, I shall have to skip many parts of my paper ; for leisure has not served to re-cast the whole satisfactorily, and I crave indulgence accordingly.

The principal consequence of these altered arrangements will be to throw into the shade many interesting features of the decimal subject as a whole, and to give prominence to our monetary system which it is proposed first to decimalise.

Permit me, then, to assume it proved that the irregular and capricious modes in which English moneys, weights, and measures are reckoned, whether upwards or downwards from any given denomination, are needlessly and painfully perplexing. In the school-room, wasting precious moments distastefully, and trenching upon opportunities all too limited for moral and mental training ; in the market, preventing the poor man from distributing his small earnings intelligently and economically ; in the warehouse and counting house, consuming costly labour, while the risks of error are increased manifold ; and in the operations of international commerce, converting what might be the simplest arithmetical processes into problems difficult of solution, even by the initiated and the experienced.

Let us take as granted the reasons upon my notes for treating decimal or all-ten reckoning as the natural one—that of the ten fingers; and for considering metrical gradations other than decimal, to be primitive methods of artificial subdivision in the absence of natural instruments capable of separation or disintegration. It is time that the still later invention of decimal arithmetic, and the more manageable ten digits which are its proper instruments, should help us so to simplify and universalise the principles of metrology, of computation, and of accountancy, as that tables of money, weights, and measures of all kinds shall be superseded, and that quantities, dimensions, prices, &c., may become reciprocally commensurable at once, without any intermediate process or effort. With this object it is proposed, first, to convert our monetary notation from the irregular one of £ s. d. qr., pounds, twentieths, twelfths, fourths, into the symetrical or all-ten notation.

Even while our coins have been thus irregularly related to each other, the superior facilities of computing decimally have been so manifest, and the means of decimalising downwards from the £—, that is, converting sums of shillings, pence, and farthings, into tenths, hundredths, and thousandths of the £—so easy and convenient, that already in 1613, as mentioned by one of our greatest authorities on this subject, Professor de Morgan, a book was published teaching this simple and rapid process.

In glancing at the history of proposals since made, not merely to decimalize our moneys of account, but our actual coins of circulation, permit me to remind you that the decimal question has been already brought before your Society by my friend Mr. Miller, of the Bank of England, whose very able paper, read last session, traced the more important changes in our coinage, and gave many interesting details of the variance of weights, fineness, value, and nomenclature, through which certain coins had passed to their present names and standards. The inconvenience of our present involved system of coins, weights, and measures, with their several tables, rules, multiplicity of figures, and non-arithmetical notation were contrasted with the brevity and simplicity of the decimal, or all-ten system. The commercial importance and facility of a change to the latter were forcibly urged, more especially with regard to our coinage and accounts, and it was demonstrated that a decimal coinage is for us in no other way practicable than by the adoption of the pound as the chief unit or first coin of the decimal scale.

The decimalisation of our currency, as well as of our accounts, was advocated by Lord Wrottesley, in 1824; by Mr. Babbage, in his Economy of Manufactures, in 1832; by General Pasley, in 1834; by Professor de Morgan, in the Companion to the Almanack for 1841-48 and 53 ; by the

Commission for the Restoration of the Standards of Weight and Lineal Measure, appointed by Lord Monteagle, in 1838; by Dr. Bowring's move in the House of Commons in 1847, from which the first practical step in advance was taken by the issue of the florin, bearing on it the words ONE-TENTH OF A POUND; by the Parliamentary Committee, in 1853, of which Mr. Wm. Brown, the Honourable Member for South Lancashire, was chairman, a gentleman whose commercial experience might fairly entitle him to be considered a high authority for the change; and by the second commission of 1851, the distinguished members of which, in 1853, wrote to the Chancellor of the Exchequer, urging the completion of our decimal system of coins from the pound to the thousandth of the pound, and who in their report in 1854, felt it incumbent upon them, although the coinage did not form a part of the inquiry referred to them, again to enforce the importance of carrying into immediate effect a change in our coinage which would so much simplify all monetary calculations and accounts. Since then, and with such authority in their support, the Decimal Association has been formed. They have, in proof of the utility of their object, the evidence, not alone of men of science, accustomed to weigh every minutia of detail with the severity of mathematical exactitude, but the evidence of men of business and accounts—men of incessant practice in every branch of trade, commerce, and money—merchants having transactions with every portion of the globe, and as familiar as with the multiplication table with every slight variance in value of the manifold moneys of the world—manufacturers, paying weekly every variety of amount to every class of workmen, skilled and unskilled — shopkeepers, selling a vast aggregate in the smallest quantities of goods of ordinary consumption that can be sold to meet the wants of the poorest and least taught, and who have certainly a knowledge both of the utility of the change, and how it would be received by the masses of the people. Nor is this the entire concert of authority upon the subject. Schoolmasters, considering how much more easily arithmetic would be taught with decimal moneys, weights, and measures, have petitioned, praying Parliament to bring about the change—Chambers of Commerce and Commercial Associations, viewing its bearings not only on home business, but in rendering our weights, measures, and money more intelligible to our foreign associates in trade, have petitioned for the system—the Bank of England, a body which, standing at the head of the monetary world, may reasonably claim to be considered a sufficient authority as to every gain that would follow from, and every difficulty that can stand in the way of the change, have, under a matured conviction that decimal coinage and accounts would spare the waste of intelligence, save labour, ensure accuracy, and be, in short, a public boon, have contributed £100 to the funds of the Decimal Association—and upwards of 250 members of Parliament, who may be presumed to have some knowledge of the opinions of the people, and amongst whom are representatives of every principal seat of commerce and manufactures, have given their names as members of the Association, which proposes, as the first step, the decimalisation of our coinage, and holds it to be utterly impracticable that it can be decimalised in any other way than with the pound as the first coin of account.

Other modes of accomplishing the end have, however, been proposed, not, it is true, on any very important authority, nor have they met with any considerable support; but "their advocates are sufficiently pertinacious (it is said) to be obstructive."

All schemes heretofore propounded for the decimalisation of our English money belong to one or other of two categories—one which retains the £, the other which retains the penny. The two are obviously irreconcilable under any decimal system properly so called, for their relation to each other is 240:1, and that of the shilling to the penny is 12:1. Either the penny or the tenpenny unit would of necessity displace the £ as our principal money of account, together with the shilling, a fact which is virtually admitted by the proposal to substitute for the £ a coin of 100 pence (8s. 4d.) under various names.* On the other hand, the £ unit, if retained, requires nothing incompatible with any other unit proposed between itself and the shilling inclusive.

The question then lies virtually between the £ and the penny, and it is not difficult to demonstrate that neither the penny unit, nor any other unit based upon the penny, could meet our obvious requirements, whether of domestic trade or of international commerce.

Since a new system cannot displace the old one, as it were, by sleight of hand, there must be due consideration for long-established habits, both of computation and of estimation by *£. s. d. qr.* The whole stock of ideas and facts concerning monetary value possessed by the present generation, and every existing record of finance, values, prices, &c., accumulated in the past for the use of the future, render it indispensable, not alone that values expressed by the old system should be convertible into any new notation which may be adopted (as also the converse) by the simplest possible operation, but that both notations should be reciprocally commensurable almost at a glance.

When sums recorded in *£. s. d. qr.* have to be expressed in the notation of the decimalised pound, *i.e.*, pounds and mils, we find the most important item, the pounds, already decimalised to hand, so as not to require any change. The three denominations (fractions of the pound) which remain, suggest their own decimal equivalents at once to all classes (and they are numerous) already accustomed to make monetary calculations decimally; for a little practice is alone needful, in order to convert or read off those equivalents at sight.†

On the other hand, if sums recorded in *£. s. d. qr.* have to be expressed by the system of the tenpenny and its mils, or of the tenpenny and hundredths of a penny, it will rarely happen but that every integer of the original sum will have to be altered. The pounds must be multiplied by 24; the shillings by 12; the remaining pence must be added to the last product, and the farthings represented by two additional places of figures next following. Both systems have three places of decimals after the unit, and both are susceptible of still further subdivision, if desired; but, *per contra*, while a pound unit needs but a single integer, that same value, expressed in tenpences, will always need an additional integer; and, in all cases beyond £4, two additional integers must be written down.

Let the most expert arithmetician endeavour to compare and estimate, side by side, sums of magnitude expressed in all three notations; and also ascertain what impressions are produced upon any eye or ear educated in the old monetary notation, by quotations of such sums in the tenpenny notation. These last, before they can become commensurable with values otherwise expressed, must be divided throughout by 12, and 20, or else by 240; whereas, the habit has already long prevailed of comparing "at sight" shillings, pence, and farthings, the only items not identical as residual fragments of £1, with like values expressed in thousandths of £1.‡

* Mr. Minasi, a candid advocate of the penny, writing under the motto "Penny Wise and Pound Foolish," says that the penny as a unit would "extinguish" the £.

† I do not, of course, overlook the fact, that the mathematical equivalent for 1-960th of £1, cannot be expressed in thousandths of £1, for that it is which constitutes the occasion for a reformed currency. But the discrepancy between a farthing and a mil is only 1-100th of a penny, and at 25 mils per sixpence even that is compensated.

‡ This habit, as taught in our best school arithmetics, under the name of "reduction by inspection," has been found to save both time and labour, even though the results have had to be reconverted into shillings, pence, and farthings. Hence, practice is already in advance of theory, in the harmonising of English money (like that of other countries) with "the all-ten reckoning," or simple method of whole numbers only, counted throughout by tens.

I propose here, in order to save the time of the meeting, to retrench arguments and examples in support of the £ *versus* the penny, as "a schoolboy's question." If those who follow me will also agree to defer that question to a practical issue—not upon problems specifically devised on one side to embarrass the other, but to be tried thus: To two classes of free school boys let us dictate an impartially selected score of arithmetical questions. One class shall work by the £ and mil, the other by the tenpenny, and the auditory shall judge between them the two systems.

The principal advocates for the penny at the expense of the pound, are—

1st. Those who propose to adopt a penny as the unit, decimalising upwards to 10 pence, 100 pence, &c.

2nd. Those who adopt a tenpenny unit, decimalising downwards to the single penny and the 10th of a penny.

3rd. Those who adopt a farthing as the unit, decimalising upwards to 10 farthings, $2\frac{1}{2}$d.; 100 farthings, 2s. 1d.; 1000 farthings, £1 0s. 10d.

It will be observed, that whether tenpenny or penny be the unit, there at present exists no coin which can be represented by unity in the next rank below the penny; so that, in either case, the simple decimal chain is broken at this stage. On the other hand, where the farthing is the starting point, every existing coin preserves its value undisturbed, but nothing except the farthing itself retains its specific rank in accountancy.

New gold coins, whether of 100 pence or 1000 farthings, would lead to endless mistakes and confusions, unless all our existing gold coin were called in and demonetised.

The small differences in size and weight of the £1 0s. 10d. from the £; of the 8s. 4d. from the $\frac{1}{2}$ sovereign, and of the tenpence from the shilling, have suggested to the advocates of the new coin a necessity to make it oval as a means of being readily distinguished. The very suggestion, strange as it is, is significant.

Our penny-piece has been spoken of as if it were one of the bulwarks of our ancient institutions, another Magna Charta. The piece we have is a thing of yesterday. Etymologically, as some hold, it signifies money in general, after the Danish word *penge*. There used to be a penny of two pence; and Henry III. coined a penny of gold, a 20 pence token. The Anglo-Saxon penny was assumed to be the 240th of a lb. of silver, a penny piece of a pennyweight. But both weight and value fluctuated considerably, eventually dwindling until it became too small for convenient circulation. At the date of Charles I., when the pound itself was a silver coin, the penny had long become too small to be useful, and small amounts were then made up of copper tokens. English copper-money is of comparatively recent date. Ruding says, that Charles II. first issued copper-money, properly so called, but that it does not appear to have been made current. The first copper penny of the realm as a legal tender, was struck at Birmingham, in 1797, and is the large rimmed penny now current, weighing exactly an ounce avoirdupois, as a ready popular test of weighed commodities. The more recent pennies are tokens, 24 to the lb., about half their nominal value, and a legal tender to twelve pence only. That sum is represented by another token, the silver shilling, current also for something more than its intrinsic value, and in turn a legal tender to 40 shillings only; whereas the sovereign is not a token current for more than its worth, but a legal tender to unlimited amount. In fact, under the law of 1816, passed at the instance of Lord Liverpool, the gold pound, long constituting the unit of our monetary system, became the sole representative of our national standard of value.

Let us trace back the £ sterling of gold to its origin. The name "sovereign" was first given to the double-royal, stamped with the effigy of Henry VII. in sovereign robes, and made current for 20 shillings. Henry VIII. expressly declared it a "pound-sovereign." James I. constituted it the chief coin in our system, called it a unit, and stamped it with the Roman numerals, XX. Hence the three significant names, pound, sovereign, and unit, applied to the chief coin of our system, came to be used. Under Charles I. this unit was called a guinea, only because of the gold coming from the Guinea coast. The guinea, somewhat later, got to bear a fluctuating premium over 20 silver shillings, until, on the advice of Sir Isaac Newton, Master of the Mint under George I., it was declared a representative of 21s. After this we had a double standard, silver being payable by tale to £25, and to any greater sum at Mint price. Thus it continued until the sagacity of Lord Liverpool and his school averted the evils of a double standard; and in 1816 the sovereign, in its present shape, was again made identical with the pound of account, and silver coin became mere tokens, as at present.

This brief historical parallel between the penny and the pound, shows that the penny has not been the unit of a monetary system for many centuries, whereas the pound unit, expressly so called, which it is pretended that a mere token may extinguish, has occupied its position since the time when Great Britain took her commercial position among the nations of the earth.

By the kind assistance of Mr. Webster, the numismatist, I am able to present a diagram, showing the coinage of all kinds, in relation to £ s. d. qr., as issued from the time of Henry VII. to Victoria, inclusive.

Mr. Webster has also obligingly brought down a valuable collection of pennies, extending over 1000 years, shewing their gradual diminution in weight of silver, and exemplifying in another series the origin and progress of our copper coinage, as I have just described.

I regret to have failed in making up a historical series of the gold pound or sovereign. The silver £ and 10s. pieces of Charles I., are in Mr. Webster's case.

*The Coinage: Pounds, Shillings, Pence, and Farthings issued from Henry VII. to Victoria, inclusive.*

GOLD.

The £. Pieces of......... 5, 3, 2, $1\frac{1}{2}$, 1, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$.
21 shillings do. ...... 5, 2, 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$.

SILVER.

The £ do. ...... 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{10}$.
The Shilling do. ...... 1, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{8}$.
The Penny do. ...... 1, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{1}{4}$.

COPPER.

(Coins) do. ...... 2, 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{12}$, $\frac{1}{16}$, $\frac{1}{24}$.
(Royal Tokens) do....... $\frac{1}{2}$, $\frac{1}{4}$.
Tin (Copper-plug) do. ...$\frac{1}{2}$, $\frac{1}{4}$.

NOTE.—The Silver pieces below 3d. have been Maunday money during the later reigns.

But how is it that our present penny piece is supposed to have so firm a hold upon the popular regard? It will generally be found, that whatever the unit of any monetary system, the public will select particular coins or values, as standards of convenient comparison. In our own system, it is indisputable that we think and speak of large values by the £; of prices from, say £4 downwards by shillings, as 80s. or 72s.; and from $1\frac{1}{2}$ shilling downwards by pence, as 18d., 15d., &c. The penny is a standard of petty traffic, not because it is the 12th of a shilling, but because, like the French sous or the Dutch stiver, both superseded coins, it is the one material point, round which as a nucleus, such things as the penny roll, the pennyworth of apples, and other cheap penn'orths can alone range themselves. Considering how very recent a thing is our penny-piece, and the alteration of values at this day as compared with older times, it is not unlikely that a coin or token 10 to the shilling in place of 12, would become a still more popular and convenient standard for petty traffic.

We have been warned of the danger to our standard of value from the pretensions of the tenpenny unit.

Mr. Yates, who received the Telford medal from the Institution of Civil Engineers for his paper read in their last

session on the French system of coins, weights, and measures, says explicitly, when advocating that a new coin of tenpence shall supplant the pound, that

"Perhaps it would be indispensable to adopt silver as the standard of value, * * silver coins would cease to be tokens, * * the gold coinage ought to be called in, * * and reissued at its real value. * * The value of a sovereign, and, consequently of a half-sovereign, should be declared by law or by a proclamation; * * they would probably, under the altered circumstances, be tokens; in this respect taking the place of silver."

And the same gentleman, who has more laboriously laboured at the question than any other advocate of his system, and who has left unsaid nothing that can be said for it, admitted in a paper read before the statistical section of the British Association at Liverpool, the necessity, if his plan were adopted, for the issue of entirely new coinage, and proposed the immediate recal of every gold and silver coin at present in circulation, and the issue of a paper money, beginning with tenpenny notes, to fill up the interim until the production of the new coins.

Mr. Theodore Rathbone, not the eminent merchant of that name, but the gentleman whose name has been given to the tenpenny scheme because of his prominence in its advocacy, read another paper upon it, at the last Liverpool meeting of the British Association. Among his manifold writings I find this expression:—

"When Great Britain has everywhere adopted the *ten pence* or twenty-fourth of her pound sterling, as the principal denomination in all her accounts, can it be doubted that the very slight adjustment required to render this coin the European franc or French tenpence, its double, the true old florin, and its quintuple the dollar, corresponding in weight and standard fineness of metal—would very soon follow?"—

In like manner has written the late Mr. Laurie and other gentlemen smitten with the supposed correspondence of an English tenpenny with the coins of other countries. I now quote from the paper read by Mr. Minasi to the Statistical Society:

"It will be readily observed, that great facilities would be afforded to travellers and others in more easily effecting exchange operations. The half-imperial would represent the United States *dollar*, and the *hard dollar* of Spain, and the South American States; the *argent* would equally approximate to the French and Belgian *francs* and other foreign coins of the same value; while the Dutch *guilder* and the *florin* of the Zollverein, &c., would be indicated by two argents. For this and other reasons, it would doubtless be found convenient to coin such pieces as

| | s. | d. |
|---|---|---|
| The *half imperial* or *dollar*—value in present money . . . . . . | 4 | 2 |
| *Four-argent* piece . . . . . | 3 | 4 |
| *Two-argent* piece, or *guilder* . . . | 1 | 8 |
| *Half-argent* . . . . . . | 0 | 5 |

* * * * * * *

A *Victoria*, equal to 10 *imperials*, or 1,000d. answering to the *double eagle* of the United States, would likewise be found useful."

Now, I have studiously avoided profitless discussion about names for new pieces; but surely those who join in disclaiming the title of florin for our two-shilling piece must be ignorant that Half-imperial is a title already appropriated by the five-rouble piece of gold, worth about 16s. 4d., and I am at loss to understand how *argent* is found more English than mil—(mite would do as well). I have constructed tables showing the discrepancies in weight and value of the pieces which Mr. Minasi and others propose shall represent each other.

*Discrepancies in Silver Coins reputed to be Equivalents.*

| Coin. | Country. | Grs. of Fine Silver. |
|---|---|---|
| Dollars. | Mexico | 376·22 |
| ,, | Peru | 375·68 |
| ,, | Spain (Pillar) | 372·66 |
| ,, | United States, 1792 | 370·93 |
| ,, | ,, 1834 | 371·25 |
| ,, | ,, 1853 | 345·55 |
| ,, | German Convention | 360·83 |
| ,, | Prussia | 255·82 |
| ,, | Denmark | 191·12 |
| ,, | Hayti | 110·96 |
| Francs | France | 69·43 |
| ,, | Belgium | 69·29 |
| 10 pence | England | 67·27 |
| 5 francs | France | 347·17 |
| 50 pence | England | 336·36 |
| Ducat | Naples | 295·00 |
| 40 pence | England | 269·09 |
| Rouble | Russia | 277·33 |
| Florins | Austria | 180·41 |
| ,, | Holland (old) | 148·01 |
| ,, | ,, (new) | 145·76 |
| 2 francs | France | 138·86 |
| Florin | England | 161·45 |
| Rupee | India | 165·00 |

*Discrepancies in Gold Coins reputed to be Equivalents.*

| Coin. | Country. | Values by London Trade Experience. |
|---|---|---|
| DUCATS | Augsburg . . | £0·437 |
| ,, | Austria (1762) . | 0·441 |
| ,, | ,, (1809-34) . | 0·460 |
| ,, | ,, (1838) . | 0·464 |
| ,, | ,, ,, . | 0·469 |
| ,, | Hungary . . | 0·468 |
| ,, | Bavaria . . | 0·467 |
| ,, | Saxony . . | 0·466 |
| ,, | Baden . . | 0·464 |
| ,, | Sweden . . | 0·459 |
| 3 Ducats | Sicily . . | 0·514 |
| THE SOVEREIGN . . . | | . £1· |
| 24 Francs . . . . . | | . 0·949 |
| 5 Dollars, (Spain) . . . | | . 0·998 |
| Ditto (United States) . . . | | . 1·026 |

*Disparities in Gold Coins mistaken for Equivalents.*

| | Contents in Grains Fine Gold. |
|---|---|
| U.S. Eagle . . . . . | 231·897 |
| 5 × 8s. 4d. British . . . . | 235·418 |
| THE SOVEREIGN . . . . . | 113·000 |
| 24 Francs { prescribed weight . | 107·528 |
| 24 Francs { Bk. of England experience | 107·339 |
| U.S. ½ Eagle, 5 dols { prescribed weight . | 116·100 |
| U.S. ½ Eagle, 5 dols { Bk. of England experience | 115·948 |

The tables should tell their own tale. In his tract "A Word in Behalf of the Poor Man's Penny," Mr. Minasi classes the Russian *bank* rouble among the coins to be approximated by the *argent* or tenpence, and the Neapolitan *ducat* as approximating 4 argents.

But Mr. Rathbone proposes what he calls "slight adjustment" between these unlike values. What adjustment would be possible between a Russian bank rouble and the 24th of a sovereign,—the rouble being a mere paper promise-to-pay by that amiable potentate, the Czar?

Between the tenpenny and the true franc, taking the latter as a basis, adjustment would, I find, involve a buying up (by the Mint) of our silver coinage now in circu-

lation, at a cost of about 6s. to 6s. 6d. per ounce, and a selling to all the world of the proposed new coinage, at about 5s. per ounce only :—below the market price, even at present quotations, of the mere material! So that the new coin would be melted down or shipped off as fast as issued, as, on the authority of the Director of their Mint, has been the case from the United States, which therefore now coin their one dollar of gold; and as is still the case from France, a fact notorious in the bullion market; 20 francs in silver having recently commanded a premium over 20 francs in gold.

The establishment of an English tenpenny piece as our chief decimal coin of account would not, therefore, for any practical purpose, bring us one atom nearer an equality with French and American coins of decimal account than now.

"The delusions respecting the homogeneity, correspondence, or harmony of French, Dutch, American, and other coins," says Mr. Miller, "is manifest. Who is to change, as a means of 'adjustment?' Is France to change her franc? If so, let it be broadly proposed, and let us have our nearest neighbour's opinion on the subject. Is America to give up the dollar, and adopt the five-franc piece? Or is she to make it fifty English pence first, by way of a beginning? The truth is, 'slight adjustment' signifies neither one nor the other. It signifies, if it signifies anything, that England should, at some time or other, abandon every one of her present measures of value, together with every single element whereby to connect the monetary statistics of the past with those of the future; and that we should prepare to do all this by the issue of a tenpenny piece! When we arrive at this point,—wherein does the tenpenny plan differ from Mr. Yates's, that we should adopt the French *systeme métrique* entire, except that it is less candid and straightforward?"

The public was, however, for a time misled into the belief that the proposed tenpenny piece and the French franc were to be identical, because certain advocates of the tenpenny piece were pleased to call their coin a franc; a confusion that was got rid of only when the actual value of the French franc was shown to differ considerably from either 10d. or £$\frac{1}{24}$.

How can those who profess to respect our standard of value, expect to accomplish a useful object by bringing about a resemblance or correspondence—not between monetary standards or fixed units themselves—but between mere tokens or counters for different units? Such tokens are our own shillings and pence, whose intrinsic value is made as much less than their current value as leaves no sufficient temptation to private fabricators. That such is becoming the case of the American silver coinage, as towards its gold, ought to be manifest. The U.S. whole dollar of silver still current contains 17dwts. $4\frac{1}{2}$grs., that is $1{\cdot}16\frac{6}{165}$ dols. per oz. The U.S. mints have bought up, since Dec. 1, 1853, as many as they could get, paying 1·21 dol. per ounce; and since 1st July last, the chief mint at Philadelphia offers as much as $1{\cdot}22\frac{1}{2}$ dols.—so buying them back at a loss; the payment being made in gold or in new silver tokens of 16dwts. per dollar, *i.e.* at the rate of 1·25 dols. per ounce. This margin, $2\frac{1}{2}$ cents per ounce, is clearly insufficient, and we may expect a still further change.

But it is said we should be compensated for the abandonment of the pound, by the facility for the calculation of international exchanges.

By long established usage, most exchanges between Great Britain and other countries are expressed very naturally by the number of small moneys of account which are to be given for a large money of account. Now, to our manifest convenience, the largest of such is our pound. Moreover, our pound sterling has long been an inflexible standard or measure of all other values, including that of silver; whereas, America is only now gravitating to the same simple system, (having made two important steps towards it, as just explained), and the best financiers in France incline in the same direction. The pound sterling signifies 113 grains of fine gold coined in a prescribed manner; and that being the one fixed point of the largest commercial system in the world, it were gratuitous folly in us to sink suddenly to an inferior unit; one, moreover, which, as a coin, is incapable of carrying its assumed value, and must remain a mere token of silver, —its weight and intrinsic value varying with the market.*

The comparative tables of coins before given show the ratio of bullion to bullion. It is obvious that, for gold, the ratio progresses in inverse order to that of silver; and, so far as in exchange operations one country estimates the actual coinage of another according to the fine bullion which can be extracted from it, so far is it altogether indifferent whether the coins of one "harmonise" or not with those of another. It is a delusion to suppose that exchange computations can be facilitated by merely approximating the still not identical units of account, (much less of circulation,) just, for instance, as it would be a delusion to suppose the ratio 1000 : 1001, a more simple proportion than 1 : 10; or $\frac{1000}{1001}$ a more tractable factor than $\frac{1}{10}$.

It cannot be too much insisted upon that the closer the approximation, stopping short of complete equality, the greater the risk of error and confusion.

But, say the tenpenny advocates, overwhelmed by these disparities, we will be content for the present with no further novelty than a new English token, twenty-four to the pound; that will suffice for the decimalisation of our monetary system, and qualify us to negotiate for closer approximations with other decimal systems. In any case, say they, we can have the boon of decimal accounts at once. Surely these gentlemen forget that Ireland had a tenpenny and half-tenpenny coin for several years, issued by the Bank of Ireland, made a legal tender for revenue, &c., and protected by law against imitations. If, as assumed, a tenpenny piece would facilitate the keeping of decimal accounts at everybody's pleasure, how is it that, despite the abundance of tenpennies, fivepennies, &c., and notwithstanding that the advantages of decimal accounts, proclaimed long before, had become obvious enough, yet people kept accounts by £ s. d., and not decimally? A tenpence was insufficient without a hundred-pence piece, and nobody then attempted to extinguish the pound and the shilling.

If, however, a "five" had existed, that is, a token of 5 mils or mites, 5 to the sixpenny piece, 10 to the shilling, 20 to the tenth of a pound, 200 to the pound, then the public accounts, those of bankers, and of all concerns which do not in accounts carry out halfpence, or pay and receive less than a penny piece, might have been kept decimally at once.

Thus, you perceive, that the tenpenny device has had its chance—the only kind of one needful to its success—according to the loudest opinion pronounced in its favour, whereas the decimalised pound, already long and firmly established for purposes of computation, still waits for the link connecting computations, accounts, payments, and exchanges, in one harmonious chain.

On the contrary, the tenpenny unit, as a "harmonised" coin, must lead to confusion; as a novel money of account, to complexity; and, as an arbitrage factor, to capricious changes which would render the past history of international finance with difficulty intelligible?

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* I may here remark how expedient it is that we, like other nations, should make the unit of our monetary system, either itself the standard of value, or, at least, a fixed quantity of the metal which *is* that standard.

Eminent merchants, engaged in daily exchange operations, have already pronounced for the decimalised pound, which many of them employ in their computations. It is now, and always has been, free to them to make their computations, and even to record them, on the penny basis; and it may be said, advisedly, that they only abstain from a demonstration against that basis being adopted, because they cannot conceive it possible that it would, even for a moment, be seriously entertained.

There remains one notion, which has been mixed up with the decimal question inconveniently, and in a manner to obstruct all progress,—it is the notion of universal standards of value, weights, measures, &c., throughout the commercial world; a notion exceedingly captivating, like that of universal language, &c.

The aspiration for universal standards, like that which animates the Peace Society, although unlikely to be attained this side the Messianic era, claims sympathy in so far as it affords a counterpoise to extreme tendencies in the opposite direction, always too powerful. Just as the efforts of the Peace propaganda may, under Providence, promote some middle course, wherein armies now arrayed for mutual destruction, may co-operate as an armed police, the peace officers of society at large, so may there be imagined some common system of account internationally; not a material Procrustean method of enforced uniformity between all things, in all places, and at all times; but, adopting an illustration familiar to my City friends, a sort of clearing-house method, devised to accommodate as many distinct and independent systems as practicable. What any bank of deposit is to its own customers *inter se* might some one State bank be to other State banks.

A Bank of England note is a deposit receipt for bullion, returnable in sovereigns. In another shape it might represent mere bullion, deposited for foreign account, and returnable in any form.

Desiring, then, to speak with the utmost respect of those who look forward to such assimilations of all the nations of the earth, let us ask, are we to stand still until this desirable time be ripe? are we to cling to a system of coins, weights, and measures, that retards the instruction of the young, and is a puzzle to all who have dealings with us, until some scheme be hit upon that all will recognise as perfect—some coin unto which, with all its divisions and multiples, every nation will at once merge its existing moneys? To say the least of it, this field of assimilation is a very wide one. Almost every country has its peculiar moneys; the one point of concert with the majority is, that they have decimal coins. Surely, then, *our* first step to an approximation with other nations, must be to adopt the decimal system.* Other countries are changing, or seem likely to change, their standards of value, or to make important alterations in their coins, but not one of them proposes to go back from the decimal system, although many are coming to our plan of a convenient unit, reducing all below it to aliquot tokens. We have but little alteration to make in order to arrive at a decimal system—no important coin to call in or displace from its column of account. We can decimalise from the pound as it stands, without putting ourselves in a worse position to adopt anything better, if it should be found hereafter.

These beautiful diagrams, which illustrate the fluctuating relations to each other of the precious metals, I owe to my ingenious young friend, Mr. N. Joseph. They demonstrate not alone serious *ex post facto* alterations of monetary contracts, but also habitual departures from mint regulations, even when altered. These discrepancies are, probably, to some small extent, attributable to the plan of double, or alternative standards. The following tables explain these diagrams:—

* I place in the hands of the chairman a table, kindly prepared by Mr. Radston, showing that two-thirds of the population of the world now have decimal money.

*Table showing the quantities of Fine Gold and of Fine Silver in the 20 shillings or the £1 sterling, from the Conquest to 1855, according to the Mint Indentures, and also the proportionate quantities found in each by Assay.*

| A.D. | Anno Regni. | GOLD. Number of Grains of Fine Gold in the pound stg. | SILVER. Number of Grains of Fine Silver in the pound stg. | Proportionate quantity of Fine Silver to one of Fine Gold found by Assay. |
|---|---|---|---|---|
| 1066 | William I. | | 4995·000 | |
| 1257 | Henry III. | 499·500 | ditto | 10 |
| 1280 | 8 Edward I. | | ditto | |
| 1344 | 18 Edward III. | 407·990 | 4933·333 | 12·091 |
| 1349 | 23 ,, | 383·705 | 4440·000 | 11·571 |
| 1356 | 30 ,, | 358·125 | 3996·000 | 11·558 |
| 1401 | 3 Henry IV. | 358·125 | ditto | 11·158 |
| 1421 | 9 Henry V. | 322·312 | 3330·000 | 10·331 |
| 1464 | 4 Edward IV. | 257·850 | 2664·000 | ditto |
| 1465 | 5 ,, | 238·750 | ditto | 11·158 |
| 1470 | ,, | ditto | ditto | ditto |
| 1482 | 22 Edward IV. | ditto | ditto | ditto |
| 1509 | 1 Henry VIII. | ditto | ditto | ditto |
| 1527 | 18 ,, | 210·149 | 2368·000 | 11·268 |
| 1543 | 34 ,, | 191·666 | 2000·000 | 10·434 |
| 1545 | 36 ,, | 176·000 | 1200·000 | 6·818 |
| 1546 | 37 ,, | 160·000 | 800·000 | 5·000 |
| 1547 | 1 Edward VI. | ditto | ditto | ditto |
| 1549 | 3 ,, | 155·294 | ditto | 5·151 |
| 1551 | 5 ,, | | 400·000 | —— |
| —— | | 160·000 | 1760·000 | 11·000 |
| 1552 | 6 Edward VI. | ditto | 1768·000 | 11·050 |
| 1553 | 1 Mary | 159·166 | 1760·000 | 11·057 |
| 1560 | 2 Elizabeth | 160·000 | 1776·000 | 11·100 |
| 1600 | 43 ,, | 157·612 | 1718·709 | 10·904 |
| 1604 | 2 James I. | 141·935 | ditto | 12·109 |
| 1626 | 2 Charles I | 128·780 | ditto | 13·346 |
| 1666 | 18 Charles II. | 118·651 | ditto | 14·485 |
| 1717 | 3 George I. | 113·001 | ditto | 15·209 |
| 1816 | 56 George III. | 113·001 | 1614·515 | 14·287 |

*The relative value of Gold and Silver, variable in all countries, indicated by the number of ounces of Silver, equivalent to 1 ounce of Gold.*

| | A.D 1641. Mr. Page. | A.D. 1780. Mr. Page. | A.D. 1818. Dr. Kelly. | A.D. 1855. Annuaire Bureau des Longitudes. |
|---|---|---|---|---|
| Amsterdam | | 14·885 | 15·8735 | |
| Hamburgh | 12· | 14·171 | 15· | |
| Paris | 13·5 | 14·581 | 15·5 | 15·5 |
| Madrid | 13·33 | 15·636 | 16· | 15·75 |
| Lisbon | | | 13·56 | 15·48 |
| Petersburgh | | | 15· | 15· |
| Brussels | | | 15·5 | 15·79 (?) |
| Venice | | 14·779 | 15· | |
| Genoa | | 14·915 | 15·34 | |
| United States | | | 15· | Error |
| Bengal | | | 14·587 | |
| Madras | | | 13·872 | |
| Bombay | | | 15· | |
| China | | | 14·25 | |
| Leghorn | | 14·510 | 14·65 | |
| Naples | | | 15·21 | |

The ten-penny and penny advocates demand our attention to France and the United States. Well, which of their coins are we to adopt with any certainty that it shall continue their chief money of account. The accomplished director of the U.S. mint, Mr. Snowden, says, in his report for 1853:—

"The depreciation of the standard weight of the half-dollar and lower denominations of silver coins, authorised by the Act of 3rd March, 1853, has been attended with good results. * * * The new issue has reached the sum of 8,654,161 dollars, which is a larger amount than we have struck during the five years preceding. * * * The appreciation of silver made the alteration necessary. * * * In England, since 1816, a silver currency has been maintained by similar means. * * * There

will constantly be a varying per centage of fluctuation (in the relative values of gold and silver) and this will sometimes be so great as to compel a legal modification of standards. * * * Although our own standard of silver has so lately been changed to suit the market, there is reason to fear that the reduction of weight was not sufficient, and that another re-coinage, at no distant date, may become necessary."

Other American writers foresee the abandonment of a silver standard for the eagle or half-eagle of gold.

Who can answer that France is not likely to alter her silver franc ere long, observing, 1st, the constant drain upon her silver coinage for the East; 2nd, the recent issue of gold 5-franc pieces to supply their place; and, 3rd, the announcement of a 4-Napoleon or 100 franc piece of gold —which would be available as a new unit of decimal account, if the ½-Napoleon be not large enough.—Witness the sagacious notes upon the Compte Annual of the Bank of France for 1853, reviewed in the *Revue des Deux Mondes* :—

"The weight of the (French) silver piece must be reduced as in the United States, without which that description of coin must inevitably be exported to the last franc; and secondly, it will be necessary to take the monetary unit in that metal likely to circulate in greatest abundance—*i.e.*, to settle that the franc for the future shall contain a certain weight of gold if gold is destined ultimately to predominate."

But, it may be asserted I am leaving out of sight that it is not merely proposed we should adopt the moneys of another state, but that a convention should be held for the settlement of international coins. Well, you have an instance before you.

There is here a collection of German coins, issued under the convention of 1838. There have been, according to Messrs. Eckfeldt and Du Bois, several such conventions; for instance, the diet of Augsburgh, in 1559, under which the well-known ducat, *called* a "universal coin" was regulated. It exists yet, unlike from different mints, still a mere token, and occasionally at a premium against silver throughout its history. There is a later and rival ducat, originating in 1740. At Leipsic, in 1690, there was a convention for the silver money of the Northern States of Germany,—another in 1753—another in 1837, leading to the last, in Dresden, in 1838. That, after all, this convention has been partial and inefficient, seems to be admitted; notwithstanding the urgent occasion for some such correspondence, (a striking illustration of which was furnished to me by the courtesy of the Austrian consulate). While drawing up this paper, I saw it stated from Vienna—where a congress had been sitting since last November, to improve the convention of 1838, that only Austria, Bavaria, Frankfort, and Russia, (qy. Prussia), had sent representatives, and that it will have separated, not only without coming to any result, but convinced of the impossibility of establishing unity between the moneys of Germany. I quote from a well-informed journal, *l'Independence Belge*. If the German States, with a common language, a federal union, and still more a Zollverein, necessitating a keeping of accounts against each other, cannot maintain old treaties for a unity of monetary regulations, why should we be asked to wait until still greater complexities shall have been removed, before adopting the obviously useful expedient of decimalizing that which at least is under our control?

For the large and interesting assortment of the monies of the world, arranged in series, which lies upon the table, I am indebted to Messrs. Samuel and Montagu, the bullion merchants of Cornhill. It embraces not alone the gold and silver coins to which my paper and tables make reference, but almost everything that can assist this investigation, including many monetary curiosities seldom brought together.

The only other suggestion for international coin which occurs to me, is the possibility of a modern coin, like the Spanish dollar of old, taking the rank and acquiring the authority of that piece. Suppose all were agreed as to whether the piece shall be gold or silver, there would still remain the question, what mint shall strike the new piece? Divers mints, diverse coins—is the teaching of all history. The United States mint charges ½ per cent. for expenses; France, fr. 6·70 per kilo. for gold, fr. 1·50 for silver; Great Britain, since Charles II., for gold, absolutely nothing. Assuming that we shall henceforward have credit for the regulation weight and fineness of our gold coin, why shall we, on the scale of the last two or three years, continue to supply other countries with coins made out of their own materials gratis, and at an expense to us which was formerly estimated at 9s. 2d. per cent.? There are gentlemen present who can tell you the enormous scale on which this losing concern has been carried on at our mint. In some other countries the sovereign is a legal tender. Even in the United States' custom-house, the sovereign, which under their old ratio of gold to silver was very equitably received at 4 dols. 44 cts. is now accepted at 4 dols. 84 cts; —a fair approximation to the theoretical equivalent which I estimate at 4 dols. 86 cents. and a fraction; whereas their mint authorities, weighing large quantities, and assaying the melted mass, show that 4 dols. 84 cents. is the average product. Canada, in order to get a decimal coinage, loses more than ½ per cent. when she exchanges the sovereign in the United States for 4 dols. 84 cents. That the sovereign is being so extensively disseminated throughout the world, is only another argument against its extinction, and for its decimalization.

But, suppose this idea of international moneys realised, how would it work?

Let us, for the sake of illustration, assume a pair of transactions between London and Paris. A London merchant ships to order of a Paris correspondent, goods (invoiced, of course in English money), total, say £100. A Paris merchant, at the same time, executes a London order to the extent of 2,500 francs, as per invoice. Now 25 francs per £1 is an arbitrary or fixed rate of exchange, called in the market "par," though not really par in any sense. To such extent as the Paris claim will pay off the London claim, say at 25 francs per £1, there is no occasion for transmission across the Channel either of coin, bullion, or any other like representative of money. Now such is virtually the case with respect to international trade generally, and money, real tangible specie, plays a very inconsiderable part even in adjusting the comparatively small balances which remain between other imports and exports. Suppose, however, that the London merchant is reduced to the clumsy expedient of remitting sovereigns to Paris, sufficient there to sell for 2,500 francs, wherewith to pay his debt; and that the Paris merchant, ignorant alike of the cross transaction, remits to London French money sufficient there to sell for £100, wherewith to pay his debt. The following are the elements which seem to me as necessary to be taken into account:—

1. The cost of packing, freight, insurance, shipping charges.

2. The cost of entry, dues, agency, &c., at place of destination.

3. The deficiency between the value according to the Mint regulations at home and the actual products abroad, *e.g.* remedy or margin for weight; remedy or margin for fineness; loss by dirt; loss by wear of coin; turn of balance.

4. The brassage, mint-charge, or other analogous difference.

5. Loss of interest pending the transaction, and risks not otherwise covered.

Although the details of these several charges, as between several countries, lie before me, I will not occupy time in reading them. In round numbers, the conveyance and attendant charges from London to Paris is ⅛ per cent. But sovereigns, claiming to be 22 carats, or 916⅔ fine, have been treated as 915 fine only; a fact scarcely to be wondered at when we hear that before the administration of the Mint by Sir John Herschel, the requirement was not to make the coin of 11-12ths fine absolutely, but according to a certain trial plate, with a margin of allowance. Our own

Bank of England does not pay more than 77s. 6½d. per oz. for cut sovereigns, although its price for bars (11-12ths) is 77s. 9d., the legal rate.* Then there is the French Mint deduction of 6·70 francs per kilo. augmented to about ⅓ per cent. by the variable delay at the mint. Estimate the total of these and like deductions at 1 per cent, and it results that £101 must be remitted in order to pay £100. On the other hand, if like deductions had to be submitted to on this side here there would be a like loss in order to pay 2,500 francs, showing an aggregate difference of 2 per cent. In practice, these aggregate differences need not be submitted to, because the debtor to Paris in London pays the London claimant upon Paris at some rate agreed upon, as already stated. The rate to be allowed in francs for the £, depends upon the balance of claims upon, or countervailing obligations to, each country severally at the moment and at the place of settlement. Be it observed, that while the par of exchange for gold, bullion against bullion, based upon the Mint regulations of France and England severally, is fr. 25·22155 per £ here, and fr. 25·2079 per £ in Paris, the oscillations of the rate of exchange have been occasionally much greater than 2 per cent. The ability to procure silver in France for a small premium, silver saleable here for still more than the same nominal amount in gold, is another and important element of calculation. Suffice it to shew that the balance of trade between two countries, which can be adjusted in so many other ways, say by national funds, shares, credits, &c., &c., is rarely adjusted by remittance of coin, even the coin of a third country treated as mere merchandise, so that the part played by the precious metals in the interchange is principally in the shape of bullion, generally cast into ingots.† It has been already attempted to spare the expense of coinage and the deteriorations of its wear and tear, by casting ingots of attested weight and fineness; and even by striking disks of gold and silver of size and weight adapted to convenient circulation. At the instance of Mr. D. Ricardo, the Mint once made golden ingots of 60 ounces; but I hear that the Bank got rid of 13 only out of 2,028, and melted down the rest.‡ Nay, at this present moment, as I am enabled to ascertain by the courtesy of the Consulate here, the United States' Mint charge for coining, or brassage, having been raised to ½ per cent. for gold, and the coinage of the new silver tokens for private depositors having been discontinued altogether, the Mints of the United States are authorised to cast bars or ingots from 10 oz. upwards, and to make and stamp disks of 1, 2, 3, 4, and 5 oz. of standard gold or silver, designating or attesting the weight and fineness in either case, and not charging the depositor more than the actual cost of operations. What has been the success of this experiment, made obviously for the purposes of international commerce? The bars or ingots reach this country in abundance, but the Bank and the Mint do not recognise the official stamps—probably because the ingots pass through private hands; so that all the expense incurred before importation is thrown away. As to the disks, although the law which gives the privilege is nearly two years old, I cannot find any one here who has seen a single specimen. A shoe, or Chinese ingot of gold, stamped all over, was submitted to me the other day, and by me exhibited at the Bank, and to the Master of the Mint. The mistrust of its stamps and attestations was justified by the result—the assay was inferior, and the touch would have been no sufficient test, for John Chinaman had probably pickled it, that is, bitten out the alloy externally by means of nitric acid.

Clearly, therefore, the work before us is to decimalize our own coins. We have nothing to gain by complicating the process from any fancied regard to foreign moneys. In short, we have no practical mode of proceeding but to take the pound as it stands.

An intelligent French *banquier* of large experience, and conscious of all the merits of the sytème métrique, tells me that all he can expect is, that we will decimalise our ancient standards, praying us not to delay what is really practicable and desirable by grasping at improbabilites.

Here is a table showing the history of French money, extending over 1000 years:—

*Table showing the Progressive Alterations of the French Standards of Value.*

| Years. | Value of Livre in the Current Money of 1789. | | |
|---|---|---|---|
| | Liv. | Sols. | Den. |
| 800 to 1103 | 78 | 17 | 0 |
| 1103 ,, 1180 | 18 | 13 | 8 |
| 1180 ,, 1226 | 19 | 18 | 4⅘ |
| 1226 ,, 1314 | 18 | 3 | 5 |
| 1314 ,, 1322 | 17 | 3 | 5 |
| 1322 ,, 1350 | 14 | 11 | 10 |
| 1350 ,, 1364 | 9 | 19 | 2⅗ |
| 1364 ,, 1380 | 9 | 9 | 8 |
| 1380 ,, 1422 | 7 | 2 | 3 |
| 1422 ,, 1461 | 5 | 13 | 9 |
| 1461 ,, 1483 | 4 | 19 | 7 |
| 1483 ,, 1498 | 4 | 10 | 7 |
| 1498 ,, 1515 | 3 | 19 | 8 |
| 1515 ,, 1547 | 3 | 11 | 2 |
| 1547 ,, 1560 | 3 | 6 | 4⅘ |
| 1560 ,, 1574 | 2 | 18 | 7 |
| 1574 ,, 1589 | 2 | 12 | 1 |
| 1589 ,, 1610 | 2 | 8 | 0 |
| 1610 ,, 1643 | 1 | 15 | 3 |
| 1643 ,, 1715 | 1 | 4 | 11 |
| 1715 ,, 1720 | 0 | 8 | 0 |
| 1720 ,, 1789 | 1 | 0 | 0 |

Système métrique, $\frac{80}{81}$ franc.

*Retained at the Mint for Coining.*

| | Gold per 31,000 francs. | Silver per 200 francs. |
|---|---|---|
| 1803 | 9 fr. | 3 fr. |
| 1835 | 6 ,, | 2 ,, |
| 1849 | 6 ,, | 1½ ,, |
| 1854 | 6$\frac{7}{10}$ ,, | 1½ ,, |

If the change in France to the *systeme metrique* has been a success, how little difficulty need we anticipate. They had also their £ s. d.—livres, sols, and deniers; the livre, their unit, subdivided also into 20ths and 240ths. But while they increased the value of the franc of circulation over the old livre of account in the ratio of 81 to 80, at the period of its decimalisation, we should scrupulously preserve the identity of our unit of circulation and account.

One of the most inflexible sticklers for the penny—because it is a penny, confesses that the poor man, the stalking horse whom he bestrides in the melée, has no concern with accounts, so that we only leave him the penny-piece to pay the huckster. The essayists who favour as a unit any decimal aliquot of the £, may well be content with the five-mil piece as a needful token in every possible case. Those whose aspirations are for a more catholic system, may wisely join the ranks of those who alone can promote it.

* Let us record, to the credit of the Mint under the present administration, that at the recent trial of the pyx, the coinage in the aggregate was proved even superior to 11-12ths fine. I have been favoured with particulars, which, however, others may more fitly communicate.

† Recent advices from Sydney quote the exchange at 5 per cent. premium, although the currency is the same in all respects. I doubt whether dissimilar moneys are often exchanged at a loss of 5 per cent., plus three months' interest between one payment and the other.

‡ By the kindness of Mr. Haggard, of the Bullion-office in the Bank, I have here a specimen of one of those gold-bar legal tenders, and a detailed history of the whole lot.

I am here omitting a suggestion of various modes by which the penny, if insisted upon, might remain intact as a current token, an alternative sort of change for a shilling; just as in several countries possessing decimal currency and accounts there still exists a non-decimal aliquot coin, without any confusion or practical difficulty.

As to the fancied incapacity of *our* market people to get over the transition stage, people who habitually deal at 7 for 6*d.*, 13 for a shilling, 4 for 3*d.*, 2 for three-halfpence, &c., it scarcely claims a serious thought. In the glass case on the table, among the coins of nations which have changed their system to the decimal one, will be found the new tenths side by side with old eighths, twelfths, sixteenths, &c.—alternative modes of breaking or giving change for the same unit.

The pound once decimalised, I propose to decimalise the assay of our gold coinage, just as the new qualities of gold wares sanctioned by a recent Act, has, at our instance, been decimalised by the Board of Trade and Goldsmiths' Hall.

In order not to restrict the opportunities of those who are to follow me, I will now, at the request of the chairman, omit to read an explanation of my proposals, by means of a decimalised assay of our coinage, to dispense with troy weight, and then to establish between both English and American moneys and weights simple relations with the weights and moneys of the several nations which have the *kilogramme* or the marc of the *Zollverein.*

Permit me, however, to say, that it is of the greatest moment that fixed simple accepted relations between the standards of commercial countries should be concerted. Here is a table shewing some disparities in respect of particular exemplars of the kilogramme, the marc, and the lb. avoir.

*The Three Principal Standards of Weight.*

| | English Grains. | Authority. |
|---|---|---|
| Lb. Avoirdupois | 7000 | Treasury Commission |
| Kilogramme | 15432· 5* | French Mint |
| | 15432· 348 | Treasury Commission |
| Cologne Marc | 3607· $64\frac{37}{400}$ | French Mint |
| | 3608· | |
| Zollverein Marc | 3608· $9672\frac{7}{8}$ | French Mint |
| | 3609· 5 | Bullion-office, Bank |

The Zollverein has cut the knot, and made a *Zollcentner*, or cwt., out of 100 half-kilogrammes. France aids, by declaring the marc of the Zollverein equal to 233·855 grammes, notwithstanding that those figures appreciably exceed the weight of the German monetary standard, the Cologne marc. I may mention incidentally that the Chinese tael is assumed to be precisely 1-twelfth of the lb. avoir.; and that Russia has a lineal measure based on the English foot.

56 sovereigns, weighing one pound avoirdupois, at the fixed rate of 25 fr. per £, would precisely purchase 1,400 silver francs, weighing seven kilogrammes. And 25 fr. per £, the conventional par of the market, the fixed rate at which English subscriptions for French loans, shares, &c., are generally computed, would make a silver franc equivalent to a 40-mil piece precisely. Ten copper pennies, if depreciated 4 per cent., would be equivalent, at such fixed rate, to a silver franc exactly. Here then is a relation established between the moneys and weights of the two countries, such as is little likely to be effected otherwise. To make French silver money, as tokens, within suitable limits, legal tender in this country, is to do what has heretofore been done by Royal proclamation, when the five-franc piece was declared a tender for four shillings. Let us see how it would operate upon the interests of both countries. France now parts with her silver money at the legal rate of 15½ kilos. of silver for one kilo. of gold. Giving one kilo. of silver coin for £8, she would part with only 15·364 kilos. of silver per kilo. of gold. As for ourselves, we should to such extent as French silver may suffice for change, lose any profit derived from issuing coin at 5s. 6d. per ounce, the metal of which costs less. But that gain, in respect of a considerable share of our silver tokens, is more than sacrificed by the wear and tear of the coin, replaced with new coin at the public expense. I have been favoured with statistics in proof of this, and, from another quarter, with evidence that the purchase of French tokens, instead of making our own, has already, in certain circumstances, been found economical and advantageous.

I may not pursue this subject further. I touch upon it merely to satisfy those who yearn for international standards, that their proper place is in the ranks of those who seek immediately to decimalize the £ sterling and the pound avoirdupois.

* The kilogramme, equal to 15,434 grains (U. S. Mint).

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The second paper read was

## ON THE BASIS OF A DECIMAL SYSTEM OF MONEY FOR THE UNITED KINGDOM.

By Frederic J. Minasi.

I have been invited to prepare a short paper which shall represent the leading views of one section of those who are desirous to see a decimal system of money, weights, and measures, established in this country. For the sake of the cause I advocate, I could have wished that a less brief exposition had been asked for; I must presume, however, that the majority of those present on this interesting occasion, have already made themselves masters of the main points and difficulties of this vexed question, so as to render it less a duty to afford instruction, than to form a comparison of the two plans which at the present time seem to occupy the chief attention of those who take an interest in this subject.

One of these assumes the pound sterling as the highest unit of account, as at present, and descends in a decimal progression by means of three new coins, termed *florins*, *cents*, and *mils*, of the respective values of 2s., 2⅖ d., and $\frac{24}{25}$ of a farthing. The other plan takes a penny as the lowest coin of importance in present use, and proposes to ascend upwards to the chief unit, by means of a new silver coin of the value of *tenpence.*

The former plan absolutely requires the creation of coins which are incommensurable with the copper currency at present in use:—the latter, by the simple expedient of the *tenpenny*, produces a system which does not interfere with a single coin of any kind. In fixing upon the *penny* as the basis of a decimal coinage for this country, its advocates are ruled by two important considerations; first, that it presents at once a simple and popular way of solving the difficulties of the question; and second, that it preserves intact a coin not only venerable from its antiquity and historical associations, dating back its existence, as it does, to a period many centuries antecedent to the sovereign and shilling, but of the highest importance to the majority of the people of this country; to the labouring classes in particular, who, in whatever form they may receive their wages, do most certainly expend a large portion of them in pence; and who, it is easy to see, would be injuriously affected by any measure that altered the value, as well as the form of the copper coinage—essentially the money of the poor man—especially if that change should involve the introduction of new coins that could not be represented by any possible combination of the old, or of the old and new together, both of which, be it observed, would have to continue side by side for many years. The principal exponents of the *tenpenny* scheme are Mr. Theodore Rathbone, of Liverpool, Dr. J. E. Gray, of the British Museum, and the late Mr. James Laurie, who in his last work devoted to this subject, seems to have clearly established the pre-eminent consideration due to the wants of the poor; and he proved incontestibly that the commodities in common demand, involving all articles of subsistence, are of a value so infinitesimally small, that the decimal fractions of £1 could scarcely lay hold of

them, particularly if such articles were to become, as they must, matters of account. When it is considered that the article of tea alone, at 3s. per pound, is sold in ounces, often in quarters of an ounce, and other articles, such as salt, &c., are sold at a certain number of pounds for a single penny, it is no easy matter to reconcile the distribution of such commodities at prices which would not be attended with even a greater loss to the poor than they at present sustain under our existing coins. In any attempt, therefore, to harmonise our coinage with our weights under a decimal system, we must first look at the equivalents of *coinage* compared with *weights*, as they at present exist with reference to these separate integers, viz.—

| Weights. | Moneys. | Decimals. |
|---|---|---|
| 1 lb. | £1 0 0 or 10d. | 1·000 |
| 8 oz. | 10 0 ,, 5 | ·500 |
| 4 ,, | 5 0 ,, 2½ | ·250 |
| 2 ,, | 2 6 ,, 1¼ | ·125 |
| 1 ,, | 1 3 ,, ⅝ | ·0625 |

It is here evident that in any assimilation between weights and moneys, upon a principle which should present an *approximation* to the existing values of commodities, if the £1 were adopted as the integer, corresponding to the pound avoirdupois, the ounce descends no lower than 15d.; while in the case of 10d. as the integer, the ounce could be obtained for 5-8ths of a penny of our existing coinage. Now, taking salt, which is sold at 1d. for 3lbs., potatoes at ½d. per pound, soda at 1d., rice at 1½d., besides a hundred other articles of first necessity for subsistence, it may be fairly asked, how are they to be measured by decimals of one pound, whether that pound refers to the coinage or the weights with which the coinage is supposed to harmonise, when the ounce alone is equivalent to 15d., or 1-16th of the pound sterling—an amount far larger than 1lb. avoirdupois of any of the great body of articles consumed by the poor can at present be obtained for?

The leading journal of the day, in a review of the pamphlet and tables of Mr. Laurie, to which reference has already been made, speaks thus:—

"The question seems only whether, by the simple introduction of a tenpenny piece, the people shall be instantly furnished with the means of adopting a decimal currency at their pleasure, which shall, at the same time, give them clear perceptions of the currencies of the principal countries of the world, or whether, by long philosophical efforts, the attempt shall still be made—although year after year passes without any apparent advance—to bring them at some distant but undefined day, to banish the penny in favour of the mil, and while thus gaining some of the advantages of the decimal system, to separate themselves hopelessly from any general affinity with the currencies of the nations with whom their chief intercourse is carried on." *

The abolition of the penny, not only as a coin of account, but, what is of more importance, as a current coin, as proposed by the late Committee on Decimal Coinage, is attended with so many important considerations that it cannot be a matter of surprise that the government of the country should decline to carry out the wishes of the partisans of the *mil* system without due consideration. Not only, as just referred to, are a vast quantity of articles retailed at this price, but it requires additional importance as being the basis upon which rates and taxes are calculated, as well as from its connection with postage, stamps, tolls, and railway fares, all of which would be disturbed by the substitution of the 4 or 5 *mil* piece for the penny—the former being 4 per cent. in defect, and the latter 20 per cent. in excess of that coin. Of the proposals made to meet these great difficulties there does not seem to be one that a House of Commons would be likely to sanction.

Further, there are difficulties connected with the practical arithmetic of the pound-and-mil scheme for a decimal coinage that do not appear to have received the attention which their importance merits—difficulties that must produce an amount of uncertainty in computations involving the lower denominations of the new money little calculated to produce confidence among a trading community. It is worthy of notice, for instance, that out of 960 amounts commencing at ¼d., and increasing by the same sum up to £1, only 40 are capable of accurate representation in *mils*, the remaining 920 being only *approximations*; hence, if a mode of reckoning on the plan of this decimal system be used, it is easy to see that serious errors and great confusion would result from its adoption, especially to the great mass of the people, who, it is unnecessary to say, are not skilled in decimal arithmetic. As an example of the difficulties referred to, let it be required to calculate, on the proposed plan of 1,000 *mils* to the pound sterling, the value of, say 9,000 articles at the present price of 10s. 2¼d., the correct answer to which is, £4,593 15s., or £4,593 7fl. 5c. According to Professor De Morgan, the representative of 10s. 2¼d. on the new scale is 511 *mils*, whence—

9,000
·511

£4,599·000
Real value... £4,593 15s.

Or, £5 5s. in *excess* on this supposition.

Nor is this all, for, according to the table of Sir John Bowring, in Appendix III. to his work on the Decimal System, 510 is the equivalent of 10s. 2¼d.; from which we obtain—

9,000
·510

£4,590·000 or a sum in *defect* to the amount of £3 15s.

The opponents of this scheme, therefore, are justified in their views on this point; indeed, there seems no escape from the conclusion, always bearing in mind that decimal *fractions*, and a decimal *coinage*, with a method of calculation *agreeing therewith*, are different things. The *exact* value of 10s. 2¼d. may be represented by ·510416̇, by the employment of which, of course, a correct result may be obtained by travelling into the regions of interminable decimals, but at such an additional cost of figures in ordinary cases, that the advocates of the pound-and-mil system have not cared to exhibit to the public so awkward a sample of their labour-*saving* plan.

Mr. Robert Mears, the author of "Decimal Coinage Tables," has endeavoured to overcome the difficulty here alluded to by the addition of vulgar fractions of a *mil*; by means of which he is able to give the exact values of present money, and consequently avoids the large errors just pointed to; unfortunately, however, for Mr. Mears, whilst saving his ship from *Scylla* he is dashed against *Charybdis*, for the addition of a long column of his decimal figures with vulgar fractions having denominators composed of every submultiple of 24, presents a task that will hardly be considered a recommendation in a *decimal* computation. Mr. Franklin is more politic in this matter, exhibiting in his tables the numerators only of these fractions, to be employed "in case of need." Sir John Bowring has not attempted to exhibit such unfortunate exactness.

As another example, may be taken a question proposed by Professor Moseley to the pupils of the Normal Schools, in the last examination for certificates of merit:—"If a spoon cost 7s. 9d., how many dozen can be bought for £44 8s. 3d.?" The question, we are told, is to be worked out on this decimal division of a pound. Now 7s. 9d. is a sum between 387 and 388 *mils*, and £44 8s. 3d. lies between £44 412 *mils* and £44 413 *mils*. Let the question be worked out with these values, and it will be seen that of four solutions there will be four *different* results, and *every one of them incorrect*. Can we wonder at the

* *Times*, Sept. 20, 1854—City Article.

remark made by an organ of the normal schools that "multitudes of very laborious and deserving candidates, who had been fagging at the expense of health and family comforts, were fairly (?) beaten" on this occasion. This which may be regarded as the first practical working of the *mil* scheme, seems to have turned out a failure, as must every system founded on approximations. I am not willing to leave this part of the subject without noticing the attempts of certain exponents of the millesimal division of the sovereign to exhibit unfair contrasts between that system and the one in present use; for example, in a treatise on this subject by Mr. Henry Taylor, are to be found a great many of these comparisons, hardly one of the decimal solutions of which is free from error. I select the following:—

"Multiply £58 17s. 1½d. by 35.

| (PRESENT METHOD.) | | | | (BY THE MIL SYSTEM.) |
|---|---|---|---|---|
| £ | s. | d. | | £ |
| 5 | 17 | 1½ | × 35. | 58·856 |
| | | 11 | | 35 |
| 647 | 8 | 4½ | | 294·280 |
| | | 3 | | 1765·68 |
| 1942 | 5 | 1½ | | £2059·960 |
| 117 | 14 | 3 | | |
| | | | | Or, £2,059 19s. 2½d. |
| £2059 | 19 | 4½ | | 26 figures." |
| 38 figures. | | | | |

I need scarcely say that a sharp little fellow to whom I gave this question, worked it as follows:—

| £ | s. | d. |
|---|---|---|
| 58 | 17 | 1½ |
| | | 5 |
| 294 | 5 | 7½ |
| | | 7 |
| £2059 | 19 | 4½ |

22 figures.

Another example is thus exhibited:—

"Multiply £562 10s. 4d. by 125

| | | | |
|---|---|---|---|
| | | 10 | £562·516 |
| | | | 125 |
| 5625 | 3 | 4 | |
| | | 10 | 2812·580 |
| | | | 11250·32 |
| 56251 | 13 | 4—100 times | 56251·6 |
| 2812 | 11 | 8—5 times | |
| 11250 | 6 | 8—20 times | £70314·500 |
| | | | Or, £70, 314 10s. |
| £70314 | 11 | 8 | 37 figures." |
| 49 figures. | | | |

It is easy to see that this illustration may be worked out in 32 figures. So much for prepared examples; than which there can hardly be anything more specious, for people look upon a subject as conclusively settled when figures are paraded before them, and without the disposition to examine them, naturally come to regard the subject as incapable of contradiction. There are other overstated advantages before the public, as, for instance, the amount of labour that could be saved in the counting-house, and in the education of youth, which deserves further examination at the hands of practical men. That a decimal system of money, weights, and measures, would really be a labour-saving machine, especially in some kinds of computation, cannot, I think, admit of a doubt, but it would hardly be to the extent that has been stated by the partisans of the pound and mil system, apparently for the purpose of inducing the public to worship the golden image they have set up. A late writer in the "Eclectic Review,"* assures his readers that not only will the compound rules of addition, subtraction, multiplication, division, and reduction disappear from our school-books, but that practice, rule-of-three, and even vulgar fractions, will follow them.

* November, 1854.

Against such assertion it should be protested that so long as our other measures of weight, capacity, length, &c., continue—so long as other countries shall continue to use compound scales, or the student would ascertain the relations of the money or weights of former times—so long as a week contains 7 days, and a year 365 days;—so long will it be necessary for the arithmetician to be acquainted with the modes of calculation on the compound scales; and, as to practice, proportion, and vulgar fractions, why should they be banished when they afford methods by which, even should a decimal coinage be established, results can be more quickly arrived at than by decimals.* An examination of "Guilmin's Arithmetique," one of the authorised works for public instruction in France, will prove the incorrectness of these assertions. There, with a complete system of decimal money, weights, and measures, the pupil is nevertheless introduced into the mysteries of rule-of-three, of vulgar fractions, and of rules of exchange, and reduction of the old moneys and measures of France to the new; processes all requiring, more or less, compound arithmetic.

A natural and not unreasonable hypothesis of those who advocate the adoption of £1 as the unit of a decimal system of coinage for this country is, that the present system should be wholly discarded, that it should all at once be abandoned and forgotten, just as if it had never existed, and that the decimal parts of that unit should be adopted, without any reference or consideration to the present and long-established arrangements, either with respect to coins or weights; the whole must be altered, the only difficulty being the *transition* between the old and new order of things. In such a case, we may imagine that we should have to revert to the principle adopted by our forefathers, namely, that our coins, weights, and measures, should be based upon some system of equal sub-division, and that, as an improvement, we should have to substitute the decimal for the duodecimal system, the question only being, what is the best unit to be adopted for such an object? Whether such unit be 1*l.*, or 1*l.* 0*s.* 10*d.*, or 2*s.*, or 2*s.* 1*d.*, or 100*d.*, or 10*d.*? There can scarcely be a doubt that this *questio vexata* must be decided, either by the respect due to the wants of the humbler classes, with reference to the commodities in general demand, and the means of obtaining and measuring these wants, by some system of coinage to be founded upon them,—or by the consideration due to monies of account alone, irrespective of such wants.

Were society to begin again, which would almost be imagined necessary so as to give a fair chance to the theory of the £1 sterling as the unit of our coinage, with a corresponding unit of 1lb. avoirdupois, or, rather, some greater weight, harmonising better with a large money unit, it would seem that we should only improve on the sagacity of our ancestors—if, indeed, it could be called an improvement—by adopting a decimal instead of the duodecimal system. It ought, however, never to be forgotten, that the *pound of silver* itself, like any other commodity, was governed by weight, as its name implies; that in the earliest periods of our history, long before gold had been introduced as an element in our coinage, the *troy pound* of silver was the foundation of our pound sterling, and that coinage itself was an expedient introduced as an evidence of the purity and weight of the metal.

* As an example, take the following:—Calculate the value of 496 articles at 2 *florins*, 7 *cents*, 5 *mils*.

BY DECIMALS.

| |
|---|
| 496 |
| ·275 |
| 2480 |
| 3472 |
| 992 |
| 136·400 |
| £136 4fl. |

BY PRACTICE.

| | | |
|---|---|---|
| 2fl. 5c. | ¼ | 496 |
| 2c. 5m. | $\frac{1}{10}$ | 124 |
| | | 12·4 |
| | | £1364fl. |

Such is the principle of our coinage even at the present day, although the improved intelligence of the people has led to the establishment, first, of silver itself, and subsequently gold in place of silver, owing to its scarcity, as the best and only measure of value; still, however, governed by the troy weight; and we should be careful not to introduce any alteration in the standard quality of that metal which measures the value of all property in the country, without due and anxious consideration.

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The third paper read was

## ON DECIMAL COINAGE.

By Hugo Reid.

The advantages of a decimal system of coinage are generally admitted, but there is much difference of opinion as to what system it would be best to adopt. My object in the present short paper is to bring more prominently into notice one or two important considerations which I think have not been sufficiently insisted on.

I may state at once that the system which I recommend is, to take the florin, or two-shilling piece, for the leading coin or *unit*, and to divide it into 100 parts, to be called *cents; florins* and *cents* being the only denominations to be used as coins of account.

The following four points appear to me to be essential in introducing a decimal system of money and accounts.

1. *That it shall be completely decimal, not composed of a decimal and a non-decimal part.*

2. *That there shall be only two coins of account, one leading coin or unit, the other the hundredth of that coin.*

3. *That the less coin of account shall be of sufficiently low value to meet all ordinary requirements of the poorer classes, and render fractions very seldom necessary.*

4. *That the leading existing coins shall be preserved in, or be easily convertible into, the new coins of account.*

The first requirement is, that the new system shall be thoroughly *decimal*, meaning, by that term, not merely proceeding by *tens*, but by any power of *ten*, as 100, or 1000; in short, a system in which reduction to a different denomination is effected by the simple cutting off or annexing one or two figures—by simple inspection. That is the essence of the decimal system, not that each coin of account shall be 10 or $\frac{1}{10}$ of the next. It is not worth while making a change that is not to be thorough. If, as has been proposed, we adopt the pound, tenpence, and penny as the coins of account, to bring tenpences to pounds we have the troublesome divisor 24, involving very little less work than the old operations of dividing by 4, 12, and 20, and certain to create much more work in the fractions which would be often required when the lowest coin is so high in value as one penny.

The second requirement is, that there shall be only *two* coins of account, one leading coin or *unit*, and the hundredth of that coin. This appears to me a *sine qua non.* It has been generally thought that *decimalising* our coinage is all that is necessary; but advantage should be taken of the change to introduce another very important simplification—to relieve us from the trouble and complexity of *four* coins of account, by at once reducing these to *two.* This would be useful by making the mere *expression* of any sum of money more short and simple, but it would also save much time and trouble by facilitating mental calculation. Most persons are tolerably familiar with the relations of numbers under a hundred, consisting of two figures only. Of the various products in the common multiplication table, only six are above 100, and the highest of these is under 150, so that from this circumstance, as well as from their greater simplicity, mental operations with two figures are, to the great majority, of infinite ease, compared with operations involving three figures. Now, if there be but two coins of account, the less being one hundredth of the greater, there would never be more than two figures of the less; the mind will readily perceive the value of any sum expressed in two figures, and mental operations of addition, subtraction, multiplication, and division, which are often of the greatest convenience, will be possible to thousands, who would be quite incapable of such operations with three figures. It is to be observed, as illustrating practically the importance of this point, that, in the United States of America, in France, and in other countries of the Continent, this arrangement is adopted. In the United States, money is expressed in dollars and cents., the intermediate decimal coin, the *dime*, being always omitted. In France, francs and centimes are the coins of account, the intermediate decimal coin, the *décime* being dropped. Further, the French, in their measures of length, have found it convenient to slip into the same method, and speak always of *metres* and *centimetres*, dropping the *decimetre.* Whatever be the other features of the system to be adopted, this one is certainly of the first importance, and, it appears to me, has not been brought out with sufficient prominence.

The *third* point is, that the lower of the two coins of account shall be sufficiently low to express all ordinary money transactions, so that fractions shall very seldom be required. It seems to be the general opinion that the present farthing descends as low as is necessary, and that the lowest coin of the new money of account should be little, if at all, above the farthing in value. The Parliamentary Committee propose what they call the mil, equal to $\frac{24}{25}$ of our present farthing; the penny seems to be generally thought too large for the lowest coin—the $\frac{1}{10}$ of a penny too small. This is a point to be decided by the experience of practical men; their experience, as far as it can be gathered, our own previous practice, and the practice of other nations, all seem to concur in showing the necessity of the lowest coin in the new system being near the value of the farthing.

The fourth point is, that the leading existing coins shall be preserved in the new coins of account, or be easily convertible into them. As a general proposition this will command ready assent, but there are infinite differences of opinion as to the existing coins to be preferred as the basis of the new system. It unfortunately happens that there is no truly decimal system that will harmonise with all our present leading coins. These leading coins are three—the pound, the shilling, and the penny. The pound and shilling are incompatible, decimally, with the penny; we must, therefore, either retain the penny and sacrifice the pound and the shilling, or retain these, and lose the penny. In the discussions I have heard or read on this subject, the battle has generally been between the pound and the penny, the shilling being overlooked. But this is a very important coin, wages and the prices of vast numbers of articles being commonly expressed in shillings. Considering that the pound is our present standard of account, and that the shilling is so universally in popular use as a measure of value, also that the Parliamentary Committee, after hearing the evidence of a number of the most competent judges to be found in the country, decided in favour of the retention of the pound, it appears highly desirable to adopt some system that will preserve to us the pound and the shilling.

If then, the 2nd and 3rd points be deemed of paramount importance, as I think they are, and if the farthing be about the proper value for the lowest coin of account, it follows that the *unit* or principal coin of account must be somewhere about the value of 100 farthings, or nearly two shillings. The nearest existing coin is the *florin*, which with its 100th part, nearly a farthing, gives the system here proposed, which appears to me to meet the four principal requirements better than any other.

1. It is thoroughly decimal. 2. It has but two coins of account, the florin and its hundredth. 3. That hundredth, nearly the value of our present farthing, is sufficiently low in value to express the great majority of small transactions, and save the use of fractions. 4. It harmonises with two leading coins, the pound and the shilling: florins are brought to pounds by the simplest of all arithmetical operations, dropping the right hand figure,

which will be so many florins, the rest being pounds; and pounds are brought to florins by simply annexing a cypher or other figure at the right. And as the shilling is one-half of the principal coin of account, it will always be retained in the coinage, and shillings will be brought to florins by the easiest divisor after 10, 2; and florins to shillings by multiplying by 2.

Thus, 12,345 cents would be read, 123 florins, 45 cents, and it would be seen at once that there were £12 3fl. They might be read £12 345 cents, but this would be objectionable, as giving *three* figures of the less coin; or, they might be read £12 3fl. 45c., but this would be tedious and intricate, as involving *three* coins of account.

If the copper coinage be adhered to, we should then have for our coins of account the farthing and a coin of the value of 100 farthings (2s. 1d.), but this coin being $\frac{25}{12}$ of a shilling, or $\frac{5}{48}$ of a pound, it would be troublesome to reduce it to shillings or pounds. If the halfpenny were thought sufficiently small, the unit would be 100 halfpence (4s. 2d.), having the relations of $\frac{5}{24}$ and $\frac{25}{6}$ to the pound and shilling.

The system here recommended is practically the same as that brought forward by the Parliamentary Committee, with only a slight modification in form, essential, as it appears to me, to render the decimal system simple and easy in practice. But, whatever system may be fixed on, I contend that it should be thoroughly decimal, of only two coins, the unit and its hundredth, and adapted to express small transactions without fractions; these great principles are equally necessary, and equally applicable whether the pound or the penny be adopted as the basis of the new system.

Further, is not this a subject on which the Society might appoint a Committee. Much new matter has been brought forward since the report of the Parliamentary Committee was published—there has been much public discussion since that time, and a report on the present state of the question emanating from the Society now might greatly promote the establishment of a decimal system.

## DISCUSSION.

Mr. W. Miller said, it seemed to him, that there was very little difference between the plan of Mr. Reid and that recommended by the Committee of the House of Commons. The only difference appeared to him to be as to where the decimal point should be put — which should be considered the fractional, and which the whole numbers. That, however, was a difference which could be easily got over by practice and experience. They could hardly know beforehand, what the public would do in the matter, but no doubt they would put the point where it best suited them. With regard to the paper of Mr. Minasi, he would make one or two observations.—Mr. Minasi seemed to claim for the penny great antiquity, and many of those who argued the subject, talked of standing upon the ancient ways, and spoke of the Poor Man's Penny, as something so connected with the mind and heart of the poor man, that it would be doing a great wrong if any alteration were made. They had only to consider two or three points in the history of the coinage of this country, to know that the penny had experienced great alterations. In the first place, he would remark that the penny by itself had never been a measure of value in England. It always derived its value from the pound. That he was fully prepared to maintain. In the most ancient times, the penny was derived from the pound of silver. Before the invasion of the Danes, the pound of silver, so far as he had ascertained, was 7,200 of our present grains, or 9,600 corns of wheat taken out of the middle of the ear, and the value of the penny was 1-300th of that weight. Its value was always in reference to the pound of silver, but the penny was not intrinsically worth 1-300th of the pound of silver, but only 1-320th part, so that the coin passed for more than the actual value of the proportional part of silver allotted to it by so much as 300 bears to 320. At the time of the Conquest the pound of silver was altered; instead of 7,200 grains, the pound troy was introduced; the pound consisted of 60s., of 5d. to the shilling; it was altered to 60s. of 4d. to the shilling, and thus the pound weight became 5,760 grains. The penny, deriving value from that pound, circulated still for more than its actual value. They came down to a later period—when great quantities of base metal were introduced, and the penny was clipped and mutilated: then they found the law passed, 12th Edward I., that all commodities above the value of 5s. should be paid for in weight, so that the penny was always received at something more than its real value. That brought them down to the year 1816. What was the penny then? Not what it now is—the 240th of 113 grains of fine gold. In 1816, it was only the 240th of 15s. 2d. of our present money; so that the penny had undergone a great many changes, and he repeated that it never had been in itself a measure of value, but always had reference to the pound as the great measure of value, for a penny meant a coin which would weigh so much to the pound. He then referred to the example brought forward by Mr. Minasi as illustrative of his system, and remarked that he considered comparative statements, such as those were unsatisfactory, because, where they had unequal gradations, there was so much of the operation to be done which could not be recorded. In the last diagram, of 32 figures only, the most difficult part of the operation was not set down at all. The other plan, although it showed 37 figures, was straightforward work. Still the multiplication by 125 was a clumsy mode of operation, when a division by 8 would do as well, which would have taken only fifteen figures. With regard to the penny, he had only to say, in addition, let them imagine the paying and receiving of the thousands upon thousands of pounds which exchanged hands in this large city in the course of a day, and for every sum they had to receive they had to divide by 240, or multiply by 240, before they could tell what they had to pay or receive; before they could pay in pounds they must divide by 240, and if they had to receive they must multiply by 240 to make the record. As to the alteration of 4 per cent. in commodities purchased by the poor man, it was not of the smallest consequence. The poor man waited till he could afford to buy his herring;—one man might buy it at a halfpenny, another at a penny, and a third at 2d., but 4 per cent. in the price of the herring would bring it within the poor man's means a little earlier. He mentioned this to show what a great difference there was in the price of the commodities upon which so much stress had been laid. The terms "scheme," "plan," "system," had been applied where there was nothing but proposition. The proposition in itself was a simple one, which would occur to every school boy who was plagued with a reduction sum. Why could not they keep their accounts in pence? That was the whole system. If they kept their accounts in pence, they had the sixpence and the fourpenny piece, and that was their tenpence. There was nothing to hinder a merchant from keeping his accounts in pence to-morrow, although, probably, he would not think of doing such a thing.

Mr. Ryley said that he would endeavour to observe the Chairman's injunctions of brevity, in the observations he had to submit to the Meeting. It might, perhaps, be useful to remind them that the only advantage sought to be gained by any change, was an arithmetical one. It so happened that we had an excellent notation for numbers abstractedly considered; but that when we came to apply those numbers to such objects as coins, and so to express these in account, we left the simplicity of arithmetical notation, and passed to a different and complicated system of notation. In fact, a considerable part of the difficulty lay in the mere different bases of notation. We had fortunately a good system of arithmetical notation; but, even

if it had been a bad one, it would have been desirable that the notation of abstract numbers, and applied numbers, should be the same. He could not but think, that the difficulties of making this desirable change, had been greatly overrated. It had been confounded with questions with which it had, in fact, no connection. It had been actually supposed that the question of prices had something to do with this question of the notation of accounts, and the issue of corresponding coins: and he had heard a good deal of the poor man's penny. Now he begged emphatically to remind the Meeting that this question had nothing whatever to do with prices, which would immediately adjust themselves to any system of notation of account, or of coinage, provided there was in these a sufficient subdivision of value, to enable the poor man to pay for small quantities of articles at a low price or value. As no one had proposed that the lowest denomination of coin should be of larger value than the present farthing, the poor man's only question was as sufficiently attended to in any of the proposed systems, as in the existing one. But he (Mr. Ryley) thought that system would be found the best which gave the greatest subdivision of value. It might not, perhaps, be generally known that it was common in the manufacturing districts, and even, to his knowledge, in the neighbourhood of London, for small quantities of pins to be given as change; not only when the change required was less than a farthing, as in the purchase of a quarter of a yard of calico, at 5½d. the yard, but even when the change required might be a farthing itself. This arose from the exceedingly insufficient supply of our existing farthing; and this insufficient supply arose from the circumstance that the bankers, who were the great medium of supply between the Mint and the great mass of the community, were accustomed to ignore the farthing, and pay sums of money, only in pounds, shillings, and pence. The question of the unit of account had again been treated with an utter misconception of the meaning of a sovereign or pound, as applied to foreign mercantile transactions; and it had been alleged that evening, as a great inducement to the retention of a pound as the unit of account, that it was the coin which had a larger circulation as a standard of value, than any other known coin. Now, in point of fact, he believed it would be found,—he had inquired amongst his mercantile friends, and been told that it was so,—that the Spanish dollar was, more than any other coin, the medium of exchange and the coin of commerce; but, quite independently of this, the sovereign, as used in foreign mercantile transactions, was only taken as a piece of gold, of a certain weight and fineness; and, in such dealings, to call the piece of gold a pound or a sovereign, was only to give it an inappropriate name, and an individuality which had, in fact, no real existence, for it was as gold, not as coin, that it changed hands in foreign commerce. Having premised thus much about the supposed, but, as he thought, the unreal difficulties, which had been suggested, he would observe that, with respect to any chosen unit of account, the matter really to be attended to, so that the change might come about in the easiest and most natural way, and be of the greatest advantage, was that the unit should be so chosen as that it would be easy to obtain an exact coincidence between the language of the people, the money of account, and the coin of payment. These advantages existed in the present system: we talked about pounds, shillings, and pence; we carried our transactions to account in our books, as pounds, shillings, and pence; and, when it came to payment, we paid our debts in coins called pounds, shillings, and pence. The single exception was the guinea, which had remained in our language after the coin had become obsolete; and the payment of the same had to be made, necessarily, in coin of other denominations. Now, if it were agreed that this coincidence of language, accounts, and coin of payment, were desirable, he considered that the conclusion was irresistible in favour of decimalising upon the shilling—that was—making the shilling either the unit or the tenth of the unit. This would preserve to us the greater part of our coin and language in talking about prices. Sugar was thirty-seven shillings, not one pound seventeen shillings, the cwt. Corn was seventy-four shillings the quarter, not three pounds fourteen shillings; and if any one would go into Lloyd's Room, he would find that the underwriters would quote any premium whatever in shillings rather than in pounds; thus, one risk was eighty, and another even one hundred shillings *per cent*, when four or five pounds would appear to be the more natural expression. The retention of the shilling as the unit, or the tenth of a new and higher unit, would secure the conformity between coin, language, and account, in ninety-nine out of a hundred of our daily transactions, and its hundredth part, which would be less than half a farthing, would be found to be a great practical convenience in very small retail dealings. This would certainly entail the loss of the pound in questions of account, but he could not consider that any very great loss; on the contrary, it was rather an objectional denomination, as there was a confusion between the pound of money or value, and the pound of weight. Prices, he would again observe, were questions of comparative exchangeable value, and would adjust themselves naturally to any system, and he thought that the only thing to be sought of coin and notation with respect to prices, was that the money of account and the coin of payment should have a subdivision sufficiently low to meet the wants of the people in their daily transactions.

Mr. Shields remarked that amidst the conflicting opinions which had been expressed in the papers which had been read that evening, he could not help thinking that the real guide to the difficulties of the subject had been overlooked in going back to prove the antiquity of the penny, and in a morbid consideration for what was called the poor man's penny, or shilling. It struck him that the scheme brought forward by the Decimal Association was one which, if fairly tried by the facts of the case, without these diversions, could not fail to be the one which must hold. It began with this fact—an indisputable fact—we *have* a unit standard common measure of value—the pound sterling. He felt sorry for those who were confused by the meaning of the word *pound*, especially as we have the pound troy and the pound avoirdupois, and used with other meanings of the word, but any one who chose to inquire what was meant by the pound sterling, would find it to be a given weight of gold, of a given standard of fineness, impressed with the mark of the Mint. The next step in the case was this, the sovereign altered in value, that was, at times a sovereign would buy 20 loaves of bread, and at other times 40 loaves, and so with regard to all other commodities. That was what he meant by the value of the pound sterling; but as to the price of it, it struck him there was some little misunderstanding. The truth was, as the Mint coined for nothing, uncoined gold of the Mint standard, and coined gold, fluctuated in value together; for any one having uncoined gold could receive weight for weight for his uncoined gold in sovereigns with the small deduction of three halfpence per ounce. Whatever alteration took place in the value of the sovereign, was a thing they could not rule, but they must remember that having made an arrangement with society upon this unit standard of common measure of value, they ought to pause before they tampered with it. Here was a sum representing a given weight of gold. What that would purchase they had nothing to do with, but whenever the government adopted the silver standard advocated by Mr. Reid, he (Mr. Shields) contended that the bargain made with the people would be violated.

The Chairman—Does Mr. Reid employ a silver standard?

Mr. Shields—He begins with the florin.

The Chairman did not understand him to employ that as a silver standard.

Mr. Shields—Assuming, then, that they were agreed that no honest set of men would tamper with the unit standard measure of value, the question was—how were they to divide it decimally? He was greatly astonished to hear so much about this tenpenny piece—the twenty-fourth of a pound. In the name of Cocker what decimal was that? If a man were occupied in teaching the nature of the decimal system, he would be astonished to find any one proposing such a solution of the decimal system of money as that which was proposed by the gentlemen (Mr. Minasi) who read the second paper. To go one step further with reference to the position taken by Mr. Reid, let them take a case. Supposing he had to represent on paper 5 sovereigns, 5 florins, and 55 cents. According to the system propounded by the Committee of the House of Commons, and advocated by the Decimal Association, he would have to put it down 5·555, but, according to Mr. Reid, the point was pushed one place further to the right, and the sum written 55·55. In a sum of a given number of figures, any arithmetical operation to be performed would be equally easy wherever the decimal point might be placed; therefore he could not see what was hoped to be gained by that. He could not help thinking that the Society of Arts might do much towards effecting the change in the system of coinage in this way—no doubt a committee would be useful; but if that little chapter upon decimal money, published by Mr. de Morgan, in an Appendix to his Arithmetic, were introduced into the Government Schools, they would have amongst the poorer classes a race of people prepared for the change which the decimal system of coinage they were desirous to make would effect, and who, because they would understand, would also appreciate the benefit of the change which was proposed.

Mr. Jellicoe said, when this subject was recently revived by, he believed, Mr. William Brown, the hon. member for South Lancashire, and his attention, amongst others, was first drawn to it, the arguments brought forward in support of the penny unit somewhat influenced his mind in its favour. On future consideration, however, and perusal of all that had been written on the subject, he had not hesitated to come to the conclusion that there could be no other unit of account advantageously introduced in this country than the pound sterling; and that it was very desirable that a decimal system, both of coinage and of money of account should be established on that basis, with as little delay as possible, if it were to be established at all. It appeared to him that the inconveniences anticipated by a change in our present system, had been and still were greatly exaggerated—many very important alterations in the coinage had been made from time to time, and no one that he was aware of had experienced inconvenience in consequence. Thus the guinea had been suppressed, and after many years had almost entirely disappeared; whilst, on the the other hand, they had recently witnessed the introducton of the florin, and the three-penny and four-penny pieces—and he thought most people would agree that these changes, which afforded greater facilities of *change*, had been rather a convenience to the public than otherwise. It was true that the two new coins required under the proposed system, would not be aliquot parts of some existing ones. But no great difficulty need be apprehended, he conceived, on that score. On their introduction they would immediately find that the smaller class of shopkeepers and salesmen generally, would be selling, as now, a given quantity for a three-penny piece and a penny, and proportionably less quantities for a cent and a mil; and as the two former coins became rare, the quantities allotted for them would cease to be in use. In many respects, these coins of smaller value would be a boon to the poorer classes; and it was only that class of persons that they need have any apprehension about, since there was abundance of intelligence amongst toll-owners and railway Directors, to see themselves righted, let the changes be what they might. Let them, then, suppose a decimal system established as regarded our coinage, and that it remained to adopt it in accounts. They could hardly doubt that bankers would be amongst the first to keep their accouuts on the new system, because their customers, for their own convenience, would commence drawing checks for pounds, florins, and cents, instead of for pounds, shillings, and pence, as at present. Some little embarrassment would perhaps arise while both systems were retained, and it might be found desirable at first to make no other change than the addition in account books of two columns to the present ones, for florins and cents, so that checks in either currency might be readily entered. The shillings cast up would then represent half the number of florins, and every twelve pence could be added as five cents. This period of transaction, however, would no doubt be shortened by notices in all public offices requesting observance of the new system, and if even it were found necessary, in some instances, to retain the old one for a time, the progress of the new need not on that account be staid. In this way, any difficulties in the more important and rapid transactions of daily business would be obviated, and as compared with them, the ordinary buying, selling, and bill paying, would, as it appeared to him offer none of importance. He was trying to look closely at the operation of this change, because a good deal of needless apprehension, as he thought, existed in some persons' minds with regard to it, which it was desirable if possible to remove; and also he wished to show that the same sort of embarrassment must evidently arise if the farthing or penny be adopted as the unit of account, and that no advantage, so far, would accrue from the adoption of a change so radical in its character as to be regarded very generally with repugnance. In a country like Turkey, they could understand a currency consisting of piastres, and accounts kept in them. But with a range of prices such as they had in England, the accounting in farthings or pence would be scarcely tolerated. The arguments put forward in favour of each particular system were numberless; but after the opinion expressed in the reports of the two Royal Commissions by the Committee of the House of Commons, and supported by the evidence of such men, amongst others, as Sir John Herschel, Sir John Lubbock, Mr. De Morgan, and their present chairman, it appeared to him that they could come to but one conclusion, viz., that if they were to have any change let them have the one so powerfully recommended—if not, the sooner the public was instructed in the mysteries of decimal arithmetic the better it would be for all parties.

Mr. William Brown, M.P., said. having acted as the chairman of the Decimal Coinage Committee of the House of Commons, it might be presumed that he had bestowed some little attention upon this subject. The penny advocates appeared to be the greatest opponents of the recommendations of that committee, on the ground that the poor man might be cheated if any other copper coins were used. Two witnesses stated that they each took about 1,000 farthings per week, and such persons made it their business to apportion the quantities they sold to the money they received. The penny did not make the fixed quantity of the article any more than the mil would do, and hence he thought it was of very little importance what the copper coin was, so long as the people understood it, and from his own experience, if an account was made out a penny or even a farthing wrong, the poor man was the first to point it out. They greatly underrated the intelligence of the working classes of this country by supposing that they would not know the value of one mil, or five mils, as well as those who occupied a higher station in life. The moment they told them they would get 25 mils or farthings for their sixpence, in place of 24, they would see that it placed them in a better condition, inasmuch as a mil would go as far as a farthing in many cases. He thought he need offer no further remarks as to the poor being likely to suffer from the introduction of a copper coin different

from the penny. Mr. Stewart, an inspector of schools, had informed him that the decimal system of arithmetic had been introduced into the Industrial Schools at Liverpool, and on the occasion of his visiting those schools, he examined a class, and was astonished to witness the rapidity with which pounds, shillings, and pence were decimalised by the scholars there; it was done mentally and immediately, without any defaulter, and the master said to him, "Only give us the one, two, and three mil pieces, and I will teach the boys their lessons in an hour, instead of two or three days." With respect to the feeling of the country generally on this subject, he might state that he was favoured with the perusal of a number of letters addressed by the Government to various bankers, and the question was, as to how they appreciated the florin, and he might state that almost universally they preferred the florin to the half-crown, as they regarded it as the entering wedge to the introduction of a decimal system, to which they looked forward; and, further, the most influential of all banking institutions—the Bank of England—testified their approbation by a donation of 100*l*. towards the circulation of a pamphlet, which had been issued in advocacy of the system. Weight of evidence was generally looked at in determining the merits of a scheme, and when he read the names of the gentlemen composing the two Royal Commissions, as well as those who formed the Parliamentary Committee upon Decimal Coinage, and when he considered the results at which those commissions arrived, he had no hesitation in saying that the opinions of men of their position and standing, and world-wide fame, were entitled to the highest consideration. The first committee, he believed, reported in 1841. That committee was composed of—The Astronomer Royal, Mr. Bailey, Mr. E. D. Bethune, Sir John Herschel, the Speaker of the House of Commons, Sir J. W. Lubbock, Rev. R. Sheepshanks, and Mr- Peacock. The second committee was composed of—The Astronomer Royal, Lord Wrottesley, Lord Rosse, The Dean of Ely, Sir John Herschel, Sir J. W. Lubbock, Prof. Miller, Rev. R. Sheepshanks, The Speaker of the House ofCommons: Chairman, Astronomer Royal. They examined both foreign and domestic evidence as to the advantages or disadvantages of decimalising weights and measures, and they could not conclude their report, which was confined to weights and measures, without making this very important remark, which he would trouble them by reading, "They examined many witnesses, and in 1841 presented their very able and elaborate report, in which they remark, that a decimal arrangement of the coinage was so connected with that of weights and measures, that they could not refrain from stating that one would be incomplete without the other, and that their report would be unsatisfactory, if they did not recommend that the coinage should be at once decimalized, dividing the pound sterling into 1000 parts." That (continued Mr. Brown) was the testimony of those very important commissions, and he might state to the meeting that, without any great exertion on his part, but with a view of abridging the labours, not only of the school teacher, but the labour of the counting-house, no fewer than 250 Members of Parliament, with many other intelligent persons, had become members of the Decimal Coinage Association, which had been formed to carry out these views by disseminating the knowledge of the advantages of the system throughout the country. He would say one word with regard to the question of a universal coinage. Supposing France, England, and the United States, were to agree upon a national currency, and one of those countries was prepared to make sovereigns of 113 grains of fine gold for all. Supposing America did it, it would depend upon the latest advices from England in which of the countries the sovereign was most valuable for the time being, for, unless the sovereign was more valuable in France than in England or America, or more valuable in the United States than in England or France, neither country would be inclined to go to the expense of freight, insurance, and other charges consequent upon the exportation of bullion. The operations of trade were continually increasing or decreasing the purchasable value of gold and silver. The gold and silver might retain the same intrinsic value in weight and fineness, but the purchasable value altered every hour, and the fluctuations of trade prevented the balance of demand being against either country; so that, he thought the hope of a national currency was out of the question, indeed, he regarded it as one of the greatest fallacies that could be entertained. He would detain the meeting further only to mention that, although the mercantile community of Liverpool had had the penny unit placed before them more prominently, perhaps, than any other town, by Mr. Rathbone, who, no doubt, conscientiously believed it to be an advantage—a petition was sent to the Chancellor of the Exchequer from the Liverpool Chamber of Commerce—a most influential body, who perfectly knew what they were about—praying the Government to adopt the pound sterling as the unit, and to give them the decimal system; and, for his own part, he thought that was the most convenient one to be used, and the only one that Government could adopt, sustained as it is by the Reports of two Royal Commissions and a Parliamentary Committee.

Mr. Moore begged to suggest a few practical difficulties in the way of the adoption of any other unit than the pound sterling, which had been entirely overlooked both by Mr. Minasi and Mr. Reid. Mr. Minasi proposed a new tenpenny coin, which he termed an *argent*, as a coin of account, but appeared to forget that in receiving money they had to count the actual coins. He did not bear in mind that in the Bank of England alone they received some 5000*l*. or 6000*l*. in silver in a day, that this 5000*l*. or 6000*l*. came to the Bank in about 125,000 pieces, that the various coins had to be separated from each other; the half-crowns, the florins, the shillings and sixpences, the fourpennies and threepennies, had all to be separated one from another. Introduce another coin, and just in proportion as the coin occurred in circulation would be the additional labour required in counting those large amounts of silver. He ventured to say there was not a banking-house in London in which the clerks had not as much to do as they could get through now. The number of clerks must be increased in all the establishments if they adopted this new coin, and some of the banks were now so pressed for room to carry on their business, that the introduction of a new coin would actually involve the necessity, in the great majority of cases, of new premises, to make room for the new clerks. Nor did the additional labour end here. Mr. Minasi, though he had not referred to it that night, yet in his "Penny Wise and Pound Foolish" pamphlet, proposed to have a gold coin of ten times his tenpenny coin, to be called an Imperial, which would be of the value of 8s. 4d. Here, then, would be a new gold coin which, in counting or weighing gold, must be separated from the sovereigns and half-sovereigns; it would weigh with neither. The Bank of England received perhaps some fifty or sixty thousand pounds in gold in the day, making from sixty-five to seventy thousand coins to be counted. The introduction of the new coin would about double the labour of counting—there must, therefore, be an increase of clerks; so it would be at all the other banks. Business must either be retarded or the present hands overworked, or greater numbers employed. Mr. Minasi boasted that his scheme retained every existing coin. Perhaps it did; but it retained them as an inconvenience. The Decimal Association, it was said, withdrew coins—it would withdraw the half-crown, the threepence and fourpence, and so lessen the labour of counting large sums. He (Mr. Moore) did not know what particular advantage was expected to be derived from this 8*s*. 4*d*., but he could say it would be attended with many disadvantages. In the first place, to cut the die, would cost just as much as that for a sovereign; the work at the Mint would cost as much as

for a sovereign. They must have a large surface in proportion to their weight of gold, the wear would therefore be rapid. They could be allowed but a very small margin of overweight. The sovereign had about three-fourths of a grain overweight, the half-sovereign about three eighths, and the eight-and-fourpenny must have not more than about one-third of a grain, so that a large proportion would very soon be found light. Mr. Minasi might say they could be made thicker, and with a proportionately smaller surface; they could not know that the present thickness of the coins was the result of experience; it was found to be the thickness which gave best the peculiar ring which so well served to detect whether coin was good or bad. If made thicker, in proportion to surface, that detective ring, which was so important, would be lost. Then came the question of individual loss. They recollected the stir which was made in 1844, he believed, respecting light gold, and the grumblings consequent upon the deductions that were made upon the deteriorated gold coin. But Mr. Minasi, in his eagerness to benefit, as he said, the poor man, forgot that the 8s. 4d., being a smaller coin than the gold at present in circulation would go into the hands of a greater number of people, and, therefore, when another proclamation was issued respecting deteriorated gold coin, the poorer classes would be much more the losers than on any former occasion—losers, too, to a much greater extent than they possibly could be by the alteration in the value of the copper coins proposed by the Decimal Association. The assertion that no change could be made in the existing value of the penny without injury to the poor was based upon the fallacy that the present penny of twelve to the shilling-worth, at least half as much more as its value in uncoined copper, was the only piece of copper money with which there could be any honest dealing. Have a coin worth more or worth less, and universally people would either cheat themselves or be cheated of the difference. There was the assumption, besides, that the penny did now meet with exactitude, in every case, the incessant variation of prices in all articles of ordinary consumption. Dealers in such articles would tell them that it did not meet one in a hundred of such changes, and that the alterations of price were met in small quantities such as the poor purchased in some other way—perhaps there was a smaller herring for a penny at one time than another, or the pound of potatoes had one or two either larger, or not quite so large, as the turn of price might be for or against the buyer. He (Mr. Moore) could imagine a man with plenty of money keeping careless accounts, and not knowing whether he was cheated of a penny or a pound in weight; but the working men were by no means likely to be cheated; they were the best arithmeticians as to pence in the nation, and if those in a higher sphere were as financially accurate, they might no doubt save themselves a considerable amount in the course of the year. But there was another thing which had been overlooked in every proposal to depart from the pound as the chief coin of account—that was the great objection of the English people to do anything in a more roundabout way than was absolutely necessary. If a man could enter a pound in his books in one figure, Mr. Minasi never undertook a more hopeless task than to attempt to make him write 24 or 240 instead of the 1; and it was that love of brevity and conciseness which constituted the essence of the business activity of the English nation. He had been told that enormous advantages were expected from the penny and tenpenny, by bringing about an approximate equality to certain foreign coins. The tenpenny coin would bring us near the French franc, while the Imperial would go to represent the double of the United States dollar. But he would ask could they gain anything by that approximation? What would be the approximation in a considerable sum? There would be 24,000 tenpennies in 1000*l.*, and 25,221 French francs, 55 centimes; so that the approximation would amount to a difference of 1,222 francs, 55 centimes in 1000*l.*; so that there would be a difference of 48*l.* 7*s.* 7¾*d.* in 1000*l.* With regard to American dollars, the case would be similar, although not so bad. There it would be a difference of 15*l.* in the 1000*l.*; the dollar, which was perhaps 4*s.* 2*d.* when Mr. Minasi had calculated, being now 4*s.* 1¼*d.* In his tract, Mr. Minasi had given an example which he appeared to regard as altogether unanswerable to the objection that inconvenience would result from the displacement of the pound as the first coin of accounts—it would be so easy to reduce imperials to pounds—reduce, says the example, 143*l.* to imperials. We were told to multiply by 12 and 2, and the answer was set down 343 imperials 2 argents, as if the multiplication required no figures, could be done at sight, would take no time to perform; the multiplication, even if the 12 and 2 were not written, would require 8 figures; and if they were, it would require 11 figures; so if there were (and it would be within the mark to say there would be) a thousand payments, requiring such calculations, made into the bank in the day, it would require some six or eight thousand figures to be written, and, coupled with the twenty-four having to be reckoned for every pound; and the separation of the tenpennies in counting silver, the imperials in counting gold—entering the imperials in a distinct account, reducing every sum paid into sixpences, and the incessant calculations to be made as to almost every receipt, payment, and entry,—it would probably not be too much to say that it would about double the business in the cash office of every bank in the kingdom. In conclusion, he would suggest that it would get rid of a great deal of confusion as to a decimal system, and the most direct mode of its accomplishment, if the word Decimal—which people very generally did not understand—were not used; and if instead of speaking of a decimal coinage, we were to speak of a common arithmetic system of coins. Every one understood the difference between common arithmetic and money arithmetic. In common arithmetic the figures stood in an invariable relation, and we always had to carry the *tens* from right to left. We wanted to have the same simplicity as to money. We wanted instead of carrying the fours from the farthings to carry the tens; instead of the twelves from the pence to carry the tens; instead of writing two columns in the shilling column, and carrying the tens from the one and the half of the other to the pounds, to have one figure in the shilling column and carry the tens. Thus they would have a system of money arithmetic, not different from the common arithmetic. Let it not be said that the working man could not understand this. There was not a man but would say, "Do your best to bring this about; I cannot spare much time for the education of my children, they must soon begin to earn their own bread, but I like to have them taught." Simplify the teaching of the children, and they would have the thanks of the people at large; and the simplest way was to make the least possible change in fixed ideas of the present system. What we needed was already half done to our hand—we had the pound—we had its tenth, the florin. We wanted a silver tenth of the florin—call it a cent; and a copper tenth of that cent. There was no more simple way of attaining a decimal coinage, and none that would be more readily understood.

The CHAIRMAN said, at the very late hour to which the discussion had extended, he would only offer two or three brief observations by way of summing up. He would not enlarge upon his own opinions on this subject, because they had already been published, but he would advert to one thing in reference to the figures to which allusions had been made, inasmuch as he thought it was not sufficiently insisted upon that the exhibition of figures did not represent the labour of the calculation. Take for example the product of 7 pence by 5. The first part of the work was multiplying 7 by 5=35. The second and more troublesome part of the work was converting 35 pence into 2s. 11d., a new set of figures entirely: in making this change, work was done

which did not appear in that exhibition. Had time permitted, he would have adverted to several other matters in relation to this subject, but he would now only advert to one to which no allusion had been made, as a possible difficulty in the way of the scheme which he himself supported,—that was as to the millesimal subdivision of the pound sterling. He believed that some shopkeepers of the lower class, would at first keep an account in shillings and the subdivisions of the shilling, and that was the only difficulty he saw in carrying it through. He thought it likely that those shopkeepers would keep this system of account,—50 mils to the shilling, and 20 shillings to the pound; but that could be got over in time; although he pointed it out as likely to be the most serious difficulty to be encountered in this scheme, he by no means despaired of ultimately getting over it.

On the motion of Viscount Ebrington, M.P., the thanks of the meeting were accorded, by acclamation, to Messrs. Franklin, Minasi, and Reid, for the papers they had read.

The Secretary announced that there would be no meeting on the evening of Wednesday next, it being Ash Wednesday; and that on the 28th inst., the paper to be read was "On the Iron Industry of the United States," by Professor John Wilson, F.R.S.E.

## IS "UNDER-GROUND MANURING" A NOVELTY.

The following letter appeared in a recent number of the *Gardener's Chronicle*:—

Sir,—I see by the *Gardeners' Chronicle* of Saturday last that a Mr. Wilkins has taken out a patent for underground manuring, and that he has had ability enough to induce the good people of Oxford to subscribe a sum of money to carry out what he calls his experiment. As the gardeners near Chelmsford have been in the habit of using this plan for the last eight or ten years, in consequence of the late Mr. Wix, solicitor, of Chelmsford, who was an excellent gardener, having got the prize there for early celery grown in this way, I should like to know if a toll is now to be levied upon those who have long been accustomed to the use of this mode of using liquid manure. My gardener tells me it is now eight years since it was so used by my desire. Mr. Wix's plan is to place two rows of common land draining pipes one on each side of the celery, and the liquid is introduced by the upright pipe, as described in Mr. Wilkins' plan. The objection to any permanent laying down of pipes is that it is well known by agriculturists, although probably not by a chance audience either at Oxford, Reading, or London, that the roots of mangold wurzel run a long way for their food, and that, consequently, these roots would soon block up the pipes; and if they were kept out by cement or collars, or any other scheme, the object of introducing the liquid manure in a proper manner would be most certainly defeated, as you say it can never be adopted to any extent except in gardens, and I confess I see no advantage, after eight year's experience (of this now called new science), in having the pipes permanently fixed. I am decidedly of the contrary opinion. I must enter my protest against this scheme being considered a novelty. Although Mr. Wix has been dead some years, it might easily be ascertained when, where, and how he adopted the plan. As this scheme is altogether upon a contrary principle to that adopted at Tiptree Hall, no doubt it is open to try various extensions of this mode of growing plants. Any man with a few pipes may easily satisfy himself of the advantage of growing celery by this plan. I have no doubt of the truth of all the circumstances stated by Mr. Wilkins; I only enter my protest against its being considered a novelty. If you think it worth while, you are at liberty to state what I have said in the *Gardeners' Chronicle*.

J. T. TYRELL.

Boreham House, January 29.

*** Mr. John Roberts has pointed out that the extract taken from page 10 of his pamphlet, and appended to his letter which appeared a fortnight back, refers to "Asparagus," and not to the "Culture of Celery," as alluded to in his letter. It was the woodcut of the latter that was in page 10, and not the description.—Ed.

## IMPORTANT TO HECKLERS.

The following letter was addressed to the Editor of the *Dundee Advertiser*:—

Sir,—My attention has lately been directed to an article in No. 48 (December) of *Chambers's Edinburgh Journal*, entitled Industrial Pathology, in which it was most gratifying to find that the pernicious effects to health in the prosecution of certain trades and professions had in many instances been counteracted by the adoption of very simple means: it also stated that the Society of Arts, with praiseworthy zeal, had taken up the matter, and appointed a committee to correspond with working men whose occupations were detrimental to health, in order, if possible, to discover some means for removing the cause. Now, Sir, it occurred to me that the trade with which I am connected, which is that of flax-dressing, has long laboured under certain disadvantages, the most serious of which is being constantly surrounded by a dense atmosphere of decayed vegetable matter, in the shape of dust or stour, the baneful effects of which any one acquainted with the statistics of the flax-dressing trade well knows, for it is a fact that, with comparatively few exceptions, such is its prenicious effects on the health, and I am also afraid on the morals, that a man, when he ought to be at his best, if left to his own exertions, either finds a premature grave or sinks into the unendurable condition of a pauper. Such a state of things, since ever I remember, has always been mourned over when too late, and, so far as I know, no remedy was ever sought; indeed it was just looked upon as one of those things that could not be helped. In the hope, therefore, that there might be an efficient remedy for this evil, I sent a note to the Secretary to the Society of Arts, pointing out our disadvantages, and requesting him to insert it in the Journal of the Society. He, in the kindest manner, complied with the request, when it was promptly noticed and replied to by that eminently philanthropic gentleman, Dr. Elliot, of Carlisle, and I cannot do better than let the Dr. speak for himself:—

"Carlisle, 15th Jan., 1855.

"Dr. Elliot, of Carlisle, having seen in the *Journal of the Society of Arts* a communication signed John Smart, Dundee, respecting Industrial Pathology, and asking for suggestions to protect flax-dressers against the effects of the stour inhaled during work, has to offer an infallible and ready safeguard against the very serious evil complained of. The remedy is to adjust a slight frame of copper wire to the face, including the nose and mouth, leaving the eyes free; cover this frame with wire gauze of large mesh, and over all sew a ply of thin silk; let this mask fit close round the edges and under the chin, and stand off from the mouth and nostrils an inch or more, and let the wearer be utterly indifferent to the novel appearance, and he may work amid all the stour of all the flaxmills of Dundee and breathe as pure an air as if no stour existed. Such a mask will enable the wearer to work the finest building stone with impunity, or to go through the dense smoke of a conflagration breathing freely while the unprotected are choking."

I therefore lost no time in personally testing the efficacy of the protector, and I am happy to say that the result exceeds my most sanguine expectations, for it would be difficult to find words to express the comfort and benefit I have derived from it. And I am aware, Mr. Editor, that

there are very many in a community such as this to whom the adoption would be most invaluable, and it is for this reason that I have requested you to give this publicity. Trusting that the importance of the subject will be deemed a sufficient apology for trespassing on your valuable space, I am your obliged,

JOHN SMART.

South Dudhope Mill,
Dundee, Jan. 26, 1855.

## Home Correspondence.

### STATISTICS OF THE IRON MANUFACTURE.

LETTER II.

SIR,—In a notice of my work on the "Iron Trade," in the *Midland Counties Herald*, Nov. 30, 1854, the reviewer says:—"It is remarkable, considering the almost countless uses to which iron is applied, and the services which it has rendered to manufacturing and agricultural industry, to the social happiness and material comfort of a large portion of the human race, and to the arts of war and peace—of which the existing system of rapid locomotion may be instanced as indeed a 'great fact'—that no other work of a similar kind to the present should have been undertaken. The subject is one replete with interest 'in a general as well as in a commercial point of view.'" This is the fact as regards the history of the iron manufacture in this country, that little has been done in the way of regular statistics, but in France several notices, which may be almost called histories of the iron trade, are published.

In 1784 the Baron de Dietrich was appointed to make a general survey and report on the state of the mines and manufactures. His report was of considerable length, and went fully into the iron manufacture, but the quantity made at that time was very limited. There is the "Enquête sur les Fers, 1829."

On the 24th April, 1831, M. Auguste Perdonnet read his report to the Society, "Du Bulletin Universal des Sciences et de l'Industrie," as to what improvement has the art of making iron received in France during late years; and the "Résume des Travaux Statistiques de l'Administration des Mines." The annual report of the state of the iron trade, by M. Hiron Villefosse, are, I believe, continued by M. de la Play. In proof of the information to be derived from French sources, we have Mr. G. R. Porter's statistical view of the recent progress and present amount of mining industry in France, published about the year 1840.

In America there is the Census, which enters into many particulars of the iron manufacture; and the various committees appointed for the investigations of facts for the settlement of the tariff, give abundance of materials relating to its various developments.

Then there is the report of Prof. John Wilson, F.R.S.E., on the "Iron Industry of the United States," noticed in the *Journal of the Society of Arts*, October 6, 1854, No. 98; and Prof. Wilson is to read a paper before the Society, on the same subject, on the 28th of February next.

In Sweden, the College of Mines gives the needful information; and last year Mr. G. J. Wærn, Jun., a member of the Swedish Diet, wrote a valuable treatise on the repeal of the taxes on iron in Sweden.

In Russia it is easy to obtain the extent of make and exports.

In Belgium and the German States information is also published.

With regard to Great Britain, there have been occasional returns of the make of the furnaces when alterations in the duties have been under consideration, the most important of which are "The Explanatory Remarks on the Statement Transmitted by the Hon. N. Vansittart, and that prepared by the Deputation of the Iron Trade." This was in 1806, when Lord Henry Petty proposed laying a duty on pig iron, and the statement prepared by Mr. Finch of the quantity of pig iron made in Great Britain in 1823 and 1830.

There are also the Parliamentary returns of the exports and imports of iron from the year 1710. I was fortunate enough to obtain official copies of the early returns from the library of the House of Commons, shortly before the Houses of Parliament were burnt down, and the originals of these papers were destroyed. I therefore sent the copies to the Board of Trade, for which I received the thanks of the Earl of Ripon, at that time President.

In the *Star*, evening newspaper, August 1839, was published an account of the "Rise, Progress, and Present Extent of the Production, Exportation, and Consumption of Iron in Great Britain," extracted from "Marshall's Statistics of the British Empire."

In several Encyclopædias, Scientific and Commercial Dictionaries, there have been valuable and interesting papers on the Iron Manufacture, and also in No. 106 of the Library of Useful Knowledge.

In 1841, I published the first edition of my history of the iron trade, which I believe is the only work (since the days of Pliny), in which an attempt has been made to give a general account of the manufacture throughout the world. At that time the make was about 1,300,000 tons; when my new edition was published, at the end of last year, it amounted to about 3,000,000 tons; but I am not aware that any account has been published respecting this great increase, and the channels through which it has been consumed.

There are two papers bearing on the subject of make. The first a valuable lecture, read by Mr. S. H. Blackwell, before the Society of Arts, on "The Iron-Making Resources of the United Kingdom," and the second, "Statistics of Commerce," by Mr. Braithwaite Poole.

I have given this sketch, to show that these inquiries are not much thought of in this country, where the iron manufacture in its various branches is the most important of all manufactures to our prosperity—and that comparatively little has been done to make the most of the information, which might be collected from well arranged statistics.

In the communications I have had with individuals connected with the trade, they all agree that it is a species of information which would be very valuable, and that government ought to take it up. An ironmaster to whom I wrote in reply, says:—"This is not the first effort that has been made to establish some species of machinery, whereby an authentic return of the progress and fluctuations of the iron trade could be shown. The failure has arisen chiefly from the indisposition of government to take the initiative in granting funds for this object—and the apathy of the trade itself in the several districts." But it appears to me that such an inquiry as the present has as much, if not more, interest for the buyers and consumers, than even for the ironmaster. I do not consider that it is necessarily a very expensive inquiry—and it might be done to some extent, if not altogether, without the assistance of government; but no doubt, such a sanction as that of government would of itself materially assist, in some quarters, in obtaining the required information. If this assistance cannot be obtained now, it may be hereafter, and in the meantime, it might receive from the public, and more particularly that part of it which is interested in the trade, (and which is not), sufficient support to commence the inquiry.

I remain, your faithful servant,

HARRY SCRIVENOR.

Liverpool, 30th January, 1855.

## THE DISCUSSION AS TO WATER SUPPLY.

Sir,—In your report of the discussion that followed the reading of Mr. Homersham's paper, "On the Chalk Strata considered as a Source for the Supply of Water to the Metropolis," there are some errors as to what I said on that occasion, of sufficient importance to induce me to request you to allow me an opportunity of correcting them. Perhaps the best method of doing so will be to give you, in a concise form, the substance of the first part of my remarks, in which chiefly the mistakes have occurred.

I said that the basis of Mr. Homersham's calculations appeared to be this: That a certain amount of rainfall took place annually, nearly the whole of which was absorbed into the soil in chalk districts, while only a certain portion was given out by the springs and rivers; and, as Mr. Homersham would not believe that the remainder was carried off by evaporation and vegetation, he assumed, without any direct proof, that a very considerable portion of the rainfall found its way out of Hertfordshire, and other inland counties, by underground currents to the sea, and might be intercepted in its course without injury to anyone. I then showed that, by gauges constructed for the purpose of ascertaining the quantity of rainfall that percolated to the springs, it was found that on an average of 19 years, out of an annual rainfall of about 26 inches, less than 9 inches descended to a depth of 3 feet below the surface; and that, taking this quantity as percolating to the springs throughout the area of the gathering ground of the River Gade above Hunton-bridge, it gave, by calculation, a supply of water that coincided as nearly as possible with the actual average flow of the river at that point. This proved that no water escaped from this district, by any underground currents, to the sea, as the river carried off all the rainfall that was not consumed by vegetation or evaporation. But, supposing that some water did escape in the way suggested by Mr. Homersham, it was evident that sinking a well at Watford would not close the outlets from the chalk into the sea, and that, whatever outflow into the sea at present exists, would still continue undiminished, and it therefore followed that whatever amount of water was pumped from the chalk at Watford for the use of the metropolis, would not be so much "intercepted" on its way to the sea, but so much abstracted from the reservoir supplying the springs and rivers of that district.

The other points I mentioned are given with sufficient accuracy, but with regard to Mr. Homersham's attempt to cast discredit on the gauge employed by Mr. Dickinson for the purpose of ascertaining the annual infiltration to the springs, I may take this opportunity of stating that *no* peat was mixed with the soil with which it was filled, and through which the rain percolates; and that most of Mr. Homersham's assertions respecting it are equally remote from the truth.

The experiment with bare chalk was made in a cast-iron cylinder, 3 feet deep, and 18 inches in diameter, sunk in the ground, and no water descended to the depth of 3 feet in the chalk from February to December of last year, notwithstanding there was a fall of 3½ inches of rain in one month.

My residence is as given below, and not at Watford.

I am, sir,
Your obedient servant,
JOHN EVANS.

Nash Mills, Hemel Hempsted, Feb. 3, 1855.

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February 3, 1855.

Sir,—Referring to the paper read before your Society on Wednesday last, I find in your report of the discussion I am made to state that the quantity of water obtainable from the chalk under London was 500,000,000 to 600,000,000 gallons *yearly*, whereas I said that if the *daily* abstraction of only 5,000,000 to 6,000,000 gallons of water had caused so serious a depression of the springs under London, as evidenced by the diagram presented by me, what would have been the depression if 50,000,000 to 60,000,000 gallons of water (the minimum daily supply to the metropolis) had been abstracted?

Your correction, as above, will oblige,
Your's very truly,
FREDERICK BRAITHWAITE.

## THE SMOKE NUISANCE.

Sir,—Will you allow a comment on a point urged by Mr. Muir, in his valuable and interesting paper, "On Smoke":—

"Once more I have to repeat that the smoke nuisance involves the consideration of *dimensions*, not *inventions*, and the sooner this truth is recognised and acted upon the sooner will our cities be freed from the nuisance of smoke, and our Government freed from the reproach of attempting to do by sheer force what could have more speedily and economically been done by instruction." This emphatic peroration of Mr. Muir's paper (Journal Soc. Arts, v. iii., p. 142), is not likely to stay the progress of improvement in the direction to which it refers, but there is in its words a retrograde or obstructive spirit, which, I am sure, belongs not to its author. It is, therefore, worth remarking, for the sake of inventors, on whose sanguine temperaments this confident assertion may fall somewhat chilly, that the distinction here drawn to their prejudice, has more of rhyme than of reason in it.

Mr. Muir states that furnaces of the ordinary construction, having their several parts properly proportioned, as respects dimensions, will effectually and smokelessly burn their coal. This is, doubtless, the fact. It is probable that any form of furnace that can be conceived, however strange, would perform correctly, if some certain dimensions were given to its several parts. Evidence, therefore, that such is the case with the many given kinds of furnaces is no proof that it is the best, or even more than tolerably good. To discover these requisite dimensions is, in any case, a business of invention. It is just as much invention to find out how to make a furnace, with a given general form of dimensions, which shall work well without additional apparatus, as it is to discover how to add to a badly constructed furnace a contrivance that shall make it smokeless, or to devise a furnace of new form that shall burn with propriety. It is just as much invention to find out a good size, as it is to find out a good shape.

It was just as truly creation to make a shark that could breathe by gill-filtration as it was to construct a seal that could breathe by lung-spiration — as truly creation to contrive a whale as a horse. Both shark and seal can breathe — both whale and horse enjoy locomotion. Gills can work as well as lungs, tail as well as legs, when the dimensions are appropriate. The whole was a very good contrivance, but we may be thankful that creation did not stop there. Let us still hope for something better than whale-like boilers, and palœosaurian furnaces. There can be no doubt that the whole art of the application of heat to human purposes is only in its infancy; that of the generation of steam by coal in embryo. Good is the embryo state, good the infancy, both of species and of class, both of animal and of instrument. But creation rested not till man was made: and invention will not rest till the perfect furnace is evolved.

Touching smoke, Mr. Muir seems to think that it is of no consequence to understand the nature thereof. He seems to turn but a cold practical eye upon theory. It it curious that people seem not to know what smoke is: I think it is also unfortunate, for, if they did, they would have got rid of it before this time. I may be allowed, perhaps, if not for the utility, at least for the interest of the matter, to point out a fact which is not usually noticed. There are two very different kinds of opaque smoke, whereof one is generally considered to constitute the whole opacity of coal smoke, while the other, which really forms by far the larger portion of it, is ignored. There are

two sorts of substances:—The one is carbon, lampblack, derived from the decomposition of the vapour of tar; the other is tar-vapour, in the vesicular or fog state. This latter voluminous nuisance may be seen issuing from coal in a fire-place, or mixed with invisible gases, from the end of a tobacco pipe used as a coal retort. It may be smelled on Hungerford-bridge, when the breeze is from the east and the steamers are stoking at the pier. It might be felt in the eyes and throat, when London fogs are green.

The only cause of smoke is the distillation of the fuel, and the production of tar, faster than air is supplied for the burning of it. Some contrivance, either of dimension or of form, is necessary for this supply. There are many such contrivances that are good. The best must be that which combines, in the highest degree, simplicity with effectiveness.

I am, sir,
Yours, &c.,
C. B. MANSFIELD.

### THE F.S.A. QUESTION.

Sir,—The F.S.A. controversy reminds me of a passage in our Shakspeare, who has gentle reproof for every folly:—

> For who shall go about
> To cozen fortune and be honourable
> Without the stamp of merit! Let none presume
> To wear an undeserved dignity.

Now dignity would be undeserved, if it were worn by him or them who had done nothing more for art or science than to subscribe some forty shillings to a scientific society, or who had patronised scientific meetings by his or their presence. Marks of honour bestowed on men of merit (as a Herschel or Brewster), who have done something for science that most men cannot do, lose much of their value when they are bestowed upon or appropriated by commonplace every-day men. A city knight, or a city baronet, looks very ridiculous when walking *pari passu* with a Sir De Lacy Evans. I hope we shall hear no more of the F.S.A. question.

Yours,
I. H. E.

February 10, 1855.

### E DISCUSSION ON THE SILK-WORM.

Sir,—" Palmam qui meruit ferat"—In your report of the discussion which followed the reading of my paper last Wednesday evening on 'The Silk-worm and its Products,' I now notice that some of the gentlemen, in their kind allusions to the subject, ascribed the entire merit of the new process of silk reeling to me.

As I have no desire for any undue eulogium, I beg to state that the origin and leading feature of the invention are due to my colleague, Mr. Chadwick.

Yours, faithfully,
THOMAS DICKINS.

Spring Vale Works, Middleton,
Feb. 13th, 1855.

### CATTLE INSURANCE.

Sir,—My attention has just been called to an observation in Mr. Mechi's paper " On British Agriculture," published in the Society's Journal of the 8th Dec. last, namely, " that on account of the imperfect homsteads in England, farm stock cannot be insured against death from natural diseases at less than twenty per cent." Now as this statement is evidently made in error, and may prevent many from availing themselves of the protection of insurance, allow me, as one of the auditors of an Insurance Company, that has, at the present moment, current insurances on its books representing several hundred thousand pounds' worth of live stock, to say that the rates are as follows, and that they have never been more during the ten years' existence of the company:—

| | | | | |
|---|---|---|---|---|
| Feeding Stock | . £2 | 10 | 0 | per cent. |
| Dairy Cows . . | 3 | 2 | 6 | ,, |
| Work Horses . . | 3 | 6 | 8 | ,, |

Were insurance more general, even these rates could be much reduced, and if all the agricultural stock in the United Kingdom were insured, it could be safely done at a premium of one pound per cent., which would realise an annual income of 3,500,000*l.*—Your obedient servant,

THOS. SCOTT.

5, Charing-cross, Feb. 14, 1855.

## Proceedings of Institutions.

Bedford.—The Rev. Frederick Cox, Curate of Woburn, gave an interesting lecture at the Literary and Scientific Institution, " On Geology," on Thursday the 6th instant, T. H. Barker, Esq., M.D., in the chair. The previous lecture evening was occupied by Mrs. Grosvenor, with a musical entertainment, entitled the " Melodies of Ireland and Scotland," which was very much applauded. Sir Hamilton Seymour, Bart., late Ambassador to Russia, has forwarded 26 volumes of useful books for the Library; and in a note to the Secretary says:—" They are intended as a very humble contribution to the collection of a Society amongst whom I spent a very agreeable evening, and in whose well-doing and success I take a lively interest."

Derby.—The Lecture Season at the Working Men's Institute was opened on the 10th of January, by Dr. Spencer T. Hall, who delivered a discourse on " Phrenology and Physiology;" Mr. W. Hirst, the treasurer, in the chair. On the 24th, Mrs. Clara L. Balfour, delivered a lecture on the " Female English Poets of the Present Century." Mr. Llewellyn Jewitt, F.S.A., introduced the talented lecturess, who, in the course of her address, spoke of the tenderness of Mrs. Hemans, the enthusiasm of L.E.L., the gentleness of Mary Howitt, and the vigour of Eliza Cook, with touching allusions, too, to Mary Russell Mitford, just departed, Mrs. Browning, and other writers—giving many beautiful illustrative quotations from their works. The lecture was attentively listened to by an admiring audience, and at its close a vote of thanks was cordially passed to Mrs. Balfour. The next lecture will be delivered by the Rev. Thomas Hincks, of Sheffield; and will be followed by Mr. Llewellyn Jewitt, the Rev. R. Lloyd, the Rev. J. Whewell, and Mr. Richard Keene, and Mrs. Balfour will close the present course of lectures on the 26th of March.

Gateshead.—On Saturday evening, the 6th ult., the members of the Washington Chemical Works Reading Institution and Library, gave a public concert, which was well attended. Mr. Pyburn, the leader of the Newcastle Harmonic Society, officiated as conductor. An excellent choir entertained the audience with many gems selected from Mendelssohn, Mozart, and other celebrated composers. The Mayor of Newcastle, J. L. Bell, Esq., president of the Institution, proposed a vote of thanks to Mr. Pyburn and his party. That gentleman, in reply, said, that it was always his object to select that class of music which was calculated to exercise a refining and elevating effect on the public mind, and he had reason to believe that the time was fast approaching when the public taste would attain a higher standard, and be enabled to appreciate and prefer the highest branches of music. On Saturday evening, the 13th ult., a lecture was delivered by Mr. John Watson, treasurer of the Institution, " On Electricity, and its Application to the Working of the Electric Telegraph; also to Submarine Blasting." Mr. R. Buddle, secretary of the Institution, presided. The lecture-table was well furnished with apparatus, which was brought into operation, short telegraphic messages being deciphered by the juveniles.

Hastings.—A quarterly general meeting of the members of the Mechanics' Institution was held on Wednesday, 7th Feb., Rev. J. Stent, one of the Vice-Presidents, in the chair. The Report of the Committee for the past quarter gave a satisfactory account of the state of the Society; 89 members had been elected during the quarter; the number of members was 394; the balance in the treasurers hands was 15*l.* 19s. 1d.; receipts, 39*l.* 7s. 9d.; expenditure, 52*l.* 14s. 6d. The *Globe* evening paper and two daily papers were taken in, and the reading department of the Institution was in a satisfactory state. The Committee has decided upon opening the Institution at 11 a.m., instead of 12 at noon. The Committee's report was received and adopted. A Building Committee, which had been appointed in November last, for the purpose of making arrangements for the purchase of the building occupied by the Literary and Scientific Institution, reported the failure of their negotiations, the members of the said Institution having, according to a communication from their secretary, resolved to reject the offer of the Committee to purchase their *nice* building and fixtures for the sum of 1400*l.*; the Committee, however, recommended that no exertions should be spared on the part of the Mechanics' Institution, to obtain other and more commodious premises. The report was received, and the Building Committee was re-appointed. The Local Museum Committee also presented a report, setting forth that a Geological Catalogue had been commenced, and that many species, geological and botanical, had been collected, and the Committee were only waiting for a locality in which they might be placed, so as to form a nucleus for the proposed museum.

London.—An interesting lecture was delivered before the members of the Jews and General Literary and Scientific Institution on Thursday evening, the 1st instant, by Mr. P. L. Simmonds, "On the Products of the Forest, Considered in their Relations to the Arts, Commerce, and Manufactures." The lecture was illustrated by an extensive and very valuable collection of all the products entering into commerce, furnished by him, particularly by specimens of fancy woods in their raw and manufactured state; a collection of the oils of commerce, and their processes of transformations and uses, with one of the patent Crimean stoves, heated by cocoa-nut fuel, furnished by the proprietors of Price's Candle Company; elastic gums, resins, barks, seeds, canes, &c., of all kinds, were shown and explained, and a vast amount of new information afforded.

London Domestic Mission.—On Monday, the 29th of January, Jelinger C. Symons, Esq., B.A., one of H.M. Inspectors of Schools, delivered a lecture "On Practical Education," at the Cripplegate branch of this Institution. As the audience was mainly composed of members of the reading room, pupils of the adult evening classes, Sunday-school teachers, and others immediately interested in the subject of practical education, it is hoped that the lecturer's good seed may have fallen into fruitful ground. Mr. Symons showed that an education which would develop the moral, religious, and intellectual faculties of children and adults in such a way as best to fit them for the everyday duties of common life, was still wanting. He pointed out, only too truthfully, the defects and inefficiencies of the old system of training, whose beginning and end seemed to consist in the bare knowledge of reading, writing, and arithmetic; mentioned many of the difficulties that now bar the way to a better state of things, and showed many easy and simple methods of obtaining results in education, compared with which the old plan, still in common use, showed anything but to advantage. The lecturer boldly and unhesitatingly declared himself in favour of a religious training for day schools, apart from any peculiar sectarian dogmas, and in the utterance of this sentiment he seemed to be warmly seconded by the meeting. He considered the masters, and not the ministers, the proper persons to undertake this work, which should not be, as it were, something added to, but a part and parcel of, the daily training of each child. Mr. Symons next touched upon some of the defects in schools for the higher classes, and censured the practice of spending so much valuable time in cultivating a knowledge of French and Latin—dead languages—and by ladies, in trying to learn the pianoforte, whether they have a natural taste for it or not; all this in servile obedience to the tyrant "fashion," who rules over us English with such an iron rod. He wished he could do something to tread him down a little. He then briefly, but forcibly, alluded to the great curse of the country —"drink"—and spoke with earnestness of the necessity of warning men from this at all hazards. He stated plainly what the Mechanics' Institutes, Athenæums, and Reading Rooms needed to make them popular with the people; in spirit, less exclusiveness and more "brotherly kindness;" in dress, less fashion, and more fustian; in books, a greater readiness and aptitude to meet the tastes of the people. He mentioned the probability of the newspaper stamp being speedily repealed, and the consequent results likely to arise from it, good and bad. He concluded by inviting the meeting to discuss the points he had touched upon in the course of his lecture. In consequence of this invitation a short discussion ensued till ten o'clock, during which some other valuable experience was elicited, when, the time having come for closing the meeting, cordial thanks were voted to Mr. Symons, to which he briefly responded, and kindly promised, some future day, to repeat his visit.

Nottingham.—The Annual Meeting of the members was held on the evening of the 30th ult., Mr. A. Morley, one of the Vice-Presidents, in the chair. From the report read by the hon. secretary (Mr. E. Renals), it appeared that the number of members was 1,132, being a slight decrease as compared with the preceding year. The issues of volumes during that period had been 41,283. More than120 members are connected with the educational classes of the Institution. The lectures had been well attended, especially by members of the various operative libraries in the town, who are admitted free to the regular course of lectures. Professor Partington's lectures "On the Progress of Science," to which working men were admitted on payment of one penny, were highly spoken of in the report. An outlay of 400*l.* had been incurred in the improvement of the organ, for the purpose of rendering the instrument more serviceable in getting up popular concerts. The receipts had exceeded 600*l.*, and the balance in hand 8s. 1d. On the whole the report gave satisfactory evidence of the progress of the Institution.

Poole.—The fourth Annual Tea Meeting and Festival of the Mechanics' Institute was held at the Town-hall, on the evening of New Year's Day, when a large number of the members and friends of the Institute assembled to partake of the physical, social, and intellectual enjoyments of the evening. After the tea had been cleared away, the chair was taken (in the absence of W. Pearce, Esq., the President) by Mr. A. S. Hodges, one of the Vice-Presidents. The honorary secretary, Mr. G. G. French, read the list of lectures for the ensuing half-session, which was as follows:—Professor W. G. Allen, (late professor of the Greek language and literature at the New York Central College), on "American Orators and Oratory." The Rev. Professor Waterman, A.M., on "Ancient Egypt," 2 lectures: I. "Its Hieroglyphic History," II. "Its Testimony to the Bible." The Rev. E. H. Bickersteth, of Hinton Martell, "Astronomy and Christianity." The Rev. E. R. Conder, A.M., "Æschylus and the Greek Drama." The Rev. D. Griffith, of Wareham, "History of the English Language." The Rev. Professor Waterman, "Canada, as a Field for Emigration." Very interesting addresses were delivered by the Chairman, the Revs. Professor Waterman, E. R. Conder, and J. H. Osborne, and by Messrs. Curtis, Harker, and Mare, interspersed with an appropriate and judicious selection of vocal and instrumental music by Mr. J. Shormey, who presided at

the pianoforte, Miss Norton, aged 8 years, his pupil, and by Messrs. Holloway, Delbin, Kellaway, Weeks, and Eaton. Votes of thanks were passed to Mr. Shormey and his friends for their kind services, and to the Mayor for the use of the Hall, followed by the National Anthem, when the crowded assembly broke up, apparently highly gratified with the evening's proceedings.

Royston.—The General Annual Meeting of the members of the Mechanics' Institute was held at the Reading-room, on Monday evening, 22nd January, 1855, at 8 o'clock. The chair was occupied by the President, V. Beldam, Esq., who having opened the meeting, called upon the Secretary, Mr. John Warren, to read the report. From this it appeared that the number of members was 255, the same as in the preceding year, and not including 9 life members. The income was 94*l.* 17*s.* and the expenditure 98*l.* 13*s.* 4*d.*, leaving a balance on the wrong side, of 3*l.* 16*s.* 4*d.* This deficiency arose from the unexpectedly small sums realised by the sale of non-subscribers' tickets for recent lectures. The report then went on to state the subscriptions paid by the different classes of members, and gave a classification of them, with a table showing the time they had severaly belonged to the Institution. During the past year fourteen lectures were delivered—four of these being for the benefit of the Building Fund. The Library had been increased by 97 volumes—63 by purchase, and 34 by donation. It now contains 972 volumes. The number of issues and renewals had amounted to 2490—the average issue, per evening, being 48, as against 27½ in the preceding year. The Reading Room had been attended, on the average, each evening by nearly 22 persons; in 1853, only 14, and in 1852, but 10 availed themselves of this privilge, which can be obtained at the low rate of 2s. per annum. The amount deposited in the Savings Bank was 25*l.* 12*s.* 4*d.*, and the number of depositors 28. After votes of thanks to the Secretary, the Librarian, and the Chairman, the meeting separated.

Rye, Sussex.—A change has taken place recently in the management of the Mechanics' Institution, which has been productive of great advantage to it—as the number of members has been doubled within two months. Endeavours are being made to obtain the assistance of eminent lecturers, so that the increased interest felt in the Institution may be sustained. W. A. Mackinnon, Esq., M.P., has extended his support to the Institution.

Sevenoaks.—The Fifth Annual General Meeting of the Literary and Scicutific Institution was held on Thursday, Jan. 25th. J. Rogers, Esq., of Riverhill-house, one of the Vice-Presidents, took the chair. From the report which was read by the secretary, it appeared that there were 353 members, being a decrease of 75 from last year. This, however, was satisfactorily explained. The Committee have purchased during the year 126 vols. of books, at a cost of 38*l.* 12s. 8d. The number of vols. now in the library is 1697. The issues have amounted to 7649 vols. Fourteen lectures were delivered; a new catalogue has been published, and a French class formed in October last. Prizes were offered to members for the three best abstracts of two-thirds of the lectures, and also for the two best essays "On the Knowledge most Useful to the Working Classes, and how best to obtain it." Four essays were sent in, and the successful candidates were: 1st prize, Mr. R. Barling; 2nd prize, Mr. J. F. Bowen. No change has taken place this year in the election of officers, except that R. H. S. Smith, Esq. was placed on the list of Vice-Presidents, and the Rev. J. Mountford elected a Vice-President in the room of the Rev. J. Gregory, who has left the town. Mr. H. Allwork was elected hon. librarian, as Mr. J. S. Palmer is placed among the Committee, which is as follows:—Messrs. J. B. Anquatil, J. Franks, E. Arnold, Isaac Cooke, S. Cooke, G. Cronk, J. Newington, J. F. Wilson, Wm. Bird, J. S. Palmer, W. Franks, J. Bligh. After the transaction of the formal business, J. Carnell, Esq., one of the Vice-Presidents, rose to present a testimonal, in the shape of a silver inkstand, from the lady members to the secretary, Mr. J. Fitness. That gentleman, in replying, begged the ladies to accept his heartfelt gratitude for their kindness, and stated that he had consented to take the office of secretary another year, hoping to be increasingly useful.

Westerham.—The Committee of the Literary Institute, at their last meeting, resolved to avail themselves of the General Interchange of Privileges between the Institutions in Union with the Society of Arts.

Whitchurch (Salop.)—The Rev. J. C. Richmond, of the American Episcopal Church, who has recently returned from the Danubian Principalities, and from a long sojourn in the East, has been lecturing, at the instance of the Mechanics' Institute, on the "War in the East," for the benefit of the Patriotic Fund, also on the "Holy Land." The lectures displayed a vast knowledge of Oriental life, a thorough personal acquaintance with the topics selected, and were exceeding valuable to all who have any acquaintance or desire to possess any knowledge of those interesting regions which are apparently destined to occupy so much of the attention of the present generation. On the evening of Thursday, the 18th of January, a lecture was given at the Mechanics' Institution, by Mrs. Clara Lucas Balfour, "On the Moral and Intellectual Influence of Woman on Society," which met with the most entire and unqualified approbation of a numerous audience.

## MEETINGS FOR THE ENSUING WEEK.

Mon. British Architects, 8.
Chemical, 8.
Statistical, 8. Mr. W. Newmarch, "On the Loans raised by Mr. Pitt during the first French War, 1793—1801; with some Statements in defence of the Methods of Funding employed,"

Tues. Royal Inst., 3. Professor Tyndall, "On Electricity."
Civil Engineers, 8. Mr. E. E. Allen, "On Steam and Sailing Colliers, and the mode of Ballasting."
Pathological, 8.
Linnean, 8.

Wed. Geological, 8. Prof. Ramsay, "Evidences of the Occurrence of Glacian Action in the Perennian Period."

Thurs. Royal Inst., 3. Mr. Donne, "On English Literature."
Numismatic, 7.
Antiquaries, 8.
Royal, 8½.

Fri. Philological, 8.
Royal Inst., 8½. Mr. John Dickinson, "On Providing an additional Supply of Pure Water for London."

Sat. Royal Inst. 3. Dr. Gladstone, "On the Principles of Chemistry."
Royal Botanic, 3¾.
Medical, 8.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS,

*Delivered on 7th February*, 1855.

Par. No.
41. Metropolitan Improvements—Statement.
Agricultural Statistics (Scotland)—Report.

*Delivered on 9th February*, 1855.

44. Cathedral and Collegiate Churches—Return.
46. Coinage—Account.
27. Deficiency Bills, &c.—Return (a corrected leaf).
19. Bill—Bills of Exchange.
Turnpike Trusts (Scotland)—Abstract of the Generul Statements of Income and Expenditure.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Feb. 9th*, 1855.]

*Dated 12th December*, 1854.

2611. R. Larkin, 2, St. John's-villas, Highbury—Locks and keys.

*Dated 16th January*, 1855.

109. U. C. Choisnet and C. E. Giajola, Birmingham—Moderateur lamps.

*Dated 19th January*, 1855.

152. M. Delcamp, Paris—Apparatus for advertizing.

*Dated 22nd January*, 1855.

166. R. Johnston, Aberdeen—Soap.

*Dated 23rd January*, 1855.
172. J. Coates, Salford—Railways.
174. W. Dray, Swan-lane—Chaff-cutting machine.
176. J. Fenton, Low Moor—Axles, shafts, rods, and bars.

*Dated 24th January*, 1855.
178. R. Laming, Carlton-villas, Maida-vale—Ammonia.
179. J. Webster, Birmingham—Changing the direction of and multiplying motion.
180. Sir J. C. Anderson, Bart., Fermoy—Steering ships.
181. C. W. Tupper, 3, Mansion-house-place—Coverings for buildings.
183. A. E. Schmersahl and J. A. Bouck, Miles Platting—Sulphuric acid.
184. W. E. Newton, 66, Chancery-lane—Raising and forcing fluids.

*Dated 25th January*, 1855.
185. J. Gregory and A. P. How, Mark-lane—Steam engines.
186. W. Winstanley and J. Kelly, Liverpool—Pump gear.
187. B. Samuel, Sheffield—Knife handles, umbrella and stick handles, door knobs, &c.
188. H. B. Powell, Lyndhurst—Precautionary keel.
189. C. F. Burnard, Plymouth—Superphosphate of lime.
190. A. W. Anderson, Birmingham—Exhibiting advertisements.
191. J. H. Johnson, 47, Lincoln's-inn-fields—Electric telegraphs. (A communication.)
192. J. H. Johnson, 47, Lincoln's-inn-fields—Cotton machinery. (A communication.)
193. G. H. Bursill, Ranelagh-road, Thames-bank—Cases for explosive substances.
194. R. A. Brooman, 166, Fleet-street—Power accumulator to be used with hydraulic presses. (A communication.)

*Dated 26th January*, 1855.
195. W. Townsend, Coventry—Vehicles without axletrees.
198. W. Beales, 12, Arlington-street, Camden-town—Cartridges.
199. G. Bell, 21, Cannon-street West—Air springs. (A communication.)
200. J. Lesse, jun., Manchester—Printing calicoes.
201. W. T. Vose, Massachusetts—Pumps.
202. J. Atkin, Basford, and M. Miller, Nottingham—Water meter.
203. W. R. Morris, Deptford—Preventing waste of water from service pipes or cisterns.
204. G. Searby, 154, Sloane-street—Boots and shoes.
205. R. Mallet, Dublin—Hollow shot and shells.

*Dated 27th January*, 1855.
209. W. Onion, Birmingham—Gas stoves.
211. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Thimbles. (A communication.)
212. H. and R. Nightingale, Chorley—Cotton machinery.

*Dated 29th January*, 1855.
214. J. Wilkins, 2, New Charles-street, City-road—Damping adhesive stamps or labels.
216. H. L. Dormoy, Paris—Platting machinery. (A communication.)
218. J. Imray, 64, Bridge-street, Lambeth—Locks.
220. A. Collinge, 65, Bridge-road, Lambeth—Spring hinges.
222. J. H. Johnson, 47, Lincoln's-inn-fields—Looms. (A communication.)
224. A. Pichot, Poitiers—Postage paper and envelopes.
226. E. Cunnah and J. Hampson, Liverpool—Turnstile counting apparatus.

*Dated 31st January*, 1855.
234. A. Lyon, Windmill-street, Finsbury—Sausage-making machines.
236. G. Price, Wolverhampton—Iron safes.
238. J. R. Delgucy-Malavas, Montbrison—Motive power.
240. J. F. Porter, Besborough-street—Bricks.
242. A. E. L. Bellford, 32, Essex-street, Strand—Forging nuts and washers. (A communication.)

INVENTION WITH COMPLETE SPECIFICATION FILED.

249. W. Soelman, 3, Bennett-street, Fitzroy-square—Naukinetic or ship moving machine.—2nd February, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed February 9th*, 1855.
1764. George Weston, Sheffield—Improved veneering apparatus.
1771. William Todd and Jacob Todd, Heywood—Improvements in power-looms for weaving.
1800. Julian Bernard, Club Chambers, Regent-street—Improvements in the manufacture of boots and shoes or other coverings for the feet.
1854. Aristide Balthazard Bérard, Paris—Improvements in the manufacture of gas, coke, and other products from coal, and in apparatus for that purpose.
1875. Richard Archibald Brooman, 166, Fleet-street—Improvements in obtaining motive power.
1878. Auguste Antoine Legras, Paris—Improved apparatus for regulating the level or flow of liquids.
1921. Pierre André Decoster, Paris—Improvements in extracting the saccharine parts of the sugar-reeds, and of other sacchariferous substances.
2017. Samuel Crabtree, Bradford—Improvements in machinery for combing wool, hair, and other fibrous substances.
2213. William Wain, Brunswick-street, Stamford-street—Improvements in the construction of screw propellers.
2494. Walter Blundell, 29, New Broad-street—Improved apparatus for treating or preparing any part of the human body requiring to be surgically operated upon for the purpose of totally or partially benumbing the sense of feeling at the desired part of the human body.
2534. Robert Christopher Witty, 9, Toriano-avenue, Camden-road-villas—Improvements in illumination by means of artificial light.
2570. John Fairrie, Church-lane, Whitechapel—Improvements in preparing solutions of sugar for filtration.
2584. Edward Acres, Pouldrew Mills, Waterford—Improvements in drying wheat and other grain.
2634. William Charles Day, Strand—Improvements in portable camp bedsteads and bedding.
2683. William Donald and William Heginbotham, Carlisle—Improvements in looms.

*Sealed February 30th*, 1855.
1773. Henry Smith, Smethwick—Improvements in the manufacture of wrought-iron wheels.
1775. John Greaves, and Charles Michael Greaves, Birmingham—Improvements in the manufacture of certain kinds of spectacle frames.
1779. Robert Caunce, Bolton-le-Moors—Improvements in machinery for preparing cotton and other fibrous materials.
1792. Thomas Wallworth, Manchester—Improvements in purifying and treating grain and in dressing flour, and in machinery for these purposes.
1797. John Hackett, Derby—Manufacture of new and improved fabrics of cotton and of linen, and of cotton and linen combined.
1801. Louis Christian Koeffler, Rochdale—Improvements in extracting coloring matter, also applicable for extracting size or glue from animal substances.
1816. Samuel Kershaw, and James Taylor, Heywood—Improvements in carding engines.
1830. William Vitruvius Greenwood and John Saxby, Brighton—Improvements in signal lamps.
1831. James Worrall, junior, Salford—Improvements in the method of cutting fustians, cotton velvets, and other piled goods or fabrics.
1836. Stopford Thomas Jones, 3, Union-court, Old Broad-street—Improvements to reduce and wash minerals to extract metal therefrom, especially gold.
1838. Robert Barlow Cooley, High-street, Notsingham—Improvement in gloves.
1880. Robert McConnel, Glasgow—Improvements in shutters for doors and windows.
1905. Julian Bernard, Club Chambers, Regent-street—Improvements in the manufacture of combs.
1915. Joseph Worthington, Manchester—Improvements in counters or fitting of shops, warehouses, and offices, for arranging, preserving, and exhibiting articles therein.
1962. Robert Macallister, Glasgow—Improvement in fitting or applying screw propellers to ships and vessels.
2390. Eugene Antoine Lépine, Madrid—Powders and collyrium for curing the diseases of the eyes without the use of surgical operations, to which invention he has given the name 'Lepine's ophthalmological powders and collyrium.'
2460. Alfred Tylor, Warwick-lane, Newgate-street—Improvements in crimping machines.
2471. William Aristides Vérel, Macduff, Banff—Improvements in grinding or pulverising.
2574. Richard Archibald Brooman, 166, Fleet-street—Apparatus for regulating tension in spinning frames. (A communication.)
2598. James John King, and Thomas Brindley, 2 Leonard-square, Finsbury—Improvements in cigar cases, card cases, and other similar cases.
2617. John Nesmith, Lowell, Massachusetts—Manufacture of wire netting and wire fence by power.
2698. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture of railway and other wheels. (A communication.)
2708. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in electro-magnetic engines. (A communication.)

APPLICATION, UNDER THE ACT 5 AND 6 WILL. IV. C. 83., S. 3. FOR CONFIRMATION OF VOID LETTERS PATENT.

7774. William Henry Porter—Anchors, 18th February. (Application refused.)

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address |
|---|---|---|---|---|
| 3683 | Feb. 10. | Safety Bracelet Clasp | Mége and Zachnsdorf | 6, Frith-street, Soho-square. |
| 3684 | ,, 13. | Carriage Iron for Carriage Lamp | Clark and Timmins | Birmingham. |

Journal of the Society of Arts.

FRIDAY, FEBRUARY 23, 1855.

## PURCHASE OF THE BERNAL COLLECTION.

TO THE HONOURABLE THE COMMONS OF THE UNITED KINGDOM OF GREAT BRITAIN AND IRELAND, IN PARLIAMENT ASSEMBLED.

*The humble Petition of the Council of the "Society for the Encouragement of Arts, Manufactures, and Commerce,"*

Sheweth,

1st.—That your Petitioners desire to call the attention of your Honourable House to a collection of Works of Art, extending from the Byzantine period to that of Louis Seize, which consists of upwards of 4000 specimens of Oriental, Dresden, Sevres, German, and Capo di Monte Porcelain; of Historical Portraits and Miniatures; of Mediæval Metal Work and Ecclesiastical Plate; Jewellery; of Limoges, Dresden and Oriental Enamels; of Carvings in Ivory, of Faenza and Palissy Ware; of Armour, Arms, and Stained Glass; Venetian and German Glass and Gris de Flandres; of Watches and Clocks, and of Ancient Furniture. These numerous objects have been collected by the late Mr. Ralph Bernal, member of your Honourable House and Chairman of its Committees for a long period, and are advertised to be sold by public auction on the 5th of March. Full details of the collection may be ascertained in a catalogue published by Messrs. Christie and Manson.

2nd.—That the said collection has been made by Mr. Bernal with sound judgment and great knowledge rarely found, and would be a most valuable acquisition for the Nation, calculated to improve public taste, and advance the arts and manufactures of the country.

3rd.—That such a collection being secured for the use of the country, would supply many of those deficiencies in the National Collections which place its Museums far below those of other European Nations, and might be made particularly useful at the Provincial Seats of Manufacture.

4th.—That in many branches the said collection is superior even to the collections of the Louvre, of Dresden, Berlin, and Vienna, and other European Museums.

5th.—That, besides its educational and manufacturing importance, the purchase of the collection would be a good commercial investment, as the value of such articles is daily increasing, and is worthy of being entertained even in the present time of war, when it is sound policy not to neglect the arts of peace, as is proved by the present commercial advantages which France enjoys in the production of articles of taste,—advantages which may be ascribed, in part, to the care which France bestowed on the general artistic education of its people, without intermission, during its course of wars and revolutions.

6th.—That the purchase of the said collection is well worthy the attention of your Honourable House, and might be secured, as your Petitioners believe, for about fifty thousand pounds, a sum which would not amount to a halfpenny on every hundred pounds sterling worth of manufactures produced for export and home consumption in the year 1854.

7th.—That, looking to the frequent mistakes hitherto made by past Governments, in declining the purchase of whole collections of Works of Art, and afterwards buying the remainders of them at greater cost than the whole, your Petitioners urge on your Honourable House that it would be the most prudent course to purchase at once the whole of the said collection, especially as duplicate specimens might hereafter be allotted among the different local Museums of the country.

Your Petitioners, therefore, pray your Honourable House to vote the necessary funds to secure to the Nation the benefits of the Bernal Collection.

And your Petitioners will ever pray.

Signed and Sealed with the Corporate Seal of the Society, by order of the Council,

P. LE NEVE FOSTER,
Secretary.

## INSTITUTE BOOK ORDERS.

January Account.

| | Full Price. £ | s. | d. | Red. Price. £ | s. | d. |
|---|---|---|---|---|---|---|
| Cambridge, Philo-Union Society | 7 | 13 | 6 | 5 | 15 | 6 |
| East Retford, Literary and Scientific Institution | 0 | 19 | 8 | 0 | 16 | 0 |
| Hants and Wilts, Educational Association | 7 | 18 | 0 | 6 | 0 | 11 |
| Hereford, Permanent Library | 6 | 6 | 0 | 4 | 18 | 11 |
| Horncastle, Mechanics' Institution | 0 | 12 | 0 | 0 | 9 | 8 |
| Lancaster, Church of England Instruction Society | 1 | 5 | 0 | 1 | 1 | 4 |
| London, Bank of England Library and Literary Association | 5 | 5 | 6 | 3 | 17 | 11 |
| Odiham, Mechanics' Institution | 1 | 15 | 6 | 1 | 8 | 1 |
| Pembroke Dock, Mechanics' Institution | 14 | 18 | 0 | 11 | 10 | 0 |
| Sevenoaks, Literary Institution | 4 | 0 | 8 | 3 | 3 | 0 |
| Stamford, Institution | 3 | 9 | 6 | 2 | 12 | 8 |
| | £54 | 3 | 4 | £41 | 14 | 0 |

Being a saving of £12 9s. 4d., or nearly 25 per cent.

## FLAX AND ITS PRODUCTS IN IRELAND.

CONTRIBUTED BY WM. CHARLEY, SEYMOUR-HILL, BELFAST.
LETTER XI.

By the time the flax plant has reached its full growth, a certain proportion of valuable inorganic substances have been extracted from the soil by its small but multitudinous fibrous roots, and, by the action of natural development, have become incorporated with its constitution. Of course flax in this respect is just like the other crops on the farm, though less severe than many; all derive their inorganic constituents from the soil, and hence follows the necessity of manure to replace the loss so caused. Professor Hodges has suggested the following compound for this purpose, as regards flax, which I have no doubt is theoretically correct; but I have no experience to relate as to the effects in practical hands. This manure is to be sown broadcast over the field, before the last harrowing previous to sowing the flax seed:—

FOR ONE ACRE (STATUTE MEASURE).

| | | s. | d. |
|---|---|---|---|
| Muriate of potash, 30lbs., | cost about . . | 2 | 6 |
| Chloride of sodium, 28lbs., | " . . . | 0 | 3 |
| Burned gypsum, powdered, 34lbs. | " . . . | 0 | 6 |
| Bone dust, 54lbs. | " . . . | 3 | 3 |
| Sulphate of magnesia, 56 lbs. | " . . . | 4 | 0 |
| | | 10 | 6 |

The usual system, as already mentioned (Letter IX.) is not to sow two crops of flax on the same soil, without an interval between of from six to ten years, so that the land under the ordinary agricultural rotation, is regularly receiving from the different manures applied, a part of the lost nourishment yielded to the flax, and in the time just specified is again ready to support another similar crop without any special restorative applications to the soil.

This point is much dwelt upon by the intelligent flax producing community of the ancient Flanders; the Société Linière, of Brussels, in its printed recommendations, states "above all things the rotation of crops must be scrupulously observed; if seven or eight years be allowed to elapse, before again sowing flax in the same field it is certain that there will be a good crop; but the less the interval between the two crops, the less is the second to be calculated on either for quality or weight."

It has already been said that before sowing, the farmer must determine whether he wishes for a good crop of seed, or has a preference for superiority of fibre. When seed is the principal object, the crop is of course sown thinly; where fibre, on the contrary, as thickly as can with safety be allowed, for the purpose of drawing up long thin stems, and gaining thereby a fine quality of fibre. In detailing the treatment of the flax plant, after it has reached almost full growth, care must be taken to discriminate between these cases, as the *modus operandi* in each is very different.

In the former case the plant is allowed to attain full maturity before being pulled, and is generally treated on the Courtrai system, which is considered the best for preserving prime seed. In the latter position it is gathered before being quite ripe, but the exact period to do so requires some judgment; the common rule is to allow two-thirds of the stalk to become yellow, and not to allow time for the seed capsules to become more than slightly tinged with brown. The Société Linière, already quoted, pronounces the following opinion:—

"It has been proved that when the flax is pulled between the falling of the flower and the formation of the seed, the fibre is finer and more solid than at any other time, so that unless it is wished to sacrifice the quality of the flax to obtain seed, the former must not await the full maturity of the latter."

As the after treatment of the crop destined *principally for seed*, will be described under the head of the "Courtrai system," it is more convenient to trace out here the progress of the plant when intended *chiefly* for the production of valuable fibre. The time for pulling, as above described, being determined, the next point is to select a fine day, and to have the operation carefully performed. The long and short stems must be kept separate as much as possible, and the lower ends kept even; the handfuls should be neatly placed over each other, so as to remain distinct; these should next be handed to the "ripplers," who pass the tops of the plants through a machine called the ripple—a kind of large comb, with wooden frame and iron teeth * The two ripplers sit opposite each other, with a large sheet below on the ground, and the bundles of flax, after the seed is taken off by the instrument, must be bound up in small sheaves, and carried off to the pool for watering. It it not judicious to ripple the flax severely; it is even better to leave some of the seed on than by overclose rippling to run the risk of splitting or bruising the delicate fibres about the head of the stem. The cost of rippling is considerable, but I believe for every £1 expended, on an average a return is realised of £2, particularly on a farmstead where many horses and cattle are regularly kept. The flax bolls contain much more nourishment than the linseed cake, from which the oil has, of course, been expressed, and they form a most valuable addition to the warm food prepared during winter for the animals just named. I believe they have also a highly beneficial effect in warding off internal disease, owing, no doubt, to the soothing and slightly purgative properties of the oil contained in the seed. The change made in the appearance of the animals receiving some of the bolls in their steamed food is very apparent after a few weeks' trial, and the smoothness and sleekness of their shining coats plainly demonstrate the propriety and importance of the system. Is it not truly surprising, with this fact before our eyes, that many agriculturists—indeed, I fear the majority—persist in the old-fashioned system of taking the flax to the watering place with its valuable freight of seed untouched, and plunge the sheaves under the water, with their full cargo of produce on board, losing thereby, in the most wanton manner, rich feeding materials, worth from £1 to £3 per statute acre!

Yet so it is. I am even told that some think the cost of rippling exceeds the benefit; but I am firmly convinced, and am quite positive, my estimate of *cent. per cent.* profit on the outlay of rippling is under the mark. Some argue that the oil of the seed cast into the water has a *beneficial* tendency in assisting fermentation, and that the yield of fibre is always better in this old-fashioned way than in any other where the seed is taken into consideration. I am not prepared to say, in reply to this objection, that the oil has an *evil* effect, because I think it has *no material influence one way or the other*; but I would beg to call attention to the statement of an intelligent member of the Belfast Literary Society, who, writing on this subject many years ago, says, "The bolls *spoil the water* in which the flax is steeped, and are very troublesome in the grassing and breaking." Now I will just place this opinion of a practical chemist opposite the counter one already alluded to. As to the second objection, I have only to say, *pull the flax when the fibre is in the best state* for your purpose, and still take off *the bolls*; which, I repeat, under ordinary circumstances, will amply repay the outlay.

In India the flax plant is cultivated almost entirely for its valuable seed; and quantities of splendid oil are annually shipped to England; besides this we import from the Continent about 600,000 quarters of flax seed, and 70,000 tons of linseed cake annually. Most assuredly, if I had the power of a dictator in this country, I would,

* "The best ripplers are made of ½-inch square rods of iron, placed with the angles of iron next to the ripplers, 3-16ths of an inch asunder at the bottom, ¼ an inch at the top, and 18 inches long, to allow a sufficient spring, and save much breaking of flax. The points should begin to taper three inches from the top."—*Extract from Royal Flax Society's Report.*

from patriotic notions, order that flax seed should not be sacrificed thus; let it be saved as carefully as grain.

When the bolls are first taken off, they are rather soft and green to keep, and consequently care must be taken to dry them thoroughly; the best way, when the weather admits, is to do so either outside in sheets, or in airy lofts, over which they must be thinly spread; but for feeding purposes, if the weather be indifferent, they may be gently dried on the nearest corn kiln. The slow drying plan by weather is, however, much the best system, and leaves the rich juices of the seed more valuable and nourishing.

When sufficiently dry, the bolls destined for crushing must be thrashed and the seed separated from the husks; this is not necessary when they are to be used for feeding only; the chaff is then a very useful auxiliary, and contributes a good deal to the efficiency of the bolls.

The flax seed having been taken off as completely as can be done without injury to the stems, the sheaves, neatly bound with rushes, should be carried to the bank of the watering place arranged for the purpose. This stage is one of the most particular, and decidedly the most disagreeable to be encountered in the management of flax. The effluvia during fermentation is so pungent and offensive as to attract notice even from the passing traveller. Mrs. S. C. Hall says, "in our progress through the north (of Ireland) we were always reminded of our proximity to a bogging (or watering) station, by the very offensive smell of the decaying flax." About Courtrai the flax is steeped in the river Lys, which contains a remarkably pure and suitable water. In Flanders district* (Paes de Waes) the flax is watered immediately after rippling, in the manner now generally recommended, and the water used is allowed to become partially stagnant in the pools previous to the immersion of the plant. In some parts of Ireland the flax is tied up in large bundles, which are attached to firm stakes by ropes, and plunged into the running stream in the same way as the Belgians do in the "Lys." This formerly occurred very frequently in the upper Ban river, County Antrim, but as the fisheries there are valuable, and the fermentation of flax is productive of noxious compounds, injurious to the health of fish, I question if it is now allowed.

It certainly is a strange fact, that the fermentation proceeds quite successfully in a *running stream* of fresh water; and it is evident, therefore, the process must go on in the juices and gummy matter, which connect the woody stem to the pure fibre of the plant, as the water itself has not time to become decomposed in passing through the bundles, a process that at first sight one would think necessary. The usual custom is to have what in old times were styled "lint holes," cut near a river, about six to twelve feet broad, and three or four feet deep, the lengths various, the pool or series of pools being so arranged as to admit water from the stream at one end when required, which would be generally a few days before the flax is ready for immersion. The sheaves of flax should be carefully placed in the water in one layer, rather sloped; the top should be covered with rushes, straw, or tough sods, and some stones put on last, to keep all firmly under water. In Flanders much more care is usually taken than in Ireland, as the flax is generally higher priced and admits of increased expenditure in its preparation. The Belgians have their pools very clean, and the cover used on the top of the flax underneath the stems is not unrarely made of basket or wicker work, so that the colour may not be tainted by contact with soil.

The period necessary to complete the steeping process varies considerably, according to the state of the weather; from 10 to 14 days is generally enough. Nothing, however, except practical experience, can prevent mistakes in this operation; it may be said, as a general rule, that when on breaking the stem of the plant the fibre separates freely from the woody part, that fermentation has done its duty, and the flax should be taken out at once.

* See Sir J. E. Tennent's work on Belgium, Vol. II., published in 1841.

The common way of performing this operation is to run off the water from the steep-holes into the stream, and afterwards take out the flax. Against this slovenly system I must record a serious protest, it being contrary to all correct acknowledged principles of agricultural economy.

In the first place, the "flax water" so lost is excellent liquid manure, and its effects can be clearly traced on meadow land, where the plant has been spread for "grassing" immediately after removal from the pool. This liquid ought, therefore, to be preserved and carted in large barrels over the grass fields adjoining, or thrown over by means of hose and pumps, on Mr. Mechi's plan. In the next place, by running off the water, all the scum and dirt in the pool are allowed to settle among the flax plants, and the bundles are pressed against the sides and bottom of the hole, where they are sure to become soiled and dirtied, thus injuring the colour and quality of the fibre. Lastly, the noxious fluid passing into the stream at a time when the river is at the lowest summer level, not only corrupts the water and renders it unfit for domestic use, but poisons the poor fish therein, an offence punishable by law.

Frequently have I seen the mountain streams in this neighbourhood, tributaries of the Lagan river, so polluted by this thoughtless mode of acting as to remind one very forcibly of the first great plague inflicted on Egypt—"And the fish that was in the river died, and the river stank, and the Egyptians could not drink of the water."

The offensive appearance and odour of this noxious liquid in our rivers can be so easily avoided, that the law prohibiting the nuisance ought to be strictly enforced, which at present is not done. The only proper way of taking out the flax is to make the men stand in the water, for thus the bundles are washed and cleansed in lifting out, and the liquid can be kept in the pools till spread over the meadows; or, if it must be wasted, it can be run off into the stream during the first flood or fresh, at which time its presence would scarcely be felt or remarked.

Before leaving this branch of the subject, I wish to call attention to Sir R. Kane's opinion as to the value of flax steep-water. This eminent chemist gives the following analysis:—

| | Flax Steep Extract. | Ditto without ashes. |
|---|---|---|
| Carbon | 30.69 | 52·93 |
| Hydrogen | 4·24 | 7·31 |
| Nitrogen | 2 24 | 3·86 |
| Oxygen | 20·82 | 35·90 |
| Ashes | 42·01 | ... |
| | 100·00 | 100 00 |

There are found 42 parts of ashes in every 100 parts of flax steep extract, consisting of—

| | |
|---|---|
| Chloride of potassium | 3·8 |
| Sulphate of potash | 4·4 |
| Carbonate of ditto | 3·8 |
| Carbonate of soda | 13·2 |
| Silica | 5·5 |
| Phosphate of iron and albumen | 3·2 |
| Phosphate of lime | 2·1 |
| Carbonate of ditto | 4·0 |
| Carbonate of magnesia | 2·0 |
| Per cent. | 42·0 |

He infers, "that as the steep-water dissolves out a great quantity of nitrogen and other inorganic materials of the stem; it removes from the plant almost everything the plant removes from the soil,"—consequently there can be no better manure, or more speedy restorative for exhausted flax ground than this very steep-water, and it is universally admitted by the most intelligent writers on agricultural subjects (such as Wakefield, Billingsby, Hodges, &c.) that it is also a valuable manure for grass and pasture land, well worth the trouble and expense of application.

I hope the time is not far distant when this truth will be more appreciated and acted upon. I may here remark, that pure *soft* water is the best for flax steeping, and that all waters having strong mineral qualities should be avoided.

Professor Hodges mentions ferruginous waters as particularly bad, and states that "the action of the salts of iron upon the modification of tannic acid in the flax straw is very prejudicial."

Some recommend that the steeping pools should not be shaded by trees, especially those possessing astringent properties in the leaves and bark, as these may be blown off, and, falling down, may stain the flax. The uncertain and unequal shade of the foliage is another drawback, consequent on the too immediate vicinity of these natural and graceful ornaments of our river banks.

It is a great advantage to have the pools cut in stiff clay, as such soil is not only more retentive, but is much cleaner than any other.

Bog water is generally not very favourable for the fermenting process, though frequently used; indeed, in some districts the watering or steeping operation is styled *bogging*.

Mrs. S. C. Hall favours us with an amusing conversation on this subject, in her work on Ireland, Vol. III. I must confess, however, the dialogue is not in true northern style, but evidently smacks of the racy south. "And why do you bog it, Larry, we inquired once of an old fellow who was reported to have 'a mightly lucky hand entirely about flax.' Is it why we bog it, dear? Why then you see we must all pass through the waters of tribulation to be purified, and so must the flax—the bad you see and the good, in that small plant, is glued together, and the water melts the glue, so that they divide, and that's the sense of it, dear."

It is desirable to allow the bundles of flax a short time to drain on the bank after being taken out, after which hey must be removed to the spread field. This of course should be nice meadow or grass land, mown close, so that the spreading may be done evenly and thinly, and thus permit the flax to derive the full benefit of the sun and air. A situation sheltered from storms is preferable to high ground, as the wind is apt to toss the flax about, and increase the difficulty of handling.

A necessary point to observe is to turn the flax over carefully after undergoing a few days' exposure, so that both sides may be bleached alike; this can be done effectively with a long slight rod, great care being used to avoid tossing.

About the same length of time is required on the grass as is occupied in the steeping process, namely, from 6 to 14 days; flax that is *under* watered will need a little *over* grassing to assist in correcting the deficiency, otherwise the period must be regulated by the state of the weather.

When the flax appears dry and brittle in the woody part of the stem, a handful or two can be tested by the scutcher, and, if approved of by him, it should at once be lifted very carefully, keeping the fibres as even and straight as possible; it should be tied up in a neat bundle, and either removed direct to the scutch-mill, or stacked, like grain, in some dry and open position. All artificial means of drying should be avoided, as the natural air is the only safe system, and as the grassing takes place about harvest time, good weather may generally be reckoned on.

Before closing this letter I wish to describe the "Courtrai system, already alluded to as the best when the saving of seed is the primary object of the agriculturist. Many, however, assert, that by this plan the fibre is *not deteriorated*, and certainly in the district which gives this system its name, the quality of the fibre is excellent. In this country the system is, perhaps, scarcely so successful as to fibre. When this mode of saving the crop is to be adopted, the flax after being pulled is at once tied up in bundles without rippling; these are piled up in long narrow "stooks," thinly put together, so as to obtain the full benefit of the sun and air. When dry, probably after a week's exposure or so, they may be collected into larger bundles or sheaves, and put up into ricks in the field or in an open stack-yard. During winter the seed is to be carefully taken off, and, under this mode of treatment, it is highly suitable for reproduction, or, if preferred, for sale to the oil manufacturers. Owing to the present state of our relations with Russia the supply of Riga seed ought certainly not to be depended on; it would, therefore, be not only politic, but, I think, quite remunerative, to rely more on our own resources, and to produce as much flax seed *at home* as would sow our fields and feed our cattle, independent of any such foreign supply. After the seed is taken off, the flax must be re-stacked or kept under cover till spring, when it can be watered, grassed, &c., in the same way as that saved in the common method, or it may be sold to some of the proprietors of the patent retteries, where the process of watering is performed on more rapid and systematic principles. The most prominent of these patents will require special consideration hereafter; meantime, in conclusion, I may state, that besides these many ways of treating flax after pulling, there is another system quite different, but now almost extinct in this country, namely, *dew rotting*. In some parts of Germany this mode of reduction is, I believe, still tried occasionally with coarse flax. The principle of the system is to omit direct *fermentation* in water, and to put the flax straight to the *grassing* process. The want of "the steeping" is, however, a *vital defect*, not easily remedied even by excessive exposure to the scorching rays of the mid-day sun, or the mellowing influence of the morning dew.

## AN EXAMINATION OF MR. ALFRED SMEE'S PAPER "ON THE SUBSTITUTION OF SURFACE PRINTING, FOR COPPERPLATE, IN THE PRODUCTION OF BANK NOTES." By Thomas Grubb, M.R.I.A., &c.*

It has for some time past been pretty generally understood that the Bank of England note, which for many years had resisted all visible change, was soon to undergo some important alterations and improvements. The nature of these has just been very fully communicated to the public, by the paper of Mr. Smee, read before the Society of Arts, on the 20th of December last, and published in their Journal for that month.

As the subject is in some measure one of general interest, and as the first published account of the new Bank of England note comes to us through the medium of a scientific society, I am led to conclude that those observations, which I feel at once desirous and to be of some importance to make on the subject generally, and also on Mr. Smee's peculiar views and conclusions, will not inaptly find a medium of publicity while being communicated to the present sectional meeting of the Royal Dublin Society.

In attempting an analysis of Mr. Smee's paper, a difficulty appears at first sight, arising out of its great length. It occupies upwards of 14 closely-printed columns. Four of these, however, are devoted to that art in the improvement of which Mr. Smee has long since distinguished himself, viz., electrotype; which process he puts into requisition for obtaining the fac-simile blocks used in preparing the form of the new Bank of England note. When I recollect those splendid specimens of electrotyped plates of the Ordnance Survey of Ireland, exhibited some years back in this room, (one of which would probably cover 100 of the tiny blocks used in the forms of the new note,) I feel there is no occasion to follow Mr. Smee through this portion of his paper.

Of its remaining ten columns much is occupied either by what may be termed the history of the subject, and of

* This paper was read at a late meeting of the Royal Dublin Society, and relates to the paper by Mr. Smee, read before the Society of Arts on the 20th of December, 1854, and published in No. 109 of this Journal, Vol. III., page 81.

Mr. Smee's proposed changes, or in minutely describing the manufacture of the new Bank-note paper, and the various manipulations and examinations which take place before it reaches the Bank, together with the sundry events which subsequently happen to it.

Perhaps I may be allowed, *en passant*, for the information of those who are not likely to read Mr. Smee's paper, to give a few particulars taken from this part of his description.

I shall premise that the note-paper, after an adequate amount of reckonings, transfers, &c., is at length printed; it thus becomes, as Mr. Smee describes it, a "perfect note." It is, however, still inanimate; it is yet to be born —not, however, as some might imagine, by being issued to the public, or even undergoing a change in its quiet position.

The event Mr. Smee describes as follows:—"These perfect notes are deposited in a place of security till life is given to them by being carried as a credit into the bank-books."

Mr. Smee thus continues his description:—"When it (that is the note) passes into the hands of the public, it is amenable to laws which are known to the authorities at the Bank. Each different denomination has a different average duration of life, like individuals in different cities, and some are never heard of again, like people who go to foreign lands and their fate ever remains unknown."

Should there be a difficulty with any one in understanding this poetical description, I may say that I believe it to mean simply—That different values of notes remain in circulation different lengths of time on the average.

The death of the note has an evident coincidence with its birth; it is thus feelingly described by Mr. Smee:—"When the note returns to the Bank, after inspection, it dies, never to be resuscitated."

Though the note thus suffers a very gentle death, it subsequently undergoes sundry post mortem amputations, which evidently render it quite unfitted for a second existence through fraudulent re-issue of any of the Bank officials. The registry of its death being taken by a system devised by Mr. Smee's brother, and in which we are told, "Those who are partial to the details of scientific book-keeping will discover many devices of interest."

I shall close my remarks on this fractional portion of Mr. Smee's paper with two observations. The first is—that I trust no one will infer either from Mr. Smee's paper or my abstracts, that arrangements equally effective with those rather ostentatiously described by Mr. Smee, have not, from the beginning, been adopted by other banks. My second observation here is, that while the details given by Mr. Smee of the management of the note paper and the printing, cancelling, &c., of the same, are such as any bank who print their own notes will wisely adopt for their own security, I cannot comprehend how Mr. Smee arrives at the conclusion announced by him in the same section of his paper, and in the following words:—"If we examine the note through its different stages we cannot help being struck with astonishment at the care which has been taken to protect the public from imposition." Nevertheless, and until I can find where the care for the protection of the public is provided for, in or by the sundry manipulations he describes, I trust he will excuse me, as also all others equally obtuse, from being in any degree astonished.

In proceeding with the more serious consideration of Mr. Smee's paper, it will be convenient to divide the subject into two parts, and consider firstly the adoption of the new water-mark paper, which, although no part of Mr. Smee's suggestion, is advocated by him as giving additional security, and secondly, to consider the adoption of surface or block printing, in lieu of copperplate, being apparently the suggestion of Mr. Smee for the printing of the new Bank of England note.

But for a reason, which shall appear by and by, I would at once admit that the new or shaded water-mark affords a small additional protection, mainly however to the bank, as enabling them to discriminate a forgery when other sources fail. To make it available to any party, each note in examination must be held separately up to the light, and I believe that the public will agree with me in concluding that they would be at once more conveniently and more efficiently protected by something suitable printed on the paper, which could be examined by being looked at, rather than something in the paper which can only be examined by looking through it.

To illustrate the peculiarity of this new water-mark, I exhibit a sheet of paper which came into my hands in 1851. It shows a combination of light and shade, similar to that in the paper now being used for the Bank of England note. A patent appears to have been obtained for this new water-mark; what the date of the same may be I do not know, but I would here observe, that the sheet of paper now before you contains not only some manuscript of the late Mr. Thomas Oldham, dated 20th April, 1851, but also the water-marks include the names of Thomas Oldham, as inventor, and Thos. H. Saunders, fecit.

The manner in which the moulds which produce such shaded water-marks are formed is interesting, and I give it in Mr. Smee's own words:—"The essential part of this process is the use of steel-faced dies, which are engraved with the desired pattern, after which they are hardened by being heated in leather charcoal, and then suddenly plunged in water. These dies are used with copper or tin forces in a stamping machine, to give an impression upon plates of sheet brass, and these plates, when embossed, are filed on the back to the requisite proportions to allow the moisture of the pulp to pass through the apertures. The different pieces of brass, when struck, filed, and put together at the paper-mill by Mr. Brewer, form the mould for the paper, and are so arranged that each mould is designed for two pair of notes."

Mr. Smee then claims, as great advantages attending the use of the paper made from such moulds, "identity in the water-mark," besides being "specially adapted to give gradations of tints, lights, and shades," and next proceeds to eulogise the advantages which the mould-maker has derived from this new method of making his moulds. I again quote from Mr. Smee's paper—"If we contrast this simple and elegant method of mould-making with that previously adopted, the difference is sufficiently striking. In a pair of five-pound notes, prepared by the old process, there are eight curved borders, 32 figures, 168 large waves, and 240 letters, which have all to be separately secured by the finest wire to the wave surface. There are 1056 wires, 67,584 twists, and the same repetition where the stout wires are introduced to support the under surface. Therefore, with the backing, laying large waves, figures, letters, and borders, before a pair of moulds are completed there are some hundreds of thousands of stitches, most of which are avoided by the new patent. Moreover, by this multitudinous stitching and sewing the parts were never placed precisely in the same place, and the water mark was consequently never identical."

Now I have a very strong opinion that this new method of making moulds, &c., is likely to produce a result exactly contrary to that which Mr. Smee anticipates.

Mr. Smee appears to forget that that which gives additional facility to produce the legal mould also gives the same facility to produce the illegal. A patent here is of no avail, while the process is highly favourable to the forger. There is no necessity that he should use steel-faced dies, brass or even hard wood will be adequate to his purpose; neither will he have to use pieces of brass for the shaded portions. I find, from direct experiment, that he has only to strike the wire web of the mould with suitable boxwood stamps to produce the required corresponding shades in the paper. So far from any additional difficulty being thrown in the way of the forger, I expect he will consider the new mould, so far as shading is concerned, to be quite a boon in his way, and that he will rejoice in getting rid of a large portion of the multitude of

stitches of the old mould, quite as much as the paid legitimate maker.

Mr. Smee urges a claim to additional identity in the new water-mark paper. Now so far as the shaded parts are concerned, identity, if obtainable, cannot be appreciated, and is therefore useless: and, for the other parts, the undefined character of any water-mark as seen in the paper, is such that taken in connexion with the unavoidable unequal contraction of the paper in the manufacture, it renders nugatory any greater amount of accuracy in a paper mould than can be readily attained by the imitator.

I am thus led to the following conclusions with respect to the new method of making moulds with shaded portions, and letters and devices for the same, viz.:—

Firstly—That letters, and other such devices, being more readily prepared by the new process, it follows that the multiplying such on the surface of the paper mould will in future be of less hindrance to the forger than formerly.

Secondly—That shaded figures or designs are so readily formed in the web of the mould by pressure from wooden blocks that no trust should be placed in such devices.

Thirdly—That from henceforth we should trust less to the water-mark as a test of the genuineness of a note, and consequently it is of increased importance that some portion of the printing should afford an adequate protection against forgery.

I now proceed to grapple with the second division of the subject, viz., the consideration of the substituting surface printing for copperplate in the production of bank notes.

The advantages which Mr. Smee assumes as the result of such substitution are—

Firstly—Increased facility and rapidity of production.

Secondly—Increased economy in production.

Thirdly—Printing effected on dry instead of damp paper.

Fourthly—Identity of subject or matter printed.

I should here state that the advantages assumed by Mr. Smee for his system are not thus classed by him. They have been collected from a general perusal of his paper, and are collated as above for the convenience of reference in examination.

The three first of these heads include what may be termed resulting advantages, and will be seen to be of minor importance. The last, or fourth head, is Mr. Smee's foundation stone of improvement, and that on which he builds his recommendation for and defence of change.

Now, with respect to "identity," of the high importance of which I am fully aware, I am prepared to show by-and-by that Mr. Smee has based his recommendation for change upon a false assumption, and I assert, and am prepared to prove, that in accomplishing a change from copperplate to surface printing, for the production of the Bank of England note, he has only introduced one system possessing identity to the rejection of another possessing the same quality, and in as high a degree.

And, with respect to the remaining or less important advantage of Mr. Smee's assumed advantage for his system I shall shew, by a very few figures, derived chiefly from his own paper, of how small importance even abstractedly considered, these are, at least so far as the Bank of England note is concerned. The daily required quantity of notes Mr. Smee states to be 30,000. This has been done lately on the old system, and with the old machinery, say by — 8 presses and 24 attendants, or it could be done with improved presses, using the old system of printing and working seven hours daily, by six presses and twelve attendants; or, if printed from surface blocks, or on Mr. Smee's system, it would require two presses and twelve attendants. So far, therefore, as the printing is concerned, there is no greater necessary difference than that of six machines and twelve attendants, against two machines and eight attendants, which in such extensive operations is surely not of that magnitude which should stand in the way of adopting that system which in other respects can be shown to be the best.

To prove my assertion, that Mr. Smee has based his recommendation for change upon a false assumption, I shall begin by giving a very concise description of a process which, although neither the process itself, nor the name of the person who introduced its use at the Bank of England has been once alluded to by Mr. Smee, I cannot think it possible that he is ignorant of.

If we take a block of steel in the soft state, prepare at least one of its surfaces flat and smooth, and engrave a design on that surface, we can, by adopting certain precautions in the hardening process, make the block or die perfectly hard, and, at the same time, preserve the engraved surface from injury. If we next take a cylinder of soft steel, prepared with suitable turned bearings or axles at either end, and place it in a frame or carriage in which it can be made to revolve on its own bearings, and, placing both die and roller in a machine adapted to the purpose, roll the soft smooth cylinder to and fro over the hard engraved surface of the die, using adequate pressure, we shall obtain on the surface of the roller a highly perfect reverse, in relief, of the subject engraved on the die, and without any injury to the latter.

The roller being next hardened with similar care to that previously used with the die, it (the roller) supplies the means of engraving, using the same combination of rolling and pressure as before described, a large number of fac-similes of the subject engraven on the die plates or surfaces as may be desired.

This is, in short, in principle the same as the method which, many years ago, was applied to engraving the copper cylinders used in the finer descriptions of calico printing, and it is that process which was subsequently applied in America, and in England by Perkins, and at the Bank of Ireland, and subsequently at the Bank of England by Oldham, to engraving portions at least of the bank-note plates.

I have looked carefully over Mr. Smee's elaborate paper without finding any reference to this process, while the only mention I can discover in it of the manner in which the note plates of the Bank of England have been engraved is contained in the following sentence, in which the date referred to is that of Mr. Smee making his suggestions for a change, viz., 1851. The words are as follow:—"Heretofore the notes and cheques of the Bank of England had invariably been printed from copper and steel plates, in which the lines were engraved or cut into the metal."

By this description hand engraving must be understood, and there is nothing in it descriptive of machine engraving, which acts, not by cutting or removing matter, but by a combination of rolling and pressure.

It is now fourteen years since I became acquainted with this method of engraving, previous to which it had been in use for engraving the vignettes and some other parts of the note plates of the Bank of Ireland, and had been used by Oldham for engraving a portion of the Bank of England note plates. I soon saw that the method was capable of extension, and that, with improved machinery, all parts of the note plates, including the writing, could be by it engraved. This has been done as opportunity presented itself, and as a proof of the capabilities of the system to produce identity, I may instance the present form of one pound note of the Bank of Ireland, now in circulation for five years without a single forgery appearing. The same note-plates, refreshed from time to time, as required, by the same engraving rollers, retain their identity from year to year, dot for dot, line for line, each plate so identical with the rest of the series that but for the number of the plate, which is the only part engraved by hand, there would be no means for telling from which of the several plates in use any one individual note was printed; and so rapid and certain is the process that a subject can be either engraved, or when required refreshed, in probably as many minutes as it would require days by

the electrotype process to produce a corresponding block suited to surface printing.

Lastly, this is a process which, together with the person who introduced its use in the Bank of England note plate, and the son who succeeded him in its use, and who must have played an important part in the production of the shaded watermark, Mr. Smee has thought fit, for good reasons no doubt, to be totally oblivious respecting. In bringing the subject to a conclusion, I propose to make a few general remarks, which, it will be seen, chiefly apply to the economic production of bank notes.

In a former part of my paper I have granted that, abstractedly speaking, Mr. Smee's plan of printing notes had an economic advantage. I now come to consider the question of economic production in a general manner, and here a principle of very extensive application presents itself, viz., that in the production or manufacture of a complex or compound article, if the desired degree of excellence can be arrived at by a modified excellence of the component parts, it is, in such case possible, that the economic production of the complex article may be much affected by a judicious tempering of the qualities, &c., of the several ingredients which form the whole.

The bank note is a striking illustration of this theorem; it is composed essentially of two ingredients, viz., the paper and the printing. The intrinsic excellence consists in the non-liability to fraudulent imitation, and the required amount of excellence may be derived either from the paper or printing, or in part from each of these.

By pushing our economic analysis a step further, we find a striking analogy to exist in one respect between these two ingredients, viz., that the mould in which the paper is formed, and the plate or surface used in printing, are not only the great sources from which we derive the desired respective amount of excellence, but they are also of merely nominal expense, for we can obtain from a quarter to half a million of sheets of paper from a pair of moulds, and a similar number of notes, using occasional repair, from one note plate.

The analogy, however, ceases here, for while every addition to the water mark brings with it a serious addition to the trouble and cost of manufacture of the paper, any addition, either to the quantity or quality of the matter on the engraved plate, scarcely affects the cost of printing.

Such general principles clearly indicate that for economic improvement it is to the printing and not to the paper of the note that our energies should be directed.

The Bank of England note, previous to Mr. Smee undertaking to improve it, had for many years remained a striking illustration of anti-economical principles. It had, however, the advantage of being printed by a system which left it open to improvement, and I think it quite within bounds to assume that had, at this time, a sum of £50 been judiciously expended in providing a suitable vignette or device, and combining that with the note, 50 times £50 might have been saved annually in the item of paper, and, at the same time, additional security against forgery given to the note. However, Mr. Smee has taken an opposite course, and, by adopting a completely different system for printing the note, he has effected two very important things, whether important for good or evil, time will tell. Firstly, he has rendered it more than ever necessary to retain the use of a highly expensive paper for the Bank of England note, and thus put a seal upon the possibility to its economic improvement, only to be broken by a fresh revolution in the machinery of the Bank and the system of printing the note.

Lastly, by the introduction of type or surface printing he has involved the necessity of using an ink which, so far as I can learn, is necessarily of a quality well adapted to be transferred and used, according to the lithographic process, for printing fac-similes of the genuine notes in lithograph; and when it is recollected that the impressions from type or surface printing are of a character very closely resembling lithographic impressions, it would appear that Mr. Smee's vaunted alterations are not yet to be classed as improvements.

## Home Correspondence.

### REVIEW OF MR. MUIR'S PAPER ON THE SMOKE NUISANCE.

By C. W. Williams.

Sir,—Mr. George Walker Muir having, at a meeting of the Society, read a paper "On the Smoke Nuisance, considered Morally, Historically, Scientifically, and Practically," it now remains on record in the Society's Journal for public use and comment. From so comprehensive a title it might naturally be inferred that the author was fully conversant with the subject—was acquainted with all recent improvements, and with the most advanced state of information in connexion with it.

Under this impression I examined Mr. Muir's paper with attention, the more so as I had myself, during the last twenty years, been engaged in considering the subject scientifically—by reference to the highest authorities; and, practically, on the largest scale in connexion with the land and marine boilers in the steam vessels under my direct control. Besides, that I had recently published a treatise on "The Combustion of Coal, Chemically, and Practically Considered," with the view of showing that the system hitherto adopted in our furnaces was essentially erroneous.

The smoke nuisance having engaged much of the public attention, and having become the subject of a recent parliamentary enactment, (16 and 17 Vic., Chap. 128,) had a legitimate claim on the Society of Arts as a medium for obtaining and disseminating useful information. Among those who consider themselves competent to instruct the public, through the Society, Mr. Muir presented himself, professing to examine the smoke nuisance, "Morally, Historically, Scientifically, and Practically." On the two first heads of his treatise I will here offer no remarks. To the two latter alone the following observations will be directed:—

Mr. Muir states, that "his enquiries have extended over a period of several years, and have been directed to the ascertaining the truth, rather than to the discovery of any hitherto unknown mode of smoke-burning or prevention." This direct reference, *in limine*, to what may be considered the prevailing impression, or rather error of the day, naturally led me to anticipate a scientific examination of the theory or doctrine of *smoke-burning*, in the pursuit of which so many patents have recently been obtained; together with the grounds, chemically considered, on which such an averment had been based.

Although Mr. Muir has professed to examine the subject scientifically, he appears, throughout, to have ignored its dependence on, or connexion with, that branch of science—chemistry, on which, however, the whole depends. Indeed, he actually sums up by saying, "once more I have to repeat that the smoke nuisance involves the consideration of *dimensions*, not inventions," meaning, the sizes and areas of the several parts of furnaces, flues, and chimneys. This is virtually assuming that the effective combustion of coal is within the department of *mechanics*, and not of *chemistry*. That the ignoring chemical considerations, and looking for a remedy for the nuisance to the *dimensions* of furnaces is a deliberately formed part of Mr. Muir's theory, may further be inferred from his opinion given in a recent letter to the Institution of Civil Engineers, to the effect that too much attention had been given to chemistry and chemical considerations, and that such only tended to render the subject more complicated. Now, I at once join issue with Mr. Muir, and assert that the smoke nuisance and its abatement involves mainly, if not exclusively, the consideration of chemical details, processes, and products. The reducing these to practice being that which necessarily belongs to all physical operations, namely, the character of the vessels in which such processes are to be carried on. In reviewing Mr. Muir's treatise, a few

words on the scientific branch of the inquiry must here, therefore, have precedence.

Effecting the combustion of fuel so as to avoid the creation of the smoke nuisance, involves the bringing together and effecting the chemical union of certain portions of the constituents of the fuel and atmospheric air. These constituents are—hydrogen and carbon from the fuel, and oxygen and nitrogen from the air. Now, if the bringing these together, ascertaining the due quantities of each that enter into union, examining their respective characteristics and affinities, and the mode of affecting that chemical union from which heat is involved, be not within the department of chemistry rather than mechanics, the very term, *chemistry*, may be at once expunged from our scientific nomenclature.

In examining Mr. Muir's paper, I find he has been carried away by the once common impression, that all coloured vapours, particularly those arising from the use of combustible bodies, were *smoke*. Such an impression was, no doubt, pardonable, during the last century, and when we knew no better. Before the nature of combustion or combustible bodies was understood, or the very term *gas* had any defined meaning in our language—our great lexicographer, even describing it as "a word invented by the chemists, and as seeming to signify a spirit not capable of being coagulated."

That so unsound, and, as we may now say, so absurd a doctrine respecting smoke should be seriously entertained in our day, would be as if we considered the labours of Dalton, Davy, and the other great luminaries of science, as but the reveries of the alchymists; and, as though we were thrown back on the age when air, earth, fire, and water, were taken as the sole elements of nature. Indeed, nothing can be more illustrative of the prevailing neglect of chemical science, or its practical application on the part of smoke-burning theorists, than the very existence of the controversy in question, namely, whether smoke be a combustible or an incombustible—in other words, what is smoke?

The theorists of the present day (among whom Mr. Muir appears to take a prominent part) assert, and, with the assumed aid of "scientific and practical" experience, that the coloured vapour, generated from coal, when subjected to heat in a furnace or retort, *is smoke*, and not *gas*, and that *gas is purified smoke*, as Mr. Muir asserts.

Another leader among the smoke-burning theorists, and who also addressed the Society on the occasion of Mr. Muir's paper being read, was Mr. Woodcock. In support of this theory, that gentleman ingeniously imagines two kinds of smoke, viz., *parliamentary* smoke and *true* smoke. In a recent letter in the *Mechanics' Magazine* he has thus described these two species of the genus smoke. "First, parliamentary smoke (or smoke as popularly understood), that is, what a furnace fire, covered with small coal, and smothering all flame, emits." This reference to *popular* impressions is rather an odd mode of deciding a chemical issue, and the more so as it should be the peculiar office of science to correct and remove popular errors, rather than to adopt and perpetuate them.

What Mr. Woodcock has here described is practically subjecting coal to a distillatory process, as in the retorts of the gas works. This inference, then, that what is generated from coal in the furnace is *smoke* and not *gas*, might be allowed to pass, were it not that even the most palpable errors, when once promulgated, are too often adopted by the mass of the community, who will not examine or think for themselves.

Mr. Woodcook continues—"There is also another substance, let us call it *true* smoke. Mr. Williams says [Mr. Woodcock in justice should have added, "in common with all writen authorities"] that this is the result of imperfect flame [imperfect combustion], and consists, for the most part, of steam, carbonic acid, and nitrogen, and minute portions of carbon in suspension. It is admitted that the two gases [and the steam] are incombustible." Now this mere enumeration of these incombustible elements of "true smoke," one might have thought sufficient to correct the errors of the most inveterate smoke-burners.

Another of the theorists who insists that smoke can be burned—in other words, that it is a combustible—is Mr. Charles Blashford Mansfield. In a letter inserted in the *Mechanics' Magazine*, and in support of Mr. Woodcock's views, Mr. Mansfield gives the following notable illustration of the grounds on which he forms his faith, in asserting that what all the world knows to be and calls gas, is not gas, but is—smoke. He observes:—"If any of your readers still believe that smoke cannot be burned, that is to say, for practical purposes, or consumed, he may satisfy himself by the following child's experiment. Let the bowl of a clay tobacco pipe be filled with coal powder, luted over with clay, and put into the fire in a common hearth. Let the nearest child or adult, of either sex, (how impartial an experimentor) be asked, "what the fumes are which will soon be seen issuing from the tube end of the pipe? He, she, or it, (or it!) will answer—*Smoke*. Let a lighted candle then be applied to it. I tried this experiment when I was an occupant of the nursery." Without meaning to be offensive, one is here tempted to ask whether such an opinion be not a sufficient qualification for an occupant of the nursery—at least of chemistry.

To bring this theory, however, to the test, I have, though in vain, inquired of these public instructors, if those vapours which issue from the pipe, or the fresh charge of fuel in the furnace, be smoke, *what then is gas?* Mr. Muir alone has had the courage to reply, manfully asserting that "Gas is purified Smoke." Now the question put is a purely scientific one, and admits of no personal feeling, and should not have been evaded by any writer professing to treat the subject scientifically.

On this I may here quote the observation of a competent witness, Mr. James Newlands, engineer to the Corporation of Liverpool, and who, in his last annual address as President of the Polytechnic Society, observes:—"The subject of smoke prevention has long occupied the attention of this society. So early as 1842, it was fully discussed. The looseness and inaccuracy of the expression 'Smoke Combustion,' has been properly animadverted on, and I wonder that it should ever be used by any one who knows the meaning of words, yet used it is, and has done an immensity of harm, having sent many on the search for that which is as visionary as the discovery of the perpetual motion." In his paper, Mr. Muir, I regret to find, although professing to have examined the subject scientifically, adheres to the error of mistaking gas for smoke, and then adopts the inference, that "smoke can be burned."

Mr. Muir, having given his essay so prominent a title and character, and having brought it before the society with so high a degree of pretension; having also introduced my name and treatise apparently for the purpose of contradicting the facts and statements there given, though shown to be in common with the highest chemical authorities of the day, I feel bound in justice to the Society and to the public, to make this review of his paper.

In considering this question, and its bearings on the Smoke Nuisance, it is manifest we should first understand what we are discussing—in a word, that we should know and determine *what smoke is*, before we can be in a position to say how it is produced, treated, consumed, or avoided. Again, that we should steer clear of the existing confusion in terms, and distinguish gas from smoke, otherwise, discussion would be a mere waste of words. For this purpose I will examine the several points insisted on by Mr. Muir.

1st. At page 138 of the Journal he observes, "As the burning of smoke is the consumption of the carburetted hydrogen gas evolved from the fuel, it follows that the product of that combustion will mainly be the same as that from the gas in our houses." Here is confusion worse

confounded, inasmuch as smoke, in the above passage, is taken as tantamount to carburetted hydrogen gas,—in other words, it means that the consumption of carburetted hydrogen *is* the combustion of carburetted hydrogen; for if, as he observes, the burning of smoke is the consumption of the gas, so, *vice versa*, the burning of the gas is the consumption of the smoke. This, however, is but trifling with the subject, while it has this disadvantage, that it is but leading the public and Mr. Muir himself away from the true merits of the question.

2nd. Mr. Muir observes, "I am sorry to differ with Mr. C. W. Williams when he says, it is impossible to consume smoke when once formed. *It can* be consumed. By that I mean that the *gas, vapour, or smoke, or whatever else it may be called*, which, whenever formed and permitted to pass through the flues and chimney into the air, the *constables* will call smoke." Here, then, the constable is to decide whether that which issues from the coal be gas, vapour, or smoke, Mr. Muir himself appearing undetermined, or unable, to say what it is.

Now, instead of taking the constable as an authority, had Mr. Muir referred to those writers who have so elaborately entered on the inquiry, and have given details which admit of no doubt or controversy, he would have found that "the gas, vapour, or smoke, or whatever else it may be called," had been thoroughly examined and described by the ablest chemists of the age, and admitted of no uncertainty whatever.

3rd. With reference to the assumed combustibility of smoke, an important point for consideration is here raised, viz., what is the quantity or weight of this finely divided, uncombined carbon, in any given volume of smoke?—for on this depends the question of economy in effecting its combustion. It would occupy too much space here to shew that, compared with the great volume of admitted incombustible gaseous matter escaping by the chimney, it is utterly insignificant, even if it were possible, which it is not, to separate and collect it. It will only be necessary to observe that whatever may be the amount of this carbon in the smoke, say from a ton weight of coals, it must go off, in company with, and intimately diffused through, the 400,000 or 500,000 cubic feet of those incombustible gaseous matters which form the products of combustion in the furnace. These products are as follows:—

1st. *Steam* (in enormous quantities), though, from the circumstances of its being invisible, remaining unnoticed by ordinary observers. This steam arises from the combustion of the hydrogen of the gas, and is equal in quantity to what would be produced by the vaporation of no less than half a ton of water, or say, half the weight of the coal used.

2nd. *Nitrogen* (also in large quantities,) being the incombustible part, or 80 per cent. of the air employed, after it has parted with its oxygen.

3rd. *Carbonic acid* (also in large quantities,) arising from the combustion, first, of the solid or coke portion of the coal on the bars; and secondly, of so much of the carbon of the gas as may have obtained contact with the air, and have entered into combustion.

4th. *Carbon*, in the purely divided state in which we see it collecting on the wick of a tallow candle. This, as to quantity, involves just so much of the carbon of the gas as had *not* obtained contact with atmospheric oxygen before its temperature had been reduced from its incandescent state, in flame—and, therefore, not entering into combustion—had returned to its state of black pulverulent matter as seen in soot or smoke.

Here we have all the elements of the coal and the air accounted for. Whatever then may be the colour or constituent of the smoke, it is manifest that we cannot dispense with the inconvenience and presence of the three first named products from the furnace, and their enormous volume—namely, steam, nitrogen, and carbonic acid, all of which are incombustible.

On this point Professor Brande's statement is conclusive. "The throwing jets of air into the inflammable gases and vapours which constitute so large a part of the matters which, in many ill-constructed fire-places and furnaces, escape by the chimney, with the *finely divided carbon or black smoke*, renders them available as sources of heat; and where that system is perfectly applied, the smoke can consist of very little else than carbonic acid, steam, and nitrogen—all incombustible, and also incapable of supporting combustion." Here we have text and context of what regards the elements and combustibility of smoke; the same illustrations being found in all chemical works of authority. Why, then, have not Mr. Muir and the smoke burning theorists sought for information in the proper quarter, and where no doubt can exist, and thus disembarrass both their own minds and the subject itself of the difficulties under which they labour, rather than relying on the mere sayings of ignorant firemen in the stoke room—of the "occupants of the nursery," or the metropolitan police?

4th. With reference to the quantity of carbon contained in smoke, Mr. Muir and the public are under great misapprehension when they speak of its being possible to consume it. Instead of being a mass of combustible matter, as the eye would lead us to believe, the amount that exists in any cubic foot of it, though comprising countless myriads of atoms, would not, *in weight*, be equal to that of a pin's head. Are we not justified then in calling for proof, either of the combustibility of the mass itself, or the economic value of such carbon, were it even separated and again employed as fuel? Yet, on the mere presence of this comparatively insignificant portion of combustible matter (but which ought not to be there) depends the theory that "*smoke can be burned*;" for, if the gas issuing from the fresh fuel in the furnace be properly supplied with air, (and as I have myself shewn to Mr. Muir,) there would be no more of this visible carbon in existence in the furnace or chimney than in the argand gas burner. With equal propriety, then, might it be said, that water was a combustible and could be burned, seeing that it contains hydrogen, or, that carbonic acid could be burned, seeing that it also contains carbon.

5th. Mr. Muir observes, "When we attempt to acquire a knowledge of the combustion of fuel and the prevention of smoke, we are bewildered by the variety of means advanced on various branches of the subject." Yet, how could it be otherwise, seeing, as already observed, that application for correct information on the subject has not been made in the right quarter. Let Mr. Muir be assured that there is but one way of avoiding the bewilderment of which he complains. Let him take up the work of any of those living authors who have treated on the combustion of fuel and the characteristics of coal gas. Let him study it until he is master of the subject, and he will then find that, instead of confusion, all is order, perspicuity, and certainty. Chemistry is an exact and positive science. It is, however, only to be learned, and practically applied, like other sciences—namely, by study and experiment.

6th. Mr. Muir observes, "We see it asserted by one authority, with a great array of chemical knowledge, that smoke is incombustible, and if once formed cannot be consumed." Does Mr. Muir mean the work of Mr. C. W. Williams, or the array of authors of unquestionable authority there referred to, viz., Brande, Faraday, Davy, Ure, Kane, Reed, Turner, and numerous others. Let him study them, or any of them, before he assumes the professor's chair, to teach the Society of Arts, or the public through them, as to what belongs to the generation or combustion of carburetted hydrogen and its constituents; to their union with the constituents of atmospheric air, and to their required temperatures, all of which are introduced into his paper, and treated as if no authority existed in reference to them. Let him thus qualify himself before he can be in a position to assert that "much learning has been thrown away on the subject," or satisfy the public that, in effecting the perfect combustion of combustible matter it is not the quantities, affinities, and

other processes to which they are to be subject, that demand our attention, but the "dimensions" of the vessels in which those processes are to be carried on.

7th. "Smoke," says Mr. Muir, "as it appears to the eye when issuing from a factory chimney, is a compound of soot, dust, steam, and gas, of the same description as is distributed and produced by the gas companies." According to this dictum, that which issues from the chimney, and what is distributed by the gas companies, are identical. Is this given as a sample of the amount of knowledge that justifies a man for discussing the subject "scientifically and practically." Is "the eye" to be the test on such chemical subjects, or on one of the most complex operations of nature, namely, the production of heat and light from combustible bodies? and are we to be gravely informed that what we burn in our apartments and purchase from the gas companies is "a compound of soot, dust, steam, and gas?" If this is to pass as the qualification test of a public scientific instructor on the combustion of coal and the cause of the smoke nuisance, it is manifest that the chemical schoolmaster, at least, is not yet abroad.

8th. Mr. Muir continues—"If the first, or sooty portion, be removed, the public will be satisfied." But who is to decide what that sooty portion is? what brought it there? and how it is to be removed? It is clear Mr. Muir himself has not made up his mind on any one of these points. "Cure me," says the patient to his doctor, "but never mind inquiring into the nature or cause of my complaint—that would only 'complicate' the matter." No doubt the public would be satisfied if the evil were removed. The question, however, here is, how is he who undertakes the remedy to proceed, until he first understands the cause and character of the evil? And does not this open the very question of chemistry?

9th. Again he adds—"The smoke which affects the public is mainly composed of hydrogen and such portions of carbon as are thrown off with it." Having already shown in detail what the smoke is composed of, and as laid down by the highest chemical authorities, it is here only necessary to add that Mr. Muir's statement is altogether erroneous.

10th. Mr. Muir goes on to speak of the "conditions of combustion;" of the "subjects of combustion;" "of the necessity for bringing them into contact;" "of the heat required for their ignition;" of the "results of imperfect combustion;" and instead of "an array of chemical knowledge," he gives an array of assertions, though on purely chemical processes, not only without reference to a single authority beyond that of the constable, but many of them in direct opposition to all known and reliable authorities. Nevertheless, we find him condemning the "array of chemical knowledge" on the part of others, although such knowledge was given as extracted from the works of the ablest chemists of our day.

11th. Mr. Muir states that "the two leading assertions of Mr. Williams are, 'smoke once formed cannot be burned in the same furnace; and that for its prevention, the air must be admitted in thin films or in thinner jets." On this he peremptorily asserts, "Smoke may be consumed, and its prevention is not affected by the admission of air above the fuel, whether in one volume or in many small ones," although he had just stated that "no doubt the more complete we can mix the air and the gases, the more completely will be the combustion." Does Mr. Muir not see that this very intimate mixing, and which he recommends, involves the whole question of effecting complete combustion? Indeed, I might here refer to the numerous patent *re-inventions* lately obtained for effecting combustion without smoke, the basis and principle of which is the effecting this very mixture with due rapidity, and causing the air to enter "in many small volumes," by the use of the perforated apparatus, in direct imitation of the mode pointed out in my treatise.

Having already occupied the limits assigned to me in your Journal, I am necessarily obliged to conclude, hoping, however, that I may be permitted to continue this review, seeing also that I have still many unsupported assertions of Mr. Muir to notice, as also to point out the direct connexion between perfect and imperfect combustion, and the existence of the smoke nuisance.

I am, yours, &c.
C. W. WILLIAMS.

Liverpool, February 12th, 1855.

## THE DISCUSSION AS TO WATER SUPPLY.

SIR,—In reference to the discussion contained in your number of the 2nd instant, after the reading of the paper on "The Chalk Strata Considered as a Source for the Supply of Water to the Metropolis," wherein I partly described the gauge for ascertaining the annual depth of rain sinking into the ground, used by Mr. Dickenson at Apsley Mill, near Hemel Hempstead, Herts, I notice a letter in your last number of the 16th inst., from Mr. John Evans (Mr. Dickenson's partner), in which, among other things, Mr. Evans states "that no peat was mixed with the soil with which the gauge was filled, and through which the rain percolates," &c.

That your readers may be in a position to judge for themselves, between my statement respecting this gauge and that of Mr. Evans, I herewith enclose you a drawing, (see woodcut, page 245,) showing the sectional elevation of the gauge alluded to.

This drawing was made in 1852, for a Committee of the House of Commons, from memoranda in the possession of and under the direction of Mr. William Long Tyers, an intelligent mechanic, who was in Messrs. Dickenson's employment as foreman of Apsley Paper Mill, and as overlooker of machinery in Messrs. Dickenson's paper mills for 17 years, namely, from July 1832 to July 1849.

The gauge was constructed, filled, and fixed for Mr. Dickenson, in the year 1835, by Mr. Tyers himself, and Mr. Tyers, some years after the gauge was made, took an account of, and registered the amount of water passing through it.

By referring to the woodcut you will find that a stratum of peat, two inches thick, is placed between the soil and the top of the gravel that covers the chalk, as stated by me, and reported in your Journal of the 2nd instant, page 181.

In 1852, I had occasion to have the guage examined. At that time a sixpenny piece could be passed at the top between some of the joints of the wood of which the body of the gauge was made.

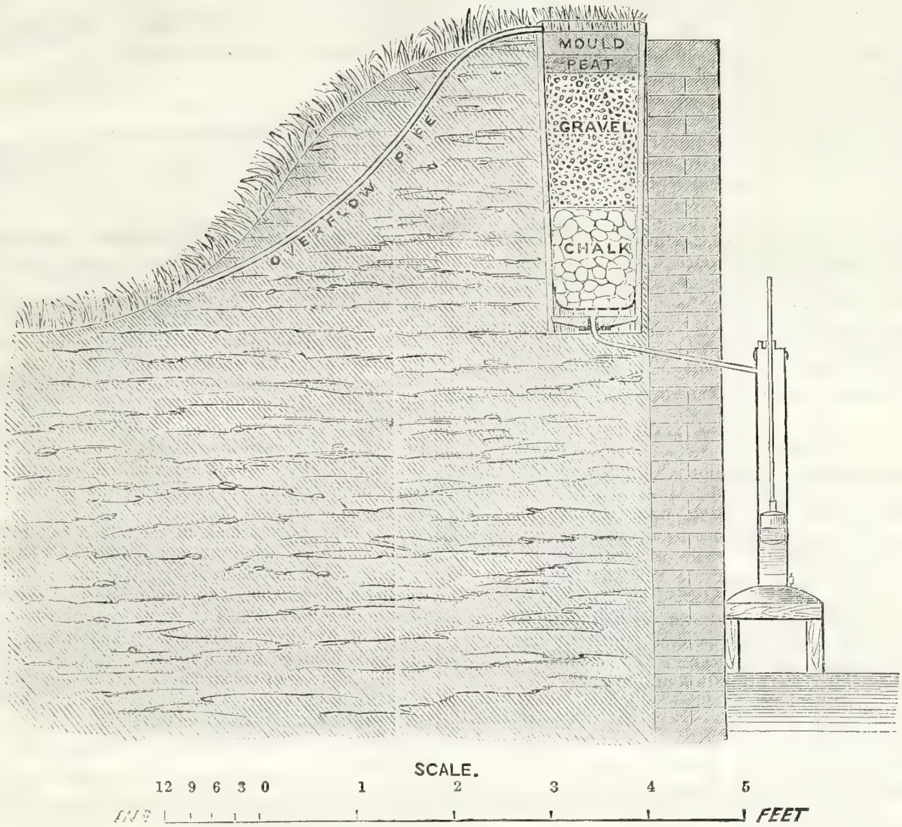
In Rees' Cyclopædia, article "Evaporation," the construction of a gauge by Mr. Hoyle and Dr. Dalton, of Manchester, of which Mr. Dickenson's is an imperfect imitation, will be found thus described:—

"They took a cylindrical vessel of tinned iron, ten inches diameter, and three feet deep; there were two pipes soldered into it, one at the bottom, the other at the top, for water to run into the bottles. The vessel was filled with gravel, sand, and soil, and subsequently the soil was covered with grass and other living vegetables. It was nearly buried in the ground in an open situation, and provision made for placing bottles to the two pipes; in this manner it was exposed to receive the rain, and to suffer evaporation from the surface, the same as the surrounding green ground. A regular register was kept of the water which percolated through the soil and gravel into the bottles, and a rain gauge of the same surface was kept close by, for the sake of comparison."

Thus Dr. Dalton made the body of his gauge of metal, and a bottle was placed to catch the water from the overflow pipe, as well as from the body of the gauge; while Mr. Dickenson made the body of his gauge of wood, and omitted to place a bottle to catch the water from the overflow pipe.

That no dependance can be placed upon the results given by such a gauge, even when well constructed and properly used, has long since been known. On this subject I would refer to a paper read by Mr. Bateman, C.E.,

SECTIONAL ELEVATION OF THE GAUGE USED BY J. DICKENSON AND CO., AT APSLEY MILL, HEMEL HEMPSTEAD, HERTS, 1852.




before the Philosophical Society of Manchester, on the 6th Feb., 1844. The paper is published in the 7th vol. of the 2nd series of "The Memoirs of the Literary and Philosophical Society of Manchester."

It is self-evident that such a gauge as Mr. Dickenson's can no more be said to represent the infiltration of rain through chalk than through gravel or peat. Snow falling on such a gauge would be blown away, while the melting of snow gives a large supply of water to the chalk formation. Experience proves that observations must be made over extensive tracts of land of different geological formations, and not upon a surface of soil about the diameter of a good-sized flowerpot, to enable us to ascertain what proportion of the rain sinks into, or flows off, the various kinds of rock.

Mr. Evans states in the same letter, that "by gauges constructed for the purpose of ascertaining the quantity of rain-fall that percolated to the springs, it was found that on an average of 19 years, out of an annual rain-fall of about 26 inches, less than 9 inches descended to a depth of 3 feet below the surface; and that, taking this quantity as percolating to the springs throughout the area of the gathering ground of the river Gade, above Hunton-bridge, it gave, by calculation, a supply of water that coincided as nearly as possible with the actual average flow of the river at that point." I have just shown that Mr. Evans's assertions are to be received with great caution. When all the details upon which this "calculation" is founded are given to the world, I will undertake to test its value. At present I have good reason for disagreeing with this statement.

In further confirmation of the statements made in my paper, the following practical illustrations of the large amount of water that can be derived from the chalk strata, may interest your readers.

Messrs. Dickenson and Evans have five paper mills upon the rivers Gade and Colne. Owing to the large amount of pure water obtained in 1840, by Mr. Paten, from four small bore holes sunk in the chalk strata, at Bushey-meadows, near Watford, by order of the late Marquis of Westminster, then chairman of a Committee of the House of Lords, sitting on the supply of water to the metropolis, Messrs. Dickenson, in 1843, employed Mr. Paten to sink a bore hole for them into the chalk at one of their mills called Home-park Mill. This bore hole is 10 inches diameter at the top, and 6 inches in diameter at the bottom, and 230 feet deep. From this bore hole, since 1843, Messrs. Dickenson have constantly raised more than 450,000 gallons per day.

In 1845, Messrs. Dickenson employed Mr. Paten to put another bore hole at one of their mills, called Apsley Mill. This bore hole is 10 inches diameter, and 205 feet deep. From this bore hole 250,000 gallons of water per day have been raised ever since.

In 1845, Messrs. Dickenson employed Mr. Paten to put in another bore hole at another of their mills, called Nash Mill. This boring is 11 inches diameter at the top, 6 inches diameter at the bottom, and 210 feet deep. From this bore hole 450,000 gallons of water per day have been raised ever since.

In 1848, Messrs. Dickenson again employed Mr. Paten to put in a bore hole at another of their mills, called Batchworth Mill. This bore hole which is 18 inches diameter for 37 feet, 10 inches diameter for 50 feet, and 7½ inches diameter for 220 feet in depth; making a total

of about 307 feet in depth. From this bore hole 500,000 gallons per day have ever since been raised.

Messrs. Dickenson are now, therefore, and have for many years past, been raising more than 1½ million of gallons of water per day, from four small borings sunk in the chalk strata, for the manufacture of paper, the river water not being pure enough for this purpose.

Notwithstanding, that Messrs. Dickenson and Evans have thus turned, and are now turning to their own private advantage, the labours of Mr. Paten, who first practically proved what a large amount of pure spring water can easily be procured from the chalk strata in suitable localities, yet in discussing this subject, Mr Evans never once alluded to the facts I have named.

When we remember, that the Registrar General's returns during the late visitation of cholera, have proved, that the unwholesome water now supplied from the Thames to London, has tended in no small degree to propagate the pestilence, and to hurry thousands of persons to their graves during the last year, I am sure you will feel with me, that the truth, and the whole truth, relating to this subject, cannot be too fully known.

I am, sir,
Your's obediently,
SAMUEL COLLETT HOMERSHAM.

19, Buckingham-street, Adelphi, Feb. 21, 1855.

## MEETINGS FOR THE ENSUING WEEK.

MON. Actuaries, 7. Discussion "On the Methods in Use of Valuing Contingent Reversionary Interests."
Geographical, 8½. 1. Letter from Mr. A. R. Wallace, giving "An Account of Singapore and Malacca, as far as Mount Ophir." 2. Dr. T. C. Sutherland, "Meteorological Observations during a Passage from London to Algoa Bay." 3. "Extracts of a Letter from the Rev. Dr. Rebman, dated Kisuludini in Rabbai, S. E. Africa. 4. Mr. T. Maclear, "On the Coast Survey of South Africa." 5. Notice on the Departure of the North Australian Expedition.

TUES. Royal Inst., 3. Professor Tyndall, "On Electricity."
Civil Engineers, 8. Mr. E. E. Allen, "On Steam and Sailing Colliers, and the modes of Ballasting."
Med. and Chirurg., 8½.
Zoological, 9.

WED. Royal Soc. Literature, 4½.
Microscopical, 7. Anniversary.
Society of Arts, 8. Prof. John Wilson, F.R.S.E., "On the Iron Industry of the United States."

THURS. Royal Inst., 3. Mr. Donne, "On English Literature."
Antiquaries, 8.
Photographic, 8.
Royal, 8½.

FRI. Botanical, 8.
Royal Inst., 8½. Dr. J. Stenhouse, "On the Economical Application of Charcoal to Sanitary Purposes."

SAT. Asiatic, 2.
Royal Inst. 3. Dr. Gladstone, "On the Principles of Chemistry."
Medical, 7. Annual Election.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Feb. 16th*, 1855.]

*Dated 24th October*, 1854.

2264. J. Adams, Massachusetts—Printing machinery.

*Dated 23rd December*, 1854.

2719. W. De la Rue, Bunhill-row—Treating products from naptha.

*Dated 30th December*, 1854.

2758. F. Preston, Manchester—Bayonets.

*Dated 16th January*, 1855.

116. J. A. F. V. Oudin, Mons, France—Preventing sea sickness.

*Dated 22nd January*, 1855.

163. S. Trotman, Portman-square—Filtering apparatus.

*Dated 26th January*, 1855.

206. J. H. Johnson, 47, Lincoln's-inn-fields—Kites for carrying lines and signalling. (A communication.)

*Dated 29th January*, 1855.

215. W. Polkinhorn, Gwennap, Redruth—Cleansing wheat.
217. J. D. Humphreys, 20, Charlotte-street, Caledonian-road—Steam engines.
219. G. Goodfellow, Great Fenton, Stoke-upon-Trent—Supplying heated air to ovens, kilns, and steam-engine boilers.
221. T. Binks, Wentworth—Raising and regulating the supply of water.
223. J. H. Johnson, 47, Lincoln's-inn-fields—Generation of steam. (A communication.)
225. E. Death and J. Popplewell, Halstead—Stop valve.

*Dated 30th January*, 1855.

227. D. Moline, Adelaide-place—Metallic window frames and sky lights. (A communication.)
228. R. A. Brooman, 166, Fleet-street—Filter. (A communication.)
230. G. W. Henri, York—Meal mixture for cattle.
232. D. Warren, Glasgow—Screw propellers.

*Dated 31st January*, 1855.

233. J. Smith and J. Hollingworth—Langley Mills—Paper.
235. S. White, Southport—Crayons.
237. J. Howard, Bedford—Ploughs.
239. M. and A. Samuelson, Hull—Steam engines.
241. J. Harrington, 14, Pelham-street, Brompton—Priming fire-arms.

*Dated 1st February*, 1855.

243. W. Taylor, 16, Oxford-terrace, Hyde-park—Cables.
244. T. O. Dixon, Steeton, Keighley—Wood-working machinery.
245. A. Prince, 4, Trafalgar-square—Fire-arms. (A communication.)
246. J. Jecks, Norwich—Machine for sweeping grass.
247. A. W. Williamson, University College—Apparatus for feeding fires.

*Dated 2nd February*, 1855.

248. B. Goodfellow, Hyde—Ordnance.
250. G. Ritchie, 3, Monmouth-place, New Cross—Mattresses.
251. J. Castel and Dr. F. M. Beaupré, Marseilles—Lamp burner.
252. J. Carlhian and J. Corbière, 27, Castle-street, Holborn—Moderator lamps.

*Dated 3rd February*, 1855.

256. R. J. Mary'on, 37, York-road, Lambeth—Projectiles.
258. E. Clegg and J. Leach, Littleborough—Temples for looms.
260. H. V. P. de la Bertoche, Paris—Paper.
262. E. C. Bisshopp, Stonehouse—Breech-loading fire-arms.

*Dated 5th February*, 1855.

264. A. E. L. Bellford, 32, Essex-street, Strand—Hulls of vessels. (A communication.)
266. A. Morton, Kilmarnock—Weaving carpets.
268. J. Dorrell, Bilston—Rolling iron.
270. J. Imray, 64, Bridge-road, Lambeth—Measuring instruments.
272. P. J. Carré, Asnières, Seine—Ornamenting fabrics with metal leaf.

*Dated 6th February*, 1855.

274. D. J. Hoare, 10, Salisbury-street, Strand—Propelling vessels.
276. H. Trappes, Manchester—Preparation of leather for a new flock. (A communication.)
280. J. H. Johnson, 47, Lincoln's-inn fields—Waterproofing. (A communication.)
282. W. S. Roberts, Lodersville, Susquehanna—Coupling railway carriages.
284. J. Grainger, Birchwood, Alfreton—Pantiles.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed February 16th*, 1855.

1834. Thomas Miller, Fair-field-place, Stepney—Improvements in apparatus for raising coals and other weights from the holds of ships and other places.
1852. James Hadden Young, 66, Great College-street, Camden-town—Improvements in the construction of railways.
1947. Joseph Westwood and Robert Baillie, Poplar—Method of protecting iron ships and vessels from corrosion and animal and vegetable matters.

*Sealed February 20th*, 1855.

1839. Thomas Lees, Stockport—Improvements in the mode of lubricating parts of steam engines and of apparatus attached to steam boilers, and in the method of preparing and adapting certain substances for that purpose.
1860. Thomas Hayter, King's Head, Southwark—Improvements in apparatus for holding straps for sharpening razors.
1861. Hector Grand de Chateauneuf, Paris—Improvements in the process and apparatus for washing.
1869. William Woodcock, Earl's Court Brewery, Brompton—Improvement in the construction of furnaces.
1890. Louis Napoleon Langlois, and Jean Baptiste Clavières, Paris—Mode of constructing steam boilers.
1892. John Seithen, 13, Wakefield-street, Brunswick-square—Improvements in the manufacture of cases or envelopes for covering bottles.
1908. John Macmillan Dunlop, Manchester—Improvements in machinery or apparatus for preparing, cleaning, and cutting India rubber and gutta percha.
1911. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in apparatus for retarding and stopping railway carriages.
1928. George Mackay Miller, Inchicore, Dublin—Improvements in axle boxes, and parts working in connection with axles of carriages and other vehicles in use upon railways.
1953. Henry Lund, Temple—Improvements in propelling and steering vessels, and in the steam engine applied to these purposes.
2121. Alfred Vincent Newton, 66, Chancery-lane—Improvements in motive-power engines applicable to the working of their valves and to the conversion of the reciprocating motion of such engines into rotary motion.
2387. Edward Loysel, Rue de Grétry, Paris—Improvements in obtaining infusions or extracts from various substances.
2403. Ismael Isaac Abadie, Paris—Improvements in the mode of working screw-propellers.
2609. Alfred Vincent Newton, 66, Chancery-lane—Improved manufacture of conducting wire for electric telegraphs.

Journal of the Society of Arts.

*FRIDAY, MARCH* 2, 1855.

## INTERNATIONAL COMMERCIAL LAW.

The Council, at the request of the Special Meeting held on the 2nd of February, has appointed a Committee to consider the best means to be adopted to further the object of the proposed Congress at Paris, for the Promotion of the Assimilation of the Commercial Laws of the Great Nations of the World; and it was resolved that the following gentlemen be requested to serve on it:—The Right Hon. Lord Brougham and Vaux, Messrs. Wm. Bird, Elihu Burritt, Edwin Chadwick, C.B., R. P. Collier, M.P., Q.C., Warren De la Rue, F.R.S., John Dillon, Viscount Ebrington, M.P., Messrs. Wm. Ewart, M.P., J. P. Gassiott, F.R.S., T. Milner Gibson, M.P., J. W. Gilbart, F.R.S., G. A. Hamilton, M.P., the Right Hon. the Earl of Harrowby, Messrs. Wm. Hawes, T. E. Headlam, M.P., Q.C., Henry Thomas Hope, John Howell, T. B. Horsfall, M.P., William Hutt, M.P., Leone Levi, F.S.A., F.S.S., Benjamin Oliveira, M.P., Lieut. Col. Sykes, F.R.S., John Ingram Travers, Dr. Waddilove, and Thomas Winkworth.

And it was further resolved that the foregoing Committee be authorised to appoint a deputation to wait upon the President of the Board of Trade, if such a course shall be deemed advisable.

## TWELFTH ORDINARY MEETING.

Wednesday, February 28, 1855.

The Twelfth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 28th of February, the Right Honourable Earl Granville, Vice-President, in the Chair.

The following Candidates were balloted for and duly elected Ordinary Members:—

Brodie, Joseph.
Costar, Francis Wright.
Hammond, Wm. Frederic.
Rammell, Thomas Webster, F.G.S.
Rawlinson, Robert.
Warren, John Neville.

The Paper read was

## ON THE IRON INDUSTRY OF THE UNITED STATES.

By Professor John Wilson, F.R.S.E.

The paper which I have been invited to read before this Society fortunately needs but few words from me by way of introduction. Its title, "The Iron Industry of the United States," secures for it a twofold consideration here. The one, natural to every country whose power has been increased and whose wealth and general prosperity have been advanced by the development of its ironmaking resources: the other, natural to this country, whose relations, both social and industrial, are so identified with those of the United States, as ever to excite a lively interest in all the questions which affect their commercial prosperity; and few questions can exert a more mighty influence on the destinies of a country than the possession of the two minerals—iron and coal—the backbones of industry, and the basis of all commercial prosperity.

It is unnecessary to occupy your time with more than a brief sketch of the past history of the iron industry of the States. It contains the usual fluctuations attendant upon the establishment of a new industry, with periods of prosperity and of adversity, induced by fiscal as well as commercial agencies. Iron appears to have been first made in Virginia about the year 1715, previous to which the colony was supplied from the mother country, and, shortly after, the manufacture was established in the States of Maryland and Pennsylvania. In 1738, we have the evidence of some progress having been made, in the shape of a Report from the officers of the dockyard at Woolwich to the Navy Board, dated September 3:—

"We have lately received from his Majesty's yard at Deptford bar iron flats of 2¼in. broad by ½in. thick, 15cwt. 0qr. 24lbs.; squares of ⅞in., 5cwt. 0qr. 12lb., imported by Mrs. Cowley from America; and, pursuant to your warrant of 11th July, 1735, have made sufficient trial of each of the sorts; find the said iron to be very good and fit for H.M. service, superior in every respect to the best Swedes iron, and in our opinion, worth £17 10s. 6d. per ton."

The manufacture progressed but slowly, though the quantity exported exhibits a regular increase, averaging during the 10 years from 1740 to 1750, about 2,360 tons per annum, which was gradually increased for the next 20 years, until in 1770 it reached 7,525 tons, being rather more than one-sixth of the entire quantity of all kinds of iron imported into England at that time. As the country settled down after successfully asserting its independence, and the works of industry were resumed, we find a great advance was made in iron-making. In 1810, the whole number of furnaces in the United States was 153, giving a production of 54,000 tons per annum;—equal to about 16lbs. per head of the population. From 1810 to 1820, but little progress was made, the trade being in a very depressed state. In 1828, the production had reached 130,000 tons, having been rather more than doubled in the 18 years. In 1829, it is given at 142,000 tons, showing an increase in one year of nearly 10 per cent.

In 1830, it was 165,000 tons, exhibiting an increase of 16 per cent. In 1831 the production was 191,000 tons; and in 1832, it reached 200,000 tons; thus showing an increase of 70,000 tons, or 55 per cent., in the four years since 1828. In 1840, the census returns give the gross production at 286,903 tons; however, according to the report of the committee of the Home League in New York, it was estimated at 347,700 tons. The mean of the two would probably give the safest estimate, this would be 315,000 tons, or an increase equal to upwards of 50 per cent. in the eight years. In 1842, many of the works were closed, and the production fell to about 225,000 tons. In 1846, the trade was in a prosperous state again, the gross production for that year being estimated by the secretary of the Treasury at 768,000 tons,—having thus been trebled in 4 years; and in the following year it is supposed to have reached its maximum amount, not less than 800,000 tons being the furnace returns for that year. Circumstances, commercial as well as fiscal, appear then to have exerted a depressing influence upon the trade, and to have checked its career, as in 1848 a downward tendency is shown, which caused a decrease of about 150,000 tons in the following year's make, and another reduction of 100,000 tons at least in that of 1850. The production for that year, according to the census returns, is given at 540,000 tons; this is, probably, too high an estimate, as we find from the Report of the Statistical Committee of the Ironmasters Convention, that the entire make in the state of Pennsylvania for that year was

198,813 tons, whereas the census returns give it at 285,703 tons, a difference in excess of 86,890 tons in one State only. In the following year, trade again reviving, a regular increased production has taken place, and the returns for the past year (1853-4), present the satisfactory appearance of a make equalling the maximum which the trade had reached previous to the depression.

The iron-making resources of the United States are very great—the distribution of ores, many of the richest description, is general throughout the Atlantic and Western States; while the enormous area occupied by the coal measures, testifies to the abundance of fuel for the development of industrial applications.* The ores comprise every variety found in Europe—those principally used for smelting are the magnetic oxides, the hæmatites, and the clay carbonates of the coal veins. Besides these, the "spathic or sparry carbonate" and the "oligist or specular ore" are used in some of the New England States, but only to a limited extent. Quite recently a discovery has been made of rich seams of black band, in connexion with the bituminous deposits of the great Eastern Coal field, which will probably hasten the development of this industry in that favoured region. The magnetic oxides and the hæmatites are dispersed pretty generally throughout the whole extent of the Union, from Maine to Texas, and from the Atlantic seaboard to the states of the far west. The clay carbonates are associated with the coal measures lying west of the Alleghanies. In general, they are not so rich as those in this country, but when mixed with the hydrated hæmatites which are met with skirting the coal districts, these ores are profitably worked up. They are also found in considerable deposits on the Atlantic side of the mountain chain in Pennsylvania, Maryland, Virginia, and North Carolina. The spathic ores are found chiefly in Connecticut and Vermont, and where they are worked in the old way, with charcoal and the cold blast, furnish iron of first-rate quality. The specular iron ores occur in the New England States, and in New York State to a comparatively limited extent:—in the more distant States, both of the south and west—Texas, Arkansas, Missouri, Iowa, and California, they are reported to exist in great abundance. The industry was first established in the New England States, where the ores and the fuel (wood) were in great abundance, and where the education, habits, and energies of the people were well adapted to the prosecution of new industrial pursuits. The existence of coal in the State of Pennsylvania soon, however, raised a formidable rival, and from the year 1820, when mineral fuel was first worked and sent to market, the production of iron in that state increased so rapidly as to cause it to become the great centre of the industry, and to give it the entire control of the home market. This position it still holds, and must do so for some years to come, until the still greater resources of the states west of the Alleghanies are sufficiently developed to contest the lead with their more advanced neighbour. These possess natural advantages superior for iron-making purposes to those of Pennsylvania. Associated with the coal measures, beds of iron ores, and also of limestone, are met with generally throughout their vast area—whereas, in Pennsylvania, the ores and the fuel have to be sought for in different localities. Thus, while the smelting furnace within the one district finds a ready supply of both ores and fuel immediately at hand, the location of the other has to be determined by calculations based upon the comparative cost of transport to the furnace of the necessary ingredients—the fuel and the ores. In my recent inquiry into the iron industry of the Union, I was led to a divisional arrangement, as best adapted for showing the chief seats of the industry, with their respective advantages and capabilities. These I will briefly give now, with their production in the last year (1853-4), and the estimated cost of manufacture:—

* Professor Wilson here pointed out on a large map, which had been kindly lent for the purpose, by Mr. Stanford, of Charing-cross, the districts occupied by the coal measures, and explained generally the characteristics of each.

1. The Houseatonic district—Production, 10,000 tons; cost per ton, 20 dols. to 25 dols.
2. The Hudson River district—Production, 80,000 tons; cost per ton, 18 dols. to 20 dols.
3. The Delaware and Lehigh Rivers district—Production, 120,000 tons; cost per ton, 16 dols. to 18 dols.
4. The Schuylkill River district—Production, 100,000 tons; cost per ton, 20 dols.
5. The Susquehanna River district — Production, 120,000 tons; cost per ton, 15 dols. to 18 dols.
6. The Potomac River district—Production, 125,000 tons; cost per ton, 20 dols.
7. The Ohio, Cumberland, and Tennessee Rivers district—Production, 150,000 tons; cost per ton, 20 dols.

Besides these well-defined districts we must allow about 100,000 tons as the production of the numerous isolated works scattered throughout the upper portions, especially of the Atlantic States, where charcoal as fuel is universally used. In these iron of the best quality is made, but at a cost of nearly double that of the coal furnaces.

The present consumption of iron in the United States may be taken at 1,200,000 tons, which approximates very closely to the estimate mentioned by Mr. Scrivenor, as given by Mr. Wœrn, of Sweden, viz., 88 lbs. per head of the population. To meet this the home production is not at present equal; about half the present make is consumed for castings, and the remaining portion is converted into wrought iron, at a loss in waste, &c., of about one-third. This practically reduces the total or available production to 700,000, leaving a deficiency of 500,000 tons to be supplied by other countries. Hitherto the demand has increased in a ratio far beyond the ratio of production, but as the capability of production is, in this case, entirely a commercial question, the interests of the supplying countries are affected equally with those of the consuming country, by all circumstances, whether fiscal or industrial, which are brought to bear upon it.

| | 1840. Tons. | 1850. Tons. | 1852. Tons. |
|---|---|---|---|
| Make of iron | 286,903 | 564,755 | 500,000 |
| Quantity imported | 80,886 | 441,514 | 501,158 |

This large importation to meet the home consumption is obtained entirely from this country, and forms a very important item in the commercial intercourse of the two countries. The value of the United States market to our iron manufacture, may be readily seen in the Board of Trade returns, which give the exports for the years 1851 and 1852 respectively:—

| | 1851. Tons. | 1852. Tons. |
|---|---|---|
| To the United States | 464,559 | 501,158 |
| To other countries | 295,211 | 393,266 |

Thus giving an excess of about one-third in favour of the United States over the gross exports to other countries.

To retain this good customer, of course is very desirable, and, from what I was enabled to glean of their resources, and what I know of our own, I am strongly of opinion that this may be done for many years to come; but the time and the quantity will depend materially upon our "economy of production." At the present time, when the consumption doubles the home manufacture, the markets of the Atlantic States are virtually ruled by the prices of iron in this, the supplying country. As long as the price of English iron prevents its importation into the Union under 20 dols. for pigs, and English bar iron under 50 dols. per ton, the home manufacture can compete profitably with it in their markets, and the iron industry of the States will flourish and increase. Any fall in the English iron that would bring down its price in the American markets lower than the sum quoted would immediately check their home production, and again throw them upon our markets for their supplies. The difference in

price between the two markets may be taken at 80 per cent. This includes all charges for freight, commission, insurance, &c., about 50 per cent., and the *ad valorem* import duty of 30 per cent. In round numbers, pig iron selling at Liverpool at 45s. to 50s. will cost 20s. at New York. Thus the ironmasters of the States possess a *natural protection* of 50 per cent., which will always remain, and an *artificial* one of 30 per cent., which, like all fiscal charges, is liable to be changed.

The fiscal charges have undergone several changes, each gradually reducing the state protection, and leading the industry to the more healthy condition of reliance upon its own vast resources. In 1815 the duty on imported pigs was fixed at 1.50 dols. per cwt. In 1818 it was reduced to 50c. per cwt. In 1828 it was slightly raised, being 62½c. per cwt. In 1830 it was again fixed at 50c. per cwt., and in 1842 it was reduced to 9 dols. per ton. In 1846 the present ad valorem duty of 30 per cent. was established. These several changes have had their effect upon the development of the home manufacture, but the great variations seen in the annual production may be traced to other causes, of which the rise and fall in our markets appear to be the most important.

The iron industry of the United States is at present only in its infancy, an offspring quite of the present century. Its growth has been somewhat irregular, it is true, but when we find that it has already reached the gross amount made in this country only 20 years ago, and when we recollect the vast mineral resources of the United States, the rapid increase of population, with its increasing demands, and its unquestionable energies and power of application, it forces upon our minds the conviction that the time is not far distant when it will not only furnish sufficient for its own consumption, but be in a position to compete with us in the other importing markets of the world. In the different districts I visited, I found every advantage taken of our experience in the construction and working of their establishments. Everywhere the charcoal forge was giving way to the superior advantages of the hot-blast anthracite furnace. *Economy of production* was the main object of the manufacture, the quality of their ores and fuel always guaranteeing a good article. The use of the waste gases of the furnace was universal in their establishments; the difference of opinion as to their value, so startling in this country, did not appear to exist there. Attempts were being made also to utilise another waste, and, at the same time, cumbersome product—the slag or cinder. This, by a process of annealing, is susceptible of conversion into a hard and durable material, which, moulded into shapes, is adapted for various purposes of construction, or, with the additional labour bestowed upon it in polishing, is suitable for ornamental applications. Some specimens which I had an opportunity of seeing in the States were apparently homogeneous in their composition, and perfectly vitrified. Those now on the table were obtained by the same process, from the Dowlais furnaces. If this process can be brought into successful operation on a large scale, it will be the means of affording us a very useful and desirable material at a low cost, while at the same time it will help to consume a waste product, which at present is an expence to the ironmaster to remove. Another process, too, which I saw in operation in the States, appears to me worthy of consideration here—that of making wrought iron *direct* from the ore. This has long been a desideratum in all iron-producing countries; many attempts have been made, but none, I believe, have been so successful as to induce an operation on a large scale.

The process I refer to was patented by Renton, in 1851, and was in operation at Cincinnati, and at Newark, New Jersey. The description and particulars of working I have given at length in my report to H.M. Government. Another operation of some magnitude for a similar purpose, and based on a similar principle (Harvey's patent), is carried on at Motthaven, New York, where the returns, I am informed, are equally satisfactory. In both the conversion is effected by mixing the ores with a proportion of fuel, both being reduced to a coarse powder, and raising the temperature by means of heat applied externally to the chamber in which the mixture is contained. The fuel is ignited, and burns at the expense of the oxygen of the ore, and metallic iron is left mixed with the foreign substances usually accompanying such minerals. This reduced ore descends through a shoot to a furnace, suitably arranged, and subjected to a temperature sufficient to bring the iron to a pasty condition, when it is worked together as in a puddling furnace, and drawn out in balls of the required size for tilting. By this process a great saving is effected, as the entire expenditure of exertion, fuel, and labour, would not much exceed that of the ordinary process of puddling—while at the same time a superior quality may be expected, as the temperature at which the deoxidizing action is carried on is not high enough to cause the iron to combine either with the carbon of the fuel or with any of the other impurities, as silicon, sulphur, phosphorus, &c., which are always found in the ordinary pig iron. The first (Renton's) I am informed will shortly be in operation at the Llynvi Valley Works, South Wales. The sectional diagrams of the furnaces used show their management, and on the table are specimens of the manufacture of both the processes—and also of the principal ores used in the manufacture of iron in the States. The great abundance of the magnetic oxide, the richest of all iron ores, and its proximity in many localities to the coast, I am inclined to think, places it quite within the reach of our ironmasters who may require additional material, either for increasing the quantity or for improving the quality of their produce. In conclusion, I would venture to specify as my claims to the attention of the meeting, the consideration of the following points:—

1. The make and the consumption of iron in the United States.
2. The deficiency is supplied from Great Britain, and the relative value of the United States trade to this country.
3. The relative price in the two markets—the natural and artificial protection of the United States.
4. The enormous mineral resources of the United States.
5. The desire for economising the cost of manufacture.

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## DISCUSSION.

Mr. T. M. Gladstone said, having listened attentively to the excellent paper of Professor Wilson, he had not only felt much interested in his clear and elaborate observations on this subject, but had gathered some instruction therefrom. At the same time, he must beg to differ from Mr. Wilson's reasons and conclusions on several points, to which he would draw the attention of the meeting. In the first place, however, he would wish to rebut the charge that gentleman had made as to the backwardness of British ironmasters, objecting to any experiments or to resist advance in any improvement offered to their acceptance. It was true that they hesitated to proceed with experiments merely upon the propositions of the theorist, unless from their own experience they saw a reasonable probability for a useful and economical purpose being attained, as interference in the manufacture of iron involved a serious expense and too frequently positive loss of time and money. He would say, however, the ironmasters of this country had always shown themselves willing and ready to promote all methods likely to be beneficial, it being not only a duty but their interest to do so; and perhaps one of the best answers to this allegation was, that the author of the paper informed us the plan shown in the model before the meeting, was about to be tried in South Wales. Of his own knowledge, in Staffordshire opportunities had been given by placing everything at the disposal of the experimentalist, and every personal assistance had been rendered to carry out on a large scale that which had appeared to the theorist and in the laboratory perfectly available and economical. Under these conditions, such experi-

ments had totally failed, evidencing the necessity of caution, and the value of practical knowledge; to determine where and in what way it was safe to proceed, and that the manufacturers were not to be lightly charged with want of energy, or desire for progress in improving their manufactures. There were many reasons operating to prevent the likelihood of any serious competition in a neutral market by the American maker against us, and, even in their own, with a protective duty. It was true that, looking at the vast fields of materials presented in the States, the elements of future and abiding riches were presented, and it seemed that Providence in his mighty wisdom in those things that were needful for the use of man, set forth in abundance all things needful for him; and while a glorious future was before that great country, as her territory was covered by people, so these things would in due time be developed and made available, but it would be a long period from the present. He rejoiced to think that such stores were ready for such universal benefit. Although this was so, and although the progress made in the States had been great, it would not be in this generation we could be so interfered with as to dread any competition, but we should still supply those rising wants to a vast extent. One reason, irrespective of any other, against economic production in America, arose from the climate. Many in that room would recollect the excitement of 1845. At that time a party came from America and took with him numbers of puddlers from Staffordshire. The inducement was payment at 21s. per ton sterling against 11s. then paid for that process. When some of these returned, they found in the year that they could not earn more money than at home, purely from climate. In the summer it was so hot they were compelled to stop working; and in the winter so cold that it caused the machinery and many adjuncts to be so disturbed that at the two extremes of the seasons they could not proceed with their employment. Of the effect of the latter, he was sure any one present engaged in iron-making would confirm what he stated; even during the recent severe weather here, the interruption and consequent loss proved great and embarrassing. He had also known instances of interruption from the heat, though the temperature of this country was much lower that in the States, not to say the months of extremes which prevailed there. The numerous, yet necessary, points which had to be thought of before being able to arrive at a just conclusion with regard to capabilities for meeting the commercial requirements connected with iron-making, clearly presented themselves to his mind, as practically acquainted with every part of the subject through a long personal experience, but which it would be difficult briefly to explain. The idea which Mr. Wilson had thrown out, that the time was likely to come for America to supply us with ores at a rate deliverable here so as to meet the market, was quite out of the question. So long as America freely sent us her cotton and corn, those bulky articles would always keep up freights from that country, so as to preclude the possibility of sending ores, whose value at the furnace ranged from 7s. to 21s. per ton in the extremes of the market; and therefore such was not to be thought of while we had still abundance in and around the works from which to draw our supplies, and need not fear competition from any other quarter. While the practical man here was desirous to know what was doing in the States, and ready to receive instruction from thence and to reciprocate the same, he was sure that the American iron-master would gladly receive and duly consider the observations made upon his progress and his position, in the best possible spirit.

Mr. Macgregor rose merely for the purpose of drawing attention to a few points which ought, he thought, to be rendered more prominent than they had been made by the author of the paper. In describing the present state of the iron trade with America, he had alluded to the natural protection enjoyed by the American ironmasters in reference to the competition of this country, and he had estimated that advantage at 50 per cent., but he had not dwelt sufficiently on the fact, that the American manufacture of iron had all along been further stimulated, and that it was now sustained by an artificial system of protective duties. This additional protection appeared to be 30 per cent., but it was really much more, for it was levied not only [on the original cost of the iron, but also upon the charges. It thus appeared that, notwithstanding all the resources which had been exhibited by Professor Wilson, the American ironmaster at present demanded and obtained protection exceeding 80 per cent., thereby nearly doubling the price of iron throughout the United States. A part of this increase of price must, indeed, continue, until they could produce iron as cheaply as it was produced in Great Britain. Looking to the future, Mr. Wilson contemplated so great a development of the iron manufacture, that America might, at no very remote period, not only supply her own wants, but also become an exporter of iron to other countries. In the first place, America had, in order to exclude British iron from her markets by fair competition, to surrender the artificial protection of 30 per cent. Then, as the iron districts of America were at a great distance from the seaboard, they had to convey the iron manufactured there to the populous Atlantic cities and states at an expense which would equal, if not exceed, the expense of conveying iron from Wales and Scotland by water to the same markets. The freight constituted the major part of that expense, and, though it had latterly been considerable, the increased charge had been occasioned by causes of a temporary nature, and it might hereafter be as low as it had been in times past. Assuming that the American people would not always tax themselves by a protective duty in favour of a few ironmasters, under the delusion that it was a national advantage thus to enhance the price of the most precious of all metals, and that the present cost of freight would gradually be reduced to its former level, those wh were interested in iron property in this country had no reason to apprehend injurious competition on the part of America. On the contrary, they might expect, with greater freedom of intercourse, equal competition, and no favour, to have an enlarged demand for their iron.

Mr. Bird, after complimenting Professor Wilson on his most excellent paper, said, there were so many practical gentlemen present, that he was surprised none of them had got up to state their own opinions as to the working of these model furnaces in America. It appeared to him that the production from these furnaces would be about 30 cwt. in 24 hours—

Professor Wilson—No, 50 cwt.

Mr. Bird—And that the puddling furnaces would be required to be fed. He could not say what was the consumption of the present furnaces. When they considered that the production of iron in this country had reached the enormous amount of 3,000,000 tons of pig iron, and that it had been three years ago produced at a cost not exceeding 36s. a ton, he did not see how any great reduction in the present mode of producing it could be effected. When a friend of his at the Great Exhibition produced one of those large pieces of iron ore he said, "What was the use of trying to produce iron of the value of 1s. at a cost of 2s. 6d." He did not think any new process could be more economic on a large scale than the one at present adopted. The commercial point of view in which they were to regard the question was, whether in future Americans would be as large customers as they were at present; or, whether it was likely they would, by being large producers, cease to be customers to this country. He considered, with Mr. Macgregor, that they should not lose America as their customer. That country made 500,000 tons annually, and imported about the same quantity. We made three millions, and exported half. Why was it that this country could sell iron cheaper than America could. It was because here a large capital was invested in the trade, and the Americans had to travel long

distances with their traffic, without being supplied with economic means of transit; on the contrary, in England as regarded the latter, manufactures could be conveyed to their customers, east or west, at a very small cost. They were so situated that they were warehousers, and that the success that would attend them in the disposal of their manufactures would necessarily be regulated by the cost of their transit. Now, on that subject his friend, Mr. Wilson, had said nothing, but he considered that the cost of transit must be always regarded as one of the largest elements in the cost to the consumer. America was in advance of them with respect to railway mileage, which would be one means of extending her traffic in iron. It was a great fault that works in iron generally preceded the necessary means of its transit. The great object which they had to consider was, how they could best bring their iron as rapidly and as economically to market as possible. There was a large—an immense, iron field in Silesia, but the means of bringing the production to market were uncertain. The Oder was not only full of shoals, but in the winter season was usually frozen for the space of two months, and the Prussian government refused to have it dredged, because they said that by so doing they would destroy the traffic of carrying by carriages and waggons, and ruin thousands of persons employed in it. Now, he was afraid that in this country too, those facilities were not given to the iron trade which were necessary to its increase. They were not afforded by the railways that facility of transport which they ought to have, and when he jotted down some of the expenses which they ought to save, these amounted to a large sum. If they would look to South Wales, the heart of the iron trade, they would see that after they had carried their iron down from Merthyr Tydvill to Cardiff, by a narrow-guage line, they found that they could not pass them on to the South Wales line, which was a broad-guage line. They had then to transfer them, at a cost of 2s. or 3s. per ton, from the waggons which brought them down into those which conveyed them to London. Again, when they arrived at London, they had to stop at Bull's-bridge or Camdentown, for, after having a system of railways for twenty years, or rather a want of system, they had still to use horse power in order to bring their goods to the shipping point. He did not know if that arose from carriers being in the direction of the railway companies; that removal of the iron in London cost 4s. or 5s. more per ton. If they had to ship them to the Baltic, they had to pay 3s. 6d. or 4s. more for Sound duties. When they got to Stettin they had to pay about 2s. again, because they were unable at once to go up the Oder. There was, then, from want of proper facilities, imposed on them an absolute cost of 11s. or 12s. per ton. Indeed, he felt convinced that, more than economy of production, was the necessity that the freedom of transit should be reduced to a minimum of cost, and that those difficulties in railway communication should not any longer exist. There was a great extent of railways in America, constructed with a single line of rail; those would soon require a double line, the rails for which they would either make themselves, or procure from England. He hoped that they would pursue the latter course, and he would give them his reasons why he thought they would. If they were to make them themselves, they would require a great amount of ready capital, which they might perhaps obtain when they wanted another line for their 19,000 miles of railway, from the English ironmasters, who would have the pleasure of supplying them for bonds probably.

Professor Wilson intimated that there were only 13,000 miles of railway in the United States.

Mr. Bird continued to say they were all aware that each country had many resources of its own, but he did think that the Americans, both in regard to their own benefit, and that of international intercourse, stood much more in their own light than in that of others, by throwing fiscal impediments in the way of the iron trade. The English would make their rails for them, and that would give them an opportunity of bringing their iron stone and their coal, much more into the market than they did at present. They would thus not only obtain a revenue from their railways, but also promote a harmony between the two countries, which he hoped would always continue. The experience of the States of the Zollverein was, that from all articles on which they had reduced the duty, they derived a considerably increased amount of revenue. It was the same with regard to France, and he thought it was natural for them to look for a removal of the duty on iron charged by that country. If the ironmasters could get that favour, it would greatly improve the prospects of the trade, in which there were indeed many phases. Even as it was, he thought they should, for many years, be the best market for iron either in the Old or New world.

Dr. Percy had listened with great pleasure to the paper by Professor Wilson, and felt thankful to him for the amount of information he had afforded. He would, however, with the permission of the chairman, put a few questions. First, he would like to know the real cost per ton of iron prepared by Renton's process; for, however ingenious any process might be, they had yet to bring it to the sordid test of pounds, shillings, and pence. Another question he wished to have answered was, whether it had in America been found adapted to the reduction of clay ores. With regard to the mode of effecting the reduction of the ores the most suitable was, in his opinion, one long in use in Sweden. A friend of his at Gottenburg had used it for six or seven years with complete success. It was one which combined the principles of the blast and reverberatory furnaces, and, by the formation of carbonic oxide, could either reduce or oxidise the ore. Should any gentleman require the plan of it, he should feel great pleasure in letting him have it. He had, some years since, furnished copies of the plan to several ironmasters, and it had also been published; but it had not, as yet, been adopted in any of our iron districts. There were one or two matters more on which he should be glad to have information. He thought that Prof. Wilson had said that the impurities of the iron, such as phosphorus and sulphur, were derived from the fuel. Now, there was in all clay iron ores a great quantity of phosphorus and likewise of sulphur, so that it was not from the fuel alone that the impurities arose. With regard to the want of a willingness on the part of the iron masters of this country to make experiments, he was not surprised that they hesitated to do so, as it was a serious thing to disturb the operations of their blast furnaces; yet, in spite of all that had been said on that subject, they still stood the first in the trade. Their lead smelting, their tin smelting, and their iron smelting, were better than those of any other country, and the process of copper smelting in use in Swansea was unsurpassed; indeed, the greatest metallurgical improvements which had been lately introduced were the offspring of the enterprise of Englishmen, as the hot blast of Neilson, and the desilvering process of Pattinson.

Mr. May said he thought that the ironmasters were in some degree open to the imputation of not being alive to the adoption of improvements, in proof of which he adduced the length of time it required to introduce hot blast, now all but universally adopted, and the benefit of which was demonstrated at an early period of the patent. He might add also, in illustration, the slow progress now making in the consumption of the gases from blast furnaces, by which one firm alone was saving 1000 tons of coal per week. Economy in using the various products of manufacturing, was a main element of progress, and there might be excessive caution on the part of the manufacturers. He would call attention to a want of true economy in the deteriorated quality of rails now made, as compared with those of 13 or 14 years ago, caused, as he believed, in a great measure, by the plan of competition adopted by railway companies, who, after advertising for

tenders, were too apt to accept the lowest offer, without sufficient reference to quality. There was, certainly, no lack of materials for making good rails, to enable this country to compete with the whole world. The discovery of the ore of the oolitic districts was but recent; and still more recently, a very extensive deposit of spathose ore had been opened up.

Mr. R. F. DAVIS said he was sure that every one present would be obliged to the Professor for the lucid paper which he had read to the meeting. He really must be allowed to differ somewhat from the last speaker, in what he had said as to the want of enterprise on the part of the ironmasters. Need he mention the honoured name of Sir John Guest, for instance, who, beginning, as he had himself told him, with a very small capital, had, by diligence, energy, and enterprise alone amassed a very large fortune, and created quite a little town, in a short space of time, where scarce a house formerly stood. Besides him, were not such names as Crawshay, Bailey, and the Ebbw-vale Company sufficient alone to rescue the ironmasters from the reproach which had been cast upon them. The manager of the Ebbw-vale Company must sell at least a ton of iron a minute every hour he was at the office, and this immense production had been obtained within a very few years. In the days of protection we were told that America would flood this country with corn—we were now told she would flood it with iron; he need not say the corn did not come, as was fancied, and his hearers might be assured the iron was still more distant. Notwithstanding all that had been said, there were good reasons why our ironmasters should not despair of competing with America or any other country. One thing especially should be remembered in considering the question, and that was, the climate. In their own country, our ironmasters were fortunately situated in this particular, free from those extremes of heat and cold which prevented the proper working of the furnaces. The result of a very slight variation from the evenness of temperature had been seen within the last few weeks. Another fortnight of such extraordinary weather, and there would barely have been a furnace at work in all South Wales. In the summer, disastrous results occasionally arose from extreme heat; the men could not stand it; and if such were the case even here, what must it be in America, where the winter was so much colder, and the summer so much hotter, than ours. The poor manufacturer must often have the pleasure of seeing his weekly production become "small by degrees and beautifully less." As to protection, again, he was surprised that our 'cute Yankee cousins should not see that the duty was not imposed so much upon us as upon themselves, and that they should be so hoodwinked for the benefit of a few individuals. The duty in that country amounted to somewhere about £3 per ton, which was not imposed on the 500,000 tons imported merely, but in practice on the 500,000 tons internally produced also, so that the nation paid three millions sterling a year to support Pensylvanian produce. Every labourer in the United States ought to know and see that he was paying 1s. more each time he bought a spade, than he would do if this duty were taken off. He was convinced, that very shortly the Americans would take a proper view of the question, and see not only this—but also that it was desirable for themselves that this country should have an extended market in America, since thereby they would obtain cheaply materials wherewith to improve their mode of transit, and thus become far more efficient manufacturers than they could under the present system. In respect to the question of cheap rails, alluded to by Mr. May, it was the same with that article as with every other; if they purchased them cheap they would have them inferior in quality; railway directors had, unfortunately, of late years, allowed everything to give way to cheapness, and what was the result? Why, that whatever line of rail you travelled on, you were surprised to see large piles of crushed and laminated rails. The fact was, such rails were not cheap, and it should be pressed at every board that if, instead of seeking cheapness so much, directors would seek quality more, and purchase such rails as were made fourteen years ago, they would find them, in reality, more economical. He most fully concurred in what had been said as to the difficulties of transit for ore and produce in England. He was aware, and many others also, that at this very moment her Majesty's government wanted iron for a certain purpose, but could not have it, because, in order to bring it from Wales, carts were obliged to be employed. Newport, for instance, a town of about 10,000 inhabitants, the centre of the iron trade, had three railways—two of them belonging to one company—each line having stations there, but no two of them joined, even a few weeks back. The company to whom the two lines belonged thought it very grand to have a station at each end of the town, but just lately these had been united. The other line—the Great Western—the great artery, as it ought to be, of South Wales, was nothing but a great nuisance, totally useless as a communication with the mineral lines of Monmouthshire and South Wales, since they were narrow, and it was broad guage, and iron and *coals* especially would bear but little transhipment. Our Yankee friends might be deficient in means of conveyance for their ores, but the English also were greatly behindhand in this respect, and he trusted the matter would soon be taken up, and uniformity of system obtained. There was, however, no fear, while the supply of ores in this country was so great, that our Yankee cousins could compete with us. They were a rich and prosperous people, and could, by getting their rails here, open their backwood trade. This reminded him of the remark of a Staffordshire labourer, who once said to him, "Send us down plenty of loaves and meat, and we will send you iron." If they would but take off the duty, the English would supply them with whatever rails they required, and then there would be no want of that friendly intercourse which now existed, and which, he trusted, might long continue.

Mr. BEVAN thought that the discussion as to what our ironmasters were doing in England was not relevant to the present paper, which he understood to have special reference to the iron-making resources of the United States. Professor Wilson had informed us that the fields of coal and ironstone in the United States were inexhaustible, and in the proportion of about one square mile of American to one acre of British, while the quality was superior to that of the British minerals; and that, as the treasures lay, for the most part, above water-level, the cost of "getting" was obviously much cheaper than in England, where the mineral operations were obliged to be carried on, to a great extent, under water-level, by expensive pits and costly driving arrangements. In addition to all these favourable natural conditions, the Americans enjoyed as large a share of acquired advantages as ourselves, in the wide ramification of railways and canals which covered their country. It seemed, therefore, of great importance to the makers of this kingdom to ascertain accurately how it was that the Americans, possessing all the great elements requisite for the production of iron, and with such superior means of transport to their principal markets, were still unable to compete with us, who had to contend with heavy charges of freights and duties, amounting to about eighty per cent. upon the English shipping price. If Professor Wilson would explain this anomaly, it would be valuable information to our ironmakers, to whom it was an object of first importance to keep so good a customer. With regard to Renton's furnace, he thought the comparison should be between the cost of the British puddled blooms and the American Renton's bloom, rather than between the Scotch pigs and the Renton's bloom.

Professor WILSON stated that he would endeavour to reply to the observations that had been made in the order in which he had noted them down. Mr. Gladstone wished to know the cost of iron per ton as made by Ren-

ton's process; the same question was put more fairly, also, by Mr. Bevan, who said the comparison should be made between this and the *wrought* iron, not the pig, of the ordinary process; but it was one which he was hardly in a position to give a definite reply to. He thought it could not much exceed the cost of refining and puddling in the ordinary process. In Renton's furnace the arrangements were very inexpensive, and the only additional labour required was for pulverising the ores and charging the chambers. Mr. Macgregor, who, he understood, was chairman of the Llynvi Valley Iron Company, had, probably well considered the money part of the question, and would certainly be able to give a more correct estimate of the cost of manufacture. Mr. Gladstone appeared to doubt the practicability of bringing ores to this country, as, owing to the extent of the cotton and corn traffic, the freights would be taken up at a price too high to admit of the transport of such heavy, low-priced, materials as ores. Now, his opinion in its favour was mainly based upon the extent and nature of this trade, which would enable the ore to be carried as ballast, at a cost not exceeding 10s. per ton; indeed, a gentleman had just informed him that he was now shipping another mineral to this country at only 4s. per ton.

Mr. Bird—To what port?

Professor Wilson—From New York to Liverpool.

Mr. Gladstone thought Mr. Wilson argued on the presumption that the iron ore was brought to New York without cost.

Professor Wilson said that that would, of course, be an additional item, but they must recollect that these rich magnetic oxides contained from ten to fifteen per cent. more iron than the market hæmatite ores, while, at the same time, they contained no water — another saving of some ten per cent. As regarded the questions of labour and temperature which had been alluded to by Mr. Gladstone and by Mr. Davis, he would observe, that the cost of labour in the States certainly did not exceed the wages at present paid in this country, and that their iron-making operations were never arrested by either the intense heat of their summer, nor the intense cold of their winter. He himself had visited the principal iron districts of the country during the summer of 1853, when the temperature marked 135° to 140° Fahrenheit, and although it certainly was very hot, it was no obstacle to the works. In this country, where the past winter had been unusually severe, inconvenience no doubt had been felt in obtaining supplies, from the continuance of the frost, especially by those who were not provident enough to secure a good stock of materials at hand. He would now take the observations of his friend Mr. Bird. The first, as to the relative cost of manufacture by the improved processes he had already noticed, and although Mr. Bird had quoted Gartsherrie pigs as having been sold at 36s., he would not venture to tell us that that was a remunerative price.

Mr. Bird—There were six brothers there, and they had each of them purchased estates worth £100,000 a piece.

Professor Wilson.—Not out of their profits while their pigs were at 36s. Mr. Bird also objected that the 1,500,000 tons of wrought iron manufactured annually in this country could not be made by Renton's furnace. Did they not pass, he would ask, through the present puddling furnace, and it appeared to him that this new process would turn out as much work as the ordinary puddling furnace—say, about 50 cwt. in the 24 hours. The argument used in reference to the want of means of transporting the home-made iron from one State to another, would operate quite as strongly against iron imported from this country. The facilities, however, were greater than our people were aware of, as, taking extreme points, from New York to Chicago, a distance of about 1,500 miles, the rates for railroad iron was only 3½ dollars per ton. The existence of so valuable a mineral as iron-ore or coals in the present day, speedily determined the location of an industry, or of such means of transportation as should render it available to the purposes of industry. Ask the Ebbw-vale Company whether the recently-discovered spathic ores of Somersetshire would be left in their present spot, or whether they would not speedily find their way across the channel to their furnaces? He cordially agreed with Mr. Bird's remarks on free trade, and regretted that a pig of iron should have such travelling difficulties to contend with as those so humourously described by Mr Bird; these, however, had reference to English railways and continental conveyances, rather than to the subject now before the meeting. Dr. Percy inquired whether the clay iron-ores could be used in the new process! There was no reason why they *could* not, but there was a reason why they *should* not, when the richer magnetic oxides and hæmatites were more abundant and more readily procured. It was quite true that the ores used in this country contained some of the impurities complained of, as phosphorus and sulphur—at the same time these substances were contained also in the fuel, but the real damage done was due to the high temperature of the blast furnace, which caused the combination of these impurities with the pig-metal produced. This was avoided in Renton's process. Nothwithstanding the high authority of Dr. Percy in all such matters, the Americans would not be disposed to adopt his suggestion of seeking for the 2 per cent. of potash which the slags contained. It evidently did not occur to him that we at present drew nearly the whole of our supply of potash from that country. His remarks in reference to the Swedish furnace, as well as some subsequent ones of Mr. May, tended materially to strengthen the original observations as to the comparative indisposition of our ironmasters to seek for or adopt improved processes. Mr. Davis instanced the successful career of Sir J. Guest, and of the Messrs. Baird, as evidence in favour of the ironmasters' enterprise and desire to advance their industry. This would indicate good judgment, good luck, and good times; but ought not by itself to be taken as evidence of advanced operations. Professor Wilson concluded by stating, that the want of capital, and the at present only partially developed state of the iron industries, were the principal reasons why the home production was at present unequal to supply the consumption of the United States.

Mr. May, in explanation, said that he intended to convey the impression that ironmasters were not so fully open to the adoption of improvements as they might be. With respect to the duties levied on iron imported into America, he was rather surprised that so acute and intelligent a people did not see, that if they would only permit rails to come in free of duty, it would stimulate their own iron manufacture in the supply of rolling stock and fittings, &c., which required a large proportion of all the iron used on railways.

Mr. Campbell, of New York, would, with the permission of the noble chairman, reply to the inquiries of one or two gentlemen in reference to the difference in the cost of making blooms by the old and the new method. In the United States the difference averaged about 25 per cent. in favour of the Renton process. At Newark, New Jersey, a ton of bloom was made at a cost of 29 dollars, a large portion of which was paid for the raw materials, the ore and coal being remote from the works, and subject to expensive transportation. The quantity necessary to make a ton of blooms cost about 10 dollars each, making 20 dollars, which left 9 dollars for labour and all other expenses. Of course, in localities where those materials were cheaper, iron, by this process, would be made at a corresponding reduction in cost. In reference to the manufacture of iron generally in the United States, he would remark that the prominent difficulty in the minds of several gentlemen, appeared to be the transportation of the article from its insulated position to a market at the seaboard. At present, and probably for years to come, the Western States would require the largest proportion of iron consumed in that country, and the fact was over-

looked that iron manufactured in the interior was, in most cases, adjacent to the channels of navigation, and already half the distance from the seaboard to its destination and place of consumption in the west, while English rails landed at New York had to pass through the same channels, double the distance, and at a corresponding increase in cost of transportation. American rails were generally very much superior in quality to English, and were invariably preferred for curves, and all places requiring the best iron; and such was the desire for these rails that the manufacturer found a ready market at his own furnace for all he could produce. In reference to the inability of Americans to compete with the English in this department of industry, Professor Wilson had very properly remarked, "that they had not the necessary capital," and he would add, that America was comparatively a young country, with a rapidly increasing population, and a large portion of her capital was employed in opening up channels of navigation and communication for developing the vast resources of the great west. Several individuals and companies in the United States commenced the manufacture of iron with sufficient capital and experience to prosecute it on a large and profitable scale, and had amassed fortunes, while a far greater number commenced with inadequate capital and experience, and consequently had had to struggle with pecuniary embarrassments, with the attendant consequences.

The Noble CHAIRMAN said, that he could not help expressing his regret when, looking around that room, he missed a face long familiar to the members of the Society. He was perfectly aware that that was not the moment to indulge in such feelings, but in the late Mr. Joseph Hume the country had lost a great and high character, and the Society of Arts an earnest and energetic friend, who ever had its interests deeply at heart. This much he thought he might say as an expression of what he himself felt, and what he had no doubt was felt by all present. With reference to the paper read by Mr. Wilson, he was sure that if they all derived the same amount of instruction from it that he had it would not be necessary for him to ask them to give to him a vote of thanks. There had been times when if the principle speaker of the evening had introduced the subject of American rivalry in trade, he would have given rise to some amount of jealousy, and the president of such an assembly would have felt somewhat uneasy; but in every assembly of liberal men in this country it was now an acknowledged thing, that the time was passed when to depreciate, intellectually or physically, their cousins on the other side of the Atlantic was considered a mark of their own superiority. As an ironmaster himself, he had felt some twinges at the prospect of American competition, and it was, therefore, very satisfactory to him to hear of the power possessed by England for such a competition; but his greatest comfort was derived from what fell from Professor Wilson himself, and it was strengthened by the last observations of Mr. May, namely, that in proportion as the American iron trade increased the import of iron from this country had increased in a still greater ratio. Although he was not himself sure on the point of a lack of energy, he had to say, that great energy had been and was being directed to the improvement of that trade. He congratulated Professor Wilson on the success of his mission to America. The valuable report which he had drawn up and presented to her Majesty's Government had not only increased his reputation, but had justified the Government in having selected him to undertake the duty.

The Secretary announced that the Paper to be read at the meeting of Wednesday next, the 7th of March, was, "On the Sewage of London; its Composition and Value as a Fertilizer," by Mr. J. B. Lawes.

## CIVIL SERVICE REFORM: THE COLONIAL OFFICE.

[*From Reports of Committees of Inquiry into Public Offices.*]

The appointment of proper persons to fill the situations of permanent Under Secretary, Assistant Under Secretary, and Précis Writer, must be left to the conscience and the judgment of the Secretary of State, and it is so extremely important, both to the public interest and to the Secretary of State himself, that these offices should be effectively executed, that the best selection is likely always to be made of which circumstances admit.

But in providing a proper succession of senior clerks for the part which they have to perform, a great deal remains to be done. In this case the previous training, being entirely within the walls of the office, depends upon the measures taken by the Government for the purpose, and as the field of selection is very limited, the preparation and instruction of the small number of persons from among whom the senior clerks must be appointed, is a matter of serious public importance. The training given to the clerks in the Colonial office is, nevertheless, at present of the most imperfect kind.

They generally receive their original appointments to the establishment before their education is finished or their characters are developed; and the early age at which they become their own masters, the dry and distasteful nature of the duties assigned to them, and the various attractions of a London life, are very unfavourable to the formation of those habits which make good public servants.

As there is no examination previously to admission, there is no security that the persons admitted possess the talents and attainments which will render their services valuable on promotion to higher stations in the office. The year's probation, although it answers useful purposes of its own, cannot supply the place of a preliminary examination, partly because the duties which are at present allotted to young men on first entering the office are not such as to furnish any test of fitness for the higher situations, and partly because a faithful report upon the conduct and qualifications of the probationer cannot easily be obtained after habits of personal intercourse have once been established.

The training which the present constitution of the body of the establishment affords is by no means calculated to develope the talents required for the successful transaction of the serious business of the office. While the functions of the Colonial office are remarkable for their variety, importance, and difficulty, and experience and ability of a high order are necessary for their proper performance, the official education partakes in a great degree of a mechanical character. Although there is a separate department of the office in which persons on the footing of law stationers' clerks are employed, under the superintendence of a clerk, in copying official papers, the greater part of the work of this description is still done by the gentlemen on the establishment, who are also charged with the duty of making up, directing, and sealing the despatches, and of keeping, arranging, and producing, as occasion requires, the current papers of the office. The first years of official employment are those in which the knowledge, the self-confidence, and the aptitude for business required for the proper discharge of difficult and responsible duties should be obtained, and it is much to be regretted that persons likely to succeed to important situations in the public service, should have occupations assigned to them at this critical period of life which are unimproving and unsuited to their education and prospects, and, as such, likely to give them a distaste for their profession. If, after ten or fifteen years spent in incessant copying and other routine work, the spirit, the mental activity, and the wide extent of acquired knowledge necessary for vigorous intellectual exertion in the transaction of business like that of the Colonial office are wanting, it is the fault of the system, and not of the individuals who have been placed in circumstances so unfavourable to them.

The honours and rewards of the establishment are removed by so many gradations from a young man on his first admission, and he has to pass so long a period of obscure labour before he can hope that his exertions will attract the notice of the Secretary of State, that the prizes of the office have practically little influence on him. There must be something very defective in a system which does not hold out the usual motives to professional exertion, and fails to secure for the public service the zeal and activity of early manhood, because it does not offer any scope for a just and reasonable ambition.

According to the *theory* of the office, a clerk can reach the first class only after he has been promoted three times on the ground of superior merit, the claims arising from length of service being provided for by the annual increase of salary within each class; but, practically, it has been found very difficult to enforce the principle of promotion according to merit, even in filling up vacancies in the senior class, while as regards the other classes of the office, the *habit* has been to promote everybody in his turn, without regard to comparative merit or qualification. In making this statement we must be understood only as describing what has been the general practice of the office on a review of a series of years, for we are aware that there have been exceptions. When considerable changes took place in the office while Lord Ripon was Secretary of State, the rule of seniority was altogether departed from; and when vacancies have occurred since Lord Grey has been Secretary of State, his lordship has in each case called upon the permanent Under Secretary of State to report what member of the class below that in which the vacancy had occurred, he considered the fittest to succeed to it, distinctly stating that, except in cases of equality of merit, seniority was not the principle on which it was right that the selection should be made. We believe that it will be impossible to overcome this tendency, and to give to official promotion the stimulating influence it ought to have, while the office is constituted as it is at present. In the minutes of evidence taken before the recent Select Committee on Miscellaneous Expenditure, the following question and answer appear in reference to the Colonial Office:—

"2298. When a gentleman in the office has risen to the highest scale of remuneration, is it entirely in the discretion of the Secretary of State to select whom he pleases for the Senior clerks?—It is undoubtedly in the power of the Secretary of State to do so; but it is a limited power, because parties feel a reasonable expectation, supposing them to have done their duty, that they would hardly be interfered with by the Secretary of State."

The fact is that the duties in the lower classes of the office are to so great a degree of a manual and routine character, that they do not furnish a suitable test of fitness for the more difficult and responsible functions of senior clerk; and when a person has done well what was given to him to do, it seems unreasonable to withold his promotion on the ground of supposed unfitness for higher functions in which he has never been tried. The principle of promotion according to merit, is also not likely to be consistently acted upon, while the Secretary of State is not personally acquainted with the manner in which the respective candidates discharge the duties entrusted to them, which it is impossible he can be according to the present system of the office; and, lastly, as the scale of salary at admission is fixed below what is sufficient for the respectable maintenance of a family in the rank of life to which the clerks belong, on the ground that by ordinary attention to ordinary duties promotion can be secured to a higher class, the principle of preferring superior merit cannot at present be strictly applied to the junior classes of clerks in the Colonial office.

The considerations above adverted to appear to us to call for a decided change of system, based upon the principle of establishing, by degrees, a clear distinction between those kinds of labour which call for the exercise of the higher intellectual faculties, and those in which good penmanship, and common attention to exactness and regularity, are all that is required; and of applying to each of these descriptions of agency the motives and facilities appropriate to it.

The measures we would recommend for this purpose are as follow:—

1. To retain the situations of permanent Under Secretary, Assistant Under Secretary, and Précis Writer, and as many of the senior clerkships as experience may prove to be necessary.

2. To establish as a permanent prospective arrangement a single class of clerks below the rank of senior, which class should be entirely employed in assisting the superior officers of the department in the execution of duties of an intellectual kind, should consist only of as many persons as may be found by experience to be required for this purpose, and should be remunerated by salaries commencing at £150 a year, and increasing at £20 a year to £400.

3. To make the first admission into this class of clerks conditional upon the candidate being not less than 20 and not more than 25 years of age, and upon its being shewn, by the result of a suitable examination, that he is highly educated, and of unequivocal ability; and also to subject him to a year's probation after his admission, as a further test of his power of application and aptitude for bu iness.

4. To lay it down as a rule never to be departed from that promotion from this class to the higher situations in the office is in every case to be conferred upon the person best qualified to succeed, seniority affording a ground for preference only in cases of equal merit. And

5. To employ under the superintendent of copyists, as many persons, to be paid at the existing rates, as may be required to do the whole of the copying and other merely manual work of the department.

If this plan were strictly carried out, we think it would ultimately have the effect of raising up a class of public servants who, besides that ample departmental experience which is the peculiar qualification of the senior clerks, would often possess general attainments rendering them eligible for the situations of précis writer and assistant under secretary of state; and the course recommended by us therefore harmonises with the view taken by the late Select Committee on Miscellaneous Expenditure in their report upon the Colonial Office, that "these offices ought to offer premiums for ability and good service to the department, without confining the Secretary of State necessarily to the selection from that body."

If it shall be determined to adopt the plan we have recommended, it should be gradually carried into effect as circumstances permit. All the clerks belonging to the second, third, and fourth classes of the establishment should, in fulfilment of the expectations under which they entered the office, continue to be eligible for promotion to the classes above them, and the appointment of clerks of the second class *on the new footing* should not commence until at least the whole of the present fourth class has become absorbed, and vacancies have begun to occur in the third class. We are, however, of opinion, that the *spirit* of our recommendations might be at once acted upon, even as regards the persons now on the establishment, by arranging that those among the junior members of the establishment who have shown more than usual dilligence and capacity should be employed, as far as possible, on work which will enlarge their knowledge of and improve their aptitude for business, and by making the promotion from class to class depend upon superior merit and qualification in a much greater degree than heretofore. As vacancies occur on the establishment, such number of additional copyists should be appointed as may be required to do the whole of that description of work.

In the view which we have taken of the defects of the existing system of the Colonial office, and of the general nature of the measures required to remedy them, we have

the entire concurrence of Sir James Stephen, and, we believe, of all the officers now belonging to the department who are most competent to form an opinion. The plan proposed by us is also in accordance with the principle upon which the Treasury establishment has recently been reformed, nearly similar circumstances in that office having led to similar results.

But the most striking confirmation of the soundness of the view which we have taken is to be found in the experience of the India House, the business of which is of the same general character, both as regards its importance and difficulty, as that transacted at the Colonial office. Previously to the year 1831, there was only one establishment of clerks at the India House, rising by successive gradations from a very low to a liberal salary, and employed both in copying and other routine work, and in duties of a much higher kind; but in the above-mentioned year a change was made, the nature of which will be best understood by a perusal of the following extract from the regulations of the India House:—

"That every established clerk appointed be allowed on his admission a salary of £80 for the first year, and that an increase of £16 be annually made until he shall have completed his twentieth year of service, and attained the maximum of £400 per annum, when al increase under the regulations will cease.

"That as there are duties in all the offices the responsibility and importance of which will require the allowance of higher salaries to the clerks performing them than will be attainable by the preceding scale, fixed salaries be established for a certain number of superior stations, to be drawn by the parties filling such stations, without reference to length of service.

"That promotion to the stations with fixed salaries be in every case conferred upon the party best qualified to succeed, seniority affording a ground of preference only in cases of equal merit."

It is also the practice at the India House to have the copying and other merely routine work done by persons paid by fixed rates, acting under proper superintendence. This system is represented by the Secretary, Sir James Melvill, who has kindly furnished us with detailed information on the subject, to have answered its purpose extremely well.

We have suggested that the salaries of the new second or probationary class of clerks at the Colonial office should rise from £150 to £400, instead of from £80 to £400, which is the scale in force at the India House, because we are of opinion that the duties at the Colonial office require qualifications of a higher kind than the greater part even of those at the India House, and that it would therefore be advisable to give a rate of salary immediately upon admission which would afford a respectable maintenance for a young man who has been educated at one of the Universities.

## REPORT OF THE AMERICAN COMMISSIONER OF PATENTS.

To the Speaker of the House of Representatives.

Sir,—I have the honour to submit the following report for the year 1854:—

The condition of the office at the present time, and also as compared with previous years, will be seen in a general way by reference to the following statements, numbered 1, 2, 3, and 4:—

I.

*Statement of Monies received at the Patent-office during the year* 1854.

| | Dols. Ct. |
|---|---|
| Received on application of patents, re-issues, additional improvements and extensions, caveats, disclaimers, and appeals . . | 134,125 00 |
| Received for copies and for recording assignments . . . . . . . | 13,664 84 |
| Amount reimbursed to Patent Fund for Act 4th Aug., 1854 . . . . . | 16,664 84 |
| | 163,789 84 |

II.

*Statement of Expenditure from Patent Fund during the year* 1854.

| | Dols. Ct. |
|---|---|
| For Salaries . . . . . . . | 51,000 85 |
| ,, Additional compensation for Act April 22, 1854 (including 6 months in 1853) | 8,827 59 |
| ,, temporary clerks . . . . . | 32,750 86 |
| ,, books for the library . . . . | 3,772 28 |
| ,, contingent expenses . . . . . | 32,339 78 |
| ,, agricultural statistics and purchase of seeds . . . . . . . . . | 2,838 00 |
| ,, librarian . . . . . . | 700 00 |
| ,, payments to judges in appeal cases . | 475 00 |
| ,, refunding money paid by mistake | 302 00 |
| ,, ,, on withdrawals . . | 34,139 96 |
| | 167,146 32 |
| Excess of expenditure over receipts during the year . . . . . . . | 3,356 48 |
| Excess of withdrawals this year over last . | 10,673 22 |

III.

*Statement of the Patent Fund.*

| | Dols. Ct. |
|---|---|
| Amount to the credit of the Patent Fund, Jan. 1, 1854 . . . . . . | 28,950 0 |
| Amount paid in during the year 1854 (including 16,000 dols. reimbursed by the Act of Aug. 4, 1854) . . . . . | 163,789 84 |
| From which deduct:— | 192,739 84 |
| Amount of expenditure during the year . | 167,146 32 |
| Leaving in the treasury, 1st Jan., 1855 . | 25,593 52 |

IV.

*Table exhibiting the business of the office for fourteen years, ending Dec.* 31*st*, 1854.

| Years. | Applications filed. | Caveats filed. | Patents issued. | Cash received. | Cash expended. |
|---|---|---|---|---|---|
| 1841 | 847 | 312 | 495 | 40,413 01 | 23,065 87 |
| 1842 | 761 | 291 | 517 | 36,505 68 | 31,241 48 |
| 1843 | 819 | 315 | 531 | 35,315 81 | 30,776 96 |
| 1844 | 1045 | 380 | 502 | 42,509 26 | 36,344 73 |
| 1845 | 1246 | 452 | 502 | 51,076 14 | 39,395 65 |
| 1846 | 1272 | 448 | 619 | 50,264 16 | 46,158 71 |
| 1847 | 1531 | 533 | 572 | 63,111 19 | 41,878 35 |
| 1848 | 1628 | 607 | 660 | 67,576 69 | 58,905 84 |
| 1849 | 1955 | 595 | 1076 | 80,752 78 | 77,716 44 |
| 1850 | 2193 | 602 | 995 | 86,927 05 | 80,100 95 |
| 1851 | 2258 | 760 | 869 | 95,738 61 | 86,916 93 |
| 1852 | 2639 | 996 | 1020 | 112,056 34 | 95,916 91 |
| 1853 | 2673 | 901 | 958 | 121,527 45 | 132,869 83 |
| 1854 | 3324 | 868 | 1902 | 163,789 84 | 167,146 32 |

From this last statement, it appears that 3,324 patents have been applied for within the past year, which is an increase of 651 over the applications of the previous year. The number of patents issued in 1854 is nearly twice as great as in 1853.

The number of cases in the office awaiting examination on the first day of January, 1854, was stated in the report of last year to have been 582. Owing to an imperfect mode of computation, this number was found to be incorrect. An actual count showed that there were really 823 cases on hand and undisposed of at the commencement of the past year. That number is now reduced to 89, so that the work of the office can hardly be regarded as being at all behind-hand. Applications are now acted upon within a very few days after being made.

The receipts of money from all sources during the past year amount to dols. 163,789·84, and the whole expenditure has been dols. 167,146·32. This exceeds the receipts by dols. 3,356·48. Among the receipts is included

the sum of 16,000 dols., refunded to the patent office for expenses incurred, partly in 1853, and partly in 1854, in fitting up the rooms for the new building and for other similar purposes, so that the revenue arising from fees alone, during the year 1854, has been only dols. 147,789·84. This falls short of the actual expenditure by dols. 19,356·48.

This excess of expenditure has resulted partly from the additional compensation allowed by the Act of 22nd April, 1854, to clerks and other persons employed in the office, in accordance with which the sum of dols. 8,827·59 has been paid during the past year, as appears from the foregoing statement, No. 2.

The expenditure has also been very much augmented during the year, by the necessity of repairing a large number of the models in the office, and also of cleansing, varnishing, and removing them to their new receptacle. The crowded condition in which it has heretofore been necessary to place them, has resulted in numerous and great injuries, which it was incumbent on the office to repair; they will be in a great measure exempt from such injuries in future.

But the largest item of extraordinary expenditure has resulted from the augmentation of force necessary to dispose of the accumulation of arrearages before mentioned. The number of cases now on hand is less by 734 than that which existed a year previous. The fees of these 734 cases (amounting to more than 20,000 dols.) were received in 1853; the labour has been performed, and the expense incurred in 1854. The entire income which has resulted from all the cases disposed of during the past year has been greater than the whole expenditure of that year.

It is therefore possible that the receipts for the coming year may be nearly or quite equal to the expenditure, if rigidly confined to those things which are indispensably necessary. There are, however, some matters which, though not altogether indispensable, seem to commend themselves strongly to the favourable consideration of Congress, and which will call for some increase of expenditure in future.

Among these may be reckoned, in the first instance, an increase of salary to some of the Examiners. In the report for last year, it was stated that the examining force had been augmented by placing an additional clerk in each of the examining rooms, as a second assistant-examiner. The dispatch of business in the office was much facilitated by this management, which was, however, found inadequate to the rapid increase in the number of applications. It was therefore thought expedient to place several of the assistant-examiners in charge of duties which had previously been entrusted only to the principal examiners. Accordingly, on the first of April last, five of the assistant-examiners were each intrusted with the charge of an independent examining desk, so that, for nine months of the past year, there has been eleven separate and independent examining-rooms, with each an acting principal and assistant-examiner. These assistant examiners, who have thus been performing the duties of principals, and the clerks of the second class, who have been acting as assistant-examiners, seem to have just claims to be placed on a footing of equality, as to compensation, with others who are performing the same duties, and are subject to the same responsibilities. The necessary examinations cannot be made with proper promptness with a less force than ten principals, and as many assistant-examiners, and should the business of the office continue increasing, as it now promises, before the end of the present year we shall need twelve of each class of examiners. The number should, therefore, I think, be increased to that extent at once, or power given to the Commissioners, so as to increase it as soon as occasion requires. The business of the Patent-office progresses or lingers in precise proportion to the efficiency of the examining corps. The increased expense of supplying a few additional examiners is trifling in comparison with the advantage of having the business of examination despatched in a few days after the application is made, instead of obliging the applicant to wait as many months for that purpose.

The Report for the year 1853 was illustrated with wood-engravings, which, though somewhat imperfect, are believed to have added much to the value of that report, by rendering it vastly more intelligible than it could otherwise have been made. Steps have more recently been taken to improve still further in this particular by providing copperplate engravings for the purpose. A conditional contract has been made with a competent artist, which, if approved by Congress, will render the report for the year 1854 highly creditable to the office, and eminently useful to the public. I feel great confidence that the advantages resulting from these illustrations will fully justify the increased expenditure thereby rendered necessary.

The present rate of fees has been in existence for more than sixty years, with but little variation. During that time the intrinsic value of money has been very essentially diminished. The labour and expense thrown upon the office has been more than doubled by the change which took place in 1836, and the additional compensation more recently provided for clerks and other persons employed in the office, has still further contributed to swell the ratio of expenditure to that of revenue, and to call for a new tariff of fees, in order to prevent the necessity of curtailing the expenses of the office in a way which cannot but be prejudicial to the best interests of those by whom those fees will be paid. It is believed that the inventors themselves would prefer a sufficient augmentation of the rate of fees to enable the business of the office to be promptly and successfully conducted, rather than to save a few dollars at the expense of great vexation and delay in obtaining official action upon their applications for patents.

In my last annual report the attention of Congress was invited to the consideration of the propriety of abolishing all discrimination in the rate of fees, as between citizens and aliens; subsequent reflection has only confirmed the opinion then entertained and expressed on that subject.

Some of the beneficial results of the liberal policy then recommended, in inducing a like liberality on the part of other nations, are already sufficiently obvious.

At the present time the laws of Canada do not permit our citizens to obtain patents in that province under any circumstances, which causes great inconvenience and loss to our inventors. All machines invented here can be made and used in Canada without any license from the American patentee, and the products of those machines can, with little trouble or expense, be brought into our markets to compete with like commodities manufactured here by persons who are obliged to pay for the right to use the patented machines for that purpose. This operates like a discriminating tariff against the home manufacturer, which cannot but be prejudicial to his interests.

Reliable information, of a private character has, however, been received, to the effect that the Canadian Parliament is taking steps to remove this cause of complaint. A bill was introduced into that body at a recent session (which has been adjourned over to some time in the present month), and is still pending, which contemplates allowing American inventors to obtain patents in Canada, and the only cause of complaint as to its becoming a law is believed to grow out of the enormous fee demanded by this office from all Canadian inventors. The proposed modification in our rate of fees would, doubtless, be followed by the desired change in the Canadian law. This would remedy the difficulty complained of by our inventors, above alluded to, so far as future patentees are concerned, and might, perhaps, do so in relation to patentees of a previous date.

It may be thought that we shall best attain our object by retaliatory measures. Such a course would be calculated to arouse angry and hostile feelings, rather than to lead to any final advantage to either party. A course

dictated by kindness and liberality will soon dissolve the barriers which make nations strangers and enemies. We can well afford to lead the way in a course of measures which will contribute no inconsiderable share towards rendering us and our Canadian neighbours practically one people.

I take the liberty of inviting the attention of Congress to the other matters treated of in my report for 1853, to which I have nothing to add at present.

Very respectfully yours, &c.,
C. MASON,
Commissioner of Patents.

## Home Correspondence.

### THE DISCUSSION ON DECIMAL COINAGE.

SIR,—The sudden close of the discussion on Wednesday evening having precluded the authors of the papers from the reply usually allowed them, I beg the favour of space for a few observations.

Two objections were made to the scheme of adopting the florin as the unit or leading coin of account, and having only one other coin of account, the hundredth of the florin.

The first objection was, that it is not strictly a decimal system. In answer to this it appears sufficient to refer to the fourth paragraph of my paper, in page 222 of last Journal, in which this objection is anticipated and disposed of.

The other objection was, that it is a matter of indifference where the decimal point is placed, the same work being required whatever position it occupies; that, in fact it is the same whether we consider 2,345 cents (hundredths of a florin) as £2·345 cents, or as 23 florins 45 cents.

It is so theoretically, but there is a wide difference in the facility of dealing with the two forms in practice. If we wish to compute the cost of two articles at 23 florins 45 cents. each, any ordinary arithmetician at once sees that the two will cost 46 florins 90 cents, and so of numbers of other simple operations. But if the question is presented in the form of "two articles at £2·345 cents each," clubbing together the three right-hand figures as cents, they present a combination the value of which is less obvious, and which few but expert arithmeticians can deal with mentally.

It may be said that the mind would remove the 3 to beside the 2, and operate with the figures as 23 and 45. Very few would readily perform that operation. Gentlemen occupied as actuaries, bank-cashiers, or teachers, whose vocation it is to be expert at figures, can, of course, easily do a thousand feats with numbers; but the great majority of those who are not compelled professionally to be proficients in arithmetic, will look at things only as they are set before them, and will have it indelibly fixed in their minds, that the fourth place, and all to the left, mean pounds, and the first three figures mean cents; they will become familiar with the figures, as expressing pounds and cents, and be practically unable to operate with them unless in that shape.

It may, perhaps, be further urged that if—to continue the above example—the three figures, 345, are more difficult to deal with, there is a figure fewer in the higher denomination, which would be, therefore, proportionately easier to calculate with. But it must be borne in mind that the great majority of money transactions, especially among the less educated classes, are with small sums, involving few florins or pounds, sometimes none, but always including the less coin, and that there is an impassable gulf to all ordinary persons between arithmetical mental operations with *two* and those with *three* figures. Hence the numbers expressing the lower coin should be kept in as simple a form as possible, that is, be limited to two figures. Thousands, and these with imperfect powers of caculation, have to deal with sums under £10 (and only these can be expressed decimally with four figures), such as £8·314 cents, £5·101 cents, 913 cents, £1·387 cents—for one who has to pass the amount of £10; and it appears sufficiently obvious that the easiest form for such sums is 83 fl. 14 cents; 51 fl. 01 cent; 9 fl. 13 cents; 13 fl. 87 cents; in short, the great majority of people have to deal with small sums, and it is for the benefit of that majority that such sums should be expressed and operated with in the simplest form.*

There is an obvious advantage, too, in having a low unit of account, as thereby quantities of the small coin or change are sooner brought to their ultimate form, in which no further operation is to be performed on them; and although there may, in many cases, be a figure more of the larger coin, this matters little, as the mind, by practice, will soon come to appreciate its value instantaneously, and it is seldom that very many figures of it will be required.

It is worthy of remark that the leading states which have adopted a decimal coinage, have only two leading coins, which are to each other as 1 to 100, and the higher of which is of a comparatively low value, varying in the different countries from 7½d. to 4s. 2d.

In next week's Journal, if you will oblige me, I shall endeavour to exhibit, by a few simple tables, the real points at issue between the advocates of the pound and of the penny.

Your's, &c.,
H. REID.

February 17, 1855.

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SIR,—The opportunity of a reply not having been afforded me last Wednesday evening, mainly owing, no doubt, to the lateness of the hour, I trust I may be allowed to offer a few brief remarks, chiefly in reference to the observations of Mr. R. R. R. Moore, the Secretary of the Decimal Association, on that occasion.

Throughout the greater part of the discussion less regard seems to have been paid to the paper I had the honour to read before the Society of Arts than to a small pamphlet entitled, "A Word in behalf of the Poor Man's Penny," which I published during the discussion on this question at the Institute of Actuaries in January and February last year, and which bore on the title-page the motto, "Penny Wise and Pound Foolish (?)." Had Mr. Moore wished to exhibit to the meeting of last Wednesday evening my particular views on the subject of a decimal coinage for this country, I submit it would have been fairer to have quoted from my subsequent paper, read before the Statistical Society in June last, and printed in their Journal for September. Mr. Moore was present on that occasion, and took part in the discussion which followed; so that he was acquainted with a more complete exposition of my views than what appears in the before-mentioned little tract. I contend, however, that Mr. Moore, in thus directing his opposition to the Penny-wise-and-pound-foolish pamphlet, as he is pleased to term it, was not altogether in order, inasmuch as I had been invited to prepare—and had closely kept the object in view—a short paper, not to explain any particular proposals of my own, but to advocate *the leading views* held in common by those who desire to see a decimal coinage established in this country, that shall not interfere with the value of the copper money so

* Mr. Yates, whose essay "On the French System of Measures, Weights, and Coins," gained a silver medal from the Institution of Civil Engineers, and is one of the best of the recent treatises on decimal coinage, observes, p. 91—"The use of three places of decimals, as in ·625=12s. 6d., and ·333=6s. 8d., would be intolerable in ordinary practice. The experience of all civilised countries showed that even the poorest and rudest persons had no difficulty in reckoning mentally by tens."—"But the proposed mode of reckoning continually in the head by mils up to 999 would be perplexing even to good arithmeticians."

extensively in circulation amongst us;* and it will not have escaped observation that my paper refers to Mr. Theodore Rathbone, Dr. Gray, and the late Mr. Laurie, as the leading supporters of this *sine qua non* of the *tenpenny system.* Whenever a fitting opportunity may offer I shall not be unprepared to discuss with Mr. Moore, or any one else, the particulars referred to in my previously published plans; at present I wish to confine my reply to some of the extraordinary statements made by this gentleman in his speech of last Wednesday evening.

Mr. Moore professed to believe that the proposal to create a new silver coin, such as the tenpenny, was fraught with danger alarming in the extreme. "He (Mr. Moore) ventured to say there was not a banking-house in London in which the clerks had not as much to do as they could get through now. The number of clerks must be increased in all the establishments if they adopted this new coin, and some of the banks were now so pressed for room to carry on their business, that the introduction of the new coin would actually involve the necessity, in the great majority of cases, of new premises, to make room for the new clerks." † Well, but Mr. Moore himself proposes a new silver coin—"We want a silver tenth of a florin—call it the cent," ‡ were his concluding words. A similar strain of useless oratory was levelled against my proposition for a gold coin of 100d., termed an *Imperial*—a question not before the meeting. Mr. Moore seems to think that I have not carefully considered the circumstances of the adoption of such a coin. "It would," he asserts, "double the labour of the counting-house—it would increase the number of clerks at every bank—it would cost as much to cut the die as for the sovereign—the wear would be rapid—they would soon become light—if they were made thick they would not ring, &c." Very well! if these be good objections, then coin *double imperials*, or any other more suitable multiple. Had Mr. Moore, however, glanced his eye over the collection of foreign coins on the table, he would probably have found gold pieces not very dissimilar to my imperial, and to which none of his fancied objections are found to apply. Mr. Moore will pardon me if I tell him he has been fighting a phantom of his own raising.

The objection made by the propounders of the tenpenny systems, that the lower coins proposed under the millesimal division of the pound sterling are incommensurable with the present copper currency, and, therefore, likely to prove injurious and confusing to the humble classes, is met by this champion of the Decimal Association with the reply, that even now the penny does not always meet the value of articles with exactness: an argument which, if it means anything, pleads the existence of an acknowledged wrong as a good reason for establishing a greater. Mr. Moore further illustrates his point, however, by informing us that the poor man would have such loss made up to him by having his *pound* of potatoes sometimes with a *few larger ones* in it! The great discovery this gentleman has made, that in £1000 there would be £48 7s. 7¾d. difference, if that sum were expressed in *tenpennies* and French *francs*, shows how fond some persons are of mystifying the statements of others. We have nowhere asserted the equality of these coins, but simply urged that a general affinity with the units of currency of these countries to which reference was made, would be expressed by our most popular coins.

Reference was made by more than one speaker in this discussion, to asserted difficulties that would exist under the tenpenny plan for a decimal coinage, in transposing the present to the new money, and *vice versa.* Now it is easy to see that at first any system that might be adopted would be attended with some amount of difficulty in this respect; in the case of the pound divided into 1000 *mils*, the process of conversion takes place at the lower end of the scale, where it presents the greater amount of labour, being opposed to the humbler and less educated class of people, and would be also of more frequent, because of almost constant occurrence. This difficulty is slighted by actuaries and others, who have to deal more commonly with pounds than with pence, and to whom the *mil*, or 1-1000th of a pound sterling, is of little consideration, because they are already practised in an easy method of converting, with sufficient exactness for their purposes, shillings and pence to the decimals of a sovereign. The tenpenny plan, on the other hand, has this difficulty of conversion at the upper end; it is, however, more especially opposed to the class of persons best fitted to cope with it. Pounds might be reduced to *tenpennies* by doubling the given sum, repeating the same operation with this last, taking care to place it one figure to the right, and then adding the two products. Example: Reduce £23 to *tenpennies.*

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  23
  —
  46
   92
 ———
Ans. 552
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Conversely; a sixth subtracted from half the number of tenpennies would be the amount in pounds sterling. A little practice would exhibit the facility with which such changes could be made, which would of course be required only until the system were generally used; tables, if desired, would serve to aid in this particular.

Before concluding I may notice that Mr. Miller speaks of the proposers of this plan as paying great deference to the penny, chiefly on account of its antiquity and name. A careful perusal of the pamphlets put forth in its behalf will, however, show that it is the *value* of the penny as a present representative of the cost of a great number of the commodities of the poor, that we really contend for; substitute other coins that will *exactly* represent the penny, and no opposition on this point will be offered. When, however, a proposal is put forth by which the shilling of the day labourer is made practically tenpence, it is not without reason that it is objected to. Did space allow, I would crave permission to make some reference to Mr. Brown's statements relative to the Decimal Association. Reserving this, however, for a further opportunity,

I remain,
Your obedient servant,
FREDERIC JAMES MINASI.

Islington, February 21st, 1855.

* During the past year there were coined at the Mint no less than 6,800,000 pennies, 12,400,000 halfpennies, and 6,500,000 farthings, constituting above 270 tons weight of copper money. The number of *florins* coined in the same period was 550,000 only.

† *Vide* Report of the Discussion, "Journal of the Society of Arts," No. 117.

‡ Value 2⅖d.

## THE SMOKE NUISANCE.

Sir,—If Mr. Stevens had allowed his observations to remain uncorrected, he would have done well, and if he had refrained from referring to Mr. Fairbairn, he would have done better.

Where there exist the preliminary conditions of boiler room and draught, there is no need whatever for any invention patented within thirty years from this date. Where these conditions do *not* exist, the modern and antique inventions are alike of no use, and where they *do* exist, they can be done without.

The reason why smoke is discharged from furnaces possessing these requisites is, that they only afford the *means* by which the *discharge* of smoke may be *prevented*, while in many cases these means are not used, just as was the case at Miller and Co.'s, when I called on them with Mr. Stevens.

I thought I had stated very clearly that much more depended on the *management* of the furnace than on the nature of the *appropriate inventions* applied to it.

I have no bias against inventions, ancient or modern; nor, truly, against the inventors. I have, however, after

lengthened inquiries and patient investigation, formed *opinions* respecting both; and, with reference to the latter, I believe that, generally speaking, they are parties who re-invent something known long before, but not to them.

I did not omit all mention of my experience as Inspector at Glasgow. My whole paper was based upon that experience, and I referred specially to Juckes's furnace because that was the invention which was the panacea of the Smoke Committee then, and it was my experience there, which proved to my satisfaction that, for all "practical purposes," inventions are useless.

I do not know what are the leading propositions set forth by me which Mr. Fairbairn did not agree with. I have not with me at present a copy of the report, but from recollection I acknowledge Mr. Fairbairn thought a large boiler the principal requisite, and that he would encourage *all* inventors. I think that draught is the first thing required to consume smoke—the economy of that process will depend on the size of the boiler being adequate to the duty required from it.

I have not ignored all that has been done in the metropolis during the last 18 months. I am, for a person residing some hundreds of miles distant, tolerably well acquainted with what has been done, but I can see nothing whatever different from what has been done over and over again. A stir is made; out come numbers of inventions; they are applied; next appear flattering testimonials. Timid smokers, or those who "wish to do something," if but for a blind, apply them, and the humbug goes on. Whenever Lord Palmerston attacks some one with a long purse and spirit, the bubble will burst, unless the law be amended, and made reasonable.

Since Mr. Stevens has referred to Mr. Fairbairn, allow me to quote from that gentleman's evidence before Mr. MacKinnon's Committee. In answer to

Q. 604. Mr. Fairbairn said:—"I think there is no question as to the practicability of consuming the smoke, for it can be done in almost any instance, even by the common boilers, by proper care and attention on the part of the fireman."—Answer 611. "I think there is no difficulty, but that with proper management, *without any apparatus*, the fireman himself could effectually consume the smoke."

Q. 612. "WITHOUT ANY APPARATUS WHATEVER?"—Answer. WITHOUT ANY APPARATUS."

Q. 613. "But with the apparatus there is no question about it?" Answer. "There is no question about it; but even with the apparatus, *unless attended to*, the smoke *will* come from the chimney.

Really it is time that the delusion about smoke-consuming inventions be dissipated, and action taken based on sound principles.

But it may be said, these were Mr. Fairbairn's views twelve years ago; they are modified now. Fortunately, I can give you that gentleman's present views in a much more satisfactory form than when conveyed in a few words spoken at a Society's meeting. Some months ago, Mr. Fairbairn was, along with two other persons, employed by the authorities of Glasgow, to inspect certain furnaces there, and to report thereon. Here, then, we have an *official professional report* of but a few months date, and in no circumstances can I imagine that greater care might and would be taken to make a report upon which dependence could be placed by Mr. Fairbairn's employers. I know that I am entitled to speak of the report as *his* and his *only*, though, according to the Act of Parliament, it is given as the report of "three engineers, or other persons of skill in such matters." What, then, does Mr. Fairbairn recommend as the *best plan* for preventing smoke? He says "There are innumerable schemes and patents in operation for the consumption of smoke,—moving grate bars, Juckes's patent, Witty's universal smoke-consuming apparatus, and a hundred others; wishing, however, to avoid all complexity and unnecessary expense in construction, we are of opinion that the object may be effected in one of three ways, viz:—1st. By a common circular boiler of sufficient power. 2nd. By the introduction of the double flue and double furnace boiler, with alternate firings, which is probably a more economical plan than the preceding. 3rd. By the introduction of one of the multitubular boilers, 24 feet long, 7 feet in diameter, with double furnaces, mixing chambers, and about 110 to 120 three-inch tubes, WHICH IS THE BEST AND MOST APPROVED PLAN." At another part of this report I find the following sentence:—"In fact, the whole secret of economy in combustion and the absence of smoke is plenty of boiler space, and that consideration should never be lost sight of in our attempts at improvements in that direction."

I quite agree in opinion with Mr. Fairbairn, that where economy *and* combustion of smoke are *jointly* the objects in view, a *comparatively* large boiler is requisite; but when the object is *only* perfect combustion and the prevention of smoke, the size of the boiler is immaterial, but draught, however obtained, is then the most important consideration.

The foregoing should prove that Mr. Fairbairn, though willing to encourage all inventors, does not now deem *apparatus* essential in smoke burning.

If Mr. Mansfield imagines that he or any other person who ascertains the best relative dimensions of furnaces, boilers, flues, and chimnies, by which the most perfect combustion may be attained, could obtain a patent for the exclusive use of such relative dimensions, I would recommend him forthwith to institute experiments and secure his discoveries by patent. But, a little reflection or inquiry of his patent agent, will soon satisfy Mr. Mansfield that such a patent could not be obtained, or, if obtained, could not be maintained in a court of law; and it is to this fact of relative dimensions being unpatentable, that we see the ingenuity of inventors turned to the contriving of *apparatus*. Now, no apparatus contrived for the admission of air above the fuel in furnaces will answer where the furnace and adjuncts are not properly constructed in the ordinary way, and of adequate relative dimensions; but, where the dimensions are adequate, air may be with advantage admitted above the fuel; and where the furnace is otherwise well managed, that is, the fuel supplied with care, the result will be perfect combustion and no smoke.

As I suppose my letter referring to Mr. Stevens' communication some weeks ago will appear with this in your next, I deem it unnecessary at present to notice Mr. Williams' review.

Yours, &c.,
G. W. MUIR.

P.S.—When speaking of *inventors*, I wish it to be understood that I consider the mechanical means invented by Brunton, Juckes, Hazledine, and Foard, reflect great credit upon them, but still their inventions are of no use except in very special cases.

## Proceedings of Institutions.

LEEDS.—The Yorkshire Union Village Library, as has been on various occasions explained, was established for the purpose of providing those villages with books where no library at present exists. The books are lent in sections of fifty volumes (exchanged every six months) to every place where twenty-five subscribers at a penny per week can be found, with a librarian to take charge of the books. The attention of his Royal Highness Prince Albert has lately been called, by the hon. secretary, Mr. James Hole, to the plan, and it will gratify the friends and subscribers of this excellent Institution to learn that, as a mark of his warm approbation of the Village Library

and its objects, the Prince has presented a handsome donation of books to the Union. The books consist of—

| | Vols. |
|---|---|
| Bohn's Standard Library . . . . . . | 109 |
| Knight's Volume, 160 vols. bound in . . | 68 |
| Longman's Travellers' Library, 75 parts bound in | 18 |
| Murray's Railway Reading, 30 parts bound in . | 16 |
| Total . . | 211 |

All are beautifully and strongly bound, and on the inside of the cover of each volume is a label with the inscription, "Presented to the Yorkshire Union of Mechanics' Institutes by his Royal Highness Prince Albert.

## To Correspondents.

A letter from Mr. John Evans, in reply to that from Mr. Homersham, which appeared last week, as well as one from Mr. R. Davison, in reference to the "Iron Industry of the United States," stand over for want of space.

## MEETINGS FOR THE ENSUING WEEK.

MON. Royal Inst., 2. General Monthly Meeting.
Architects, 8.
Chemical, 8.
Entomological, 8.

TUES. Horticultural, 2.
Royal Inst., 3. Professor Tyndall, "On Electricity."
Civil Engineers, 8. Discussion upon Mr. Allen's paper, "On Steam and Sailing Colliers, and the modes of Ballasting," and "On the Application of the Screw Propeller to the larger class of Sailing Vessels," by Mr. R. A. Robinson.
Linnæan, 8.
Pathological, 8.

WED. Meteorological, 7.
Society of Arts, 8. Mr. J. B. Lawes, "On the Sewage of London; its Composition and Value as a Fertiliser."
Geological, 8. 1. Mr. M. H. Rosales, "On the Geology of the Ballarat and Creswick Creek Gold Fields, Australia." 2. Mr. M. F. Odernheimer, "On the Geology of the Peel River District, Australia." 3. Rev. Mr. Clarke, "On the Occurrence of Fossil Mammalian Bones in the Auriferous Alluvia of Australia." 4. Rev. Mr. Clarke, "On the Occurrence of Obsidian Bombs in Auriferous Alluvia of Australia."
Pharmaceutical, 8½.

THURS. Royal Inst., 3. Mr. Donne, "On English Literature."
Medical, 5. Anniversary Oration.
Antiquaries, 8.
Royal, 8½.

FRI. Astronomical, 8.
Philological, 8.
Royal Inst., 8½. Mr. T. Sopwith, "On the Mining Districts of the North of England."

SAT. Royal Inst. 3. Dr. Gladstone, "On the Principles of Chemistry."
Royal Botanic, 3¾.
Medical, 8.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS,

*Delivered on 10th, 12th, 14th, 15th, and 16th February*, 1855.

Par. No.
45. Steam-ship "Philadelphia"—Copy of Report.
47. Bank of England—Annual Accounts.
50. Civil Service—Supplementary Estimates, 1854-55.
40. Small Arms—Return.
14. Land Revenue (East India)—Return.
52. Navy Estimates.
53. Transport Service and Prisoners of War—Estimate.
51. Army Estimates.
48. Bullion, &c.—Return.
54. Railway Acts—Return.
55. Acts of Parliament—Return.
56. Royal Military College (Sandhurst)—Return.
20. Bills—Education.
21. Bills—Mines (Ireland).
22. Bills—Schools (Scotland).
Poor Relief (Scotland)—9th Annual Report of the Board of Supervision.

*Delivered on 17th and 19th February*, 1855.
22. Poor Law (Ireland)—Return.
43. Coffee (Crimea)—Copy of Correspondence.
57. Promotion and Retirement (Army)—Copy of Royal Warrant.
49. Metropolitan Police—Accounts.
Factories—Reports of the Inspectors for the half-year ending 31st October, 1854.

SESSION, 1854.
484. Valuations—Return.

*Delivered on 20th February*, 1855.
25. Duchy of Cornwall—Account.
59. Russian Dutch Loan—Account.
60. Greek Loan—Account.
63. War with Russia—Dispatches from Governors of British Colonies.
Inclosure Commission—10th Annual Report.
Tithe Commission—Report.
Copyholds—13th Report of Commissioners.
Railways—Report upon the Accidents which have occurred during the year 1854.

*Delivered on 22nd February*, 1855.
58. Ordnance Estimates.
64. Exchequer Bills—Account.
23. Bills—Intramurial Burials (Ireland).
25. Bills—Army Service Act Amendment.
Railway Accidents (1st July to 31st December, 1854)—Return.

*Delivered on 23rd February*, 1855.
42. Emigration (Australia)—Copies of Despatches.
65. Trade and Navigation—Accounts.
24. Bills—Poor Relief (Ireland).
31. Bills—Cathedral Appointments Act Continuance.

*Delivered on 24th and 26th February*, 1855.
24. Transports—Return (a corrected Copy).
66. Paupers—Returns.
69. Poor Law (Ireland)—Return.
70. Banks of Issue—Return.
72. Staff and Garrison Appointments (Colonies)—Return.
27. Bills—Newspaper, &c., Postage and Stamp Duties.
26. Bills—Public Prosecutors.
41. Bills—Militia (Ireland).
42. Bills—Commons Inclosure.
44. Bills—Lunatic Asylums (Ireland) (Advances).

SESSION, 1854.
489. Poor Removal—Return.

*Delivered on 27th February*, 1855.
71. Committee of Selection—1st Report.
74. British Ships—Returns.
76. Commissariat (transfer to the War Department)—Copy of Treasury Minute.
28. Bills—Sea Coast Fisheries (Ireland).
29. Bills—Iceland Fisheries (Ireland).

SESSION, 1854.
469. Mails on Railways—Return.

*Delivered on 28th February*, 1855.
40 (1). Small Arms—Return.
30. Bills—Dwelling Houses. (Scotland.)
33. Bills—Court of Chancery. (Ireland.) (Procedure.)
35. Bills—Court of Chancery. (Ireland.) (Sales of Estates.)
36. Bills—Court of Chancery. (Ireland.) (Appeals.)
38. Bills—Intestacy. (Scotland.)
40. Nuisances Removal, &c. (Amended.)
43. Dean and Woolmer Forests.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Feb. 23rd*, 1855.]

*Dated 10th January*, 1855.
67. H. Bessemer, Queen-street-place, New Cannon-street—Ordnance.

*Dated 20th January*, 1855.
161. J. H. Johnson, 47, Lincoln's-inn-fields—Seats. (A communication.)

*Dated 27th January*, 1855.
207. J. Hutchinson, Huddersfield—Apparatus to economize steam.
210. E. Davis, Aldgate—Waterproofing paper.

*Dated 3rd Febrvary*, 1855.
253. F. S. Thomas, 17, Cornhill, and W. E. Tilley, 6, Kirby-street—Coating metals.
255. J. T. Chance, Birmingham—Glass pipes.
257. J. Patterson, Beverley—Washing, wringing, and mangling machinery.
259. J. Lippman, Paris—Dyeing skins.
261. T. Allan, Adelphi-terrace—Motive power.

*Dated 5th February*, 1855.
263. G. Pattison, Glasgow—Finishing woven fabrics. (A communication.)
265. J. H. Johnson, 47, Lincoln's-inn-fields—Steam boilers. (A communication.)
267. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Preserving railway tickets. (A communication.)
269. E. Hartnall, 1, St. Mary Axe—Preserving food.
271. J. Gibbons, 345, Oxford-street—Fixing spindles of door locks to knobs.
273. T. B. Daft, Isle of Man—Beds.

*Dated 6th February*, 1855.
275. J. Gedge, 4, Wellington-street South, Strand—Frames for photographic portraits. (A communication.)
277. T. Aston, Compton-street, Regent's-square—Communicating with drivers of carriages.

279. A. Warner, 11, New Bond-street—Coating sheet iron and steel with lead, &c.
281. P. Smith, Glasgow—Printing textile fabrics.
283. G. Audemars, Lausanne—Treating vegetable fibres.

*Dated 7th February*, 1855.

285. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury —Motive power by heated air. (A communication.)
286. W. Warbrick, Dukinfield, and J. Walker, Compstall-bridge, Stockport—Spinning machinery.
287. J. G. Johnson, 18a, Basinghall-street—Surgical bandages.
288. G. T. Bousfield, Sussex-place, Loughborough-road—Steam ploughing machines. (A communication.)
289. E. Davies, Liverpool—New oil.
290. G. T. Bousfield, Sussex-place, Loughborough-road—Looms. (A communication.)
291. R. D. Chatterton, Cobourg, Canada West—Propelling vessels.
292. A. J. Hoffstaedt, Albion-plain, Blackfriars, and S. Blackwell —Powder flasks and shot belts.
293. G. Briggs, Wigmore-street—Carriage spring.
294. A. V. Newton, 66, Chancery-lane—Spur. (A communication.)
295. A. V. Newton, 66. Chancery-lane—Dry docks. (A communication.)
296. W. Hartfield, Prospect-place, Bermondsey—Book covers in tortoiseshell, and also inlaid with pearl and ivory, &c.

*Dated 8th February*, 1855.

297. J. Wilson, Manchester—Rollers for printing fabrics.
298. A. Girard, Pertuis, Vaucluse—Extinguishing fires.
299. F. Puls, Soho-square—Apparatus for smoking tobacco.
300. J. Armstrong, Normanton—Permanent way.
301. G. F. Wilson and G. Payne, Vauxhall—Glycerine.
302. F. Ransome, Ipswich—Drying articles made of plastic materials.
303. R. J. Mary'on, 37, York-road, Lambeth—Ordnance and fire-arms.

*Dated 9th February*, 1855.

304. C. Armsdell, Fenchurch-street—Sifter.
305. J. Martin, Liverpool—Treating grain.
306. W. B. Adams, 1, Adam-street, Adelphi—Elastic springs.
307. J. Lees and W. Heap, Ashton-under-Lyne—Machine for cutting bars of metal.
308. W. B. Johnson, Manchester—Steam boilers and engines.
309. B. Pont, Paris—Autographic engraving.
310. F. Parker, Northampton—Paper.
311. J. Langman, Plymouth—Portable buildings.

*Dated 10th February*, 1855.

312. C. Barnard and J. Bishop, Norwich—Apparatus for cutting vegetable substances.
314. G. H. Ingall, Throgmorton-street—Telegraph apparatus.
315. S. Russell, Sheffield—Projectiles.
316. G. H. and H. R. Cottam, Old St. Pancras-road—Iron buildings.
317. W. Balk, Ipswich—Machinery for crushing grain.
318. A. Sands, Liverpool—Substitute for clothes-pegs. (A communication.)
319. L. A. F. Besnard, Paris—Fixing lithographs, &c., on canvas.
320. A. E. L. Bellford, 32, Essex-street, Strand—Materials for cementing, painting, &c. (A communication.)
321. G. Rennie, Holland-street—Marine engines.

*Dated 12th February*, 1855.

323. S. Smith, Manchester—Winding yarns.
325. D. Barr, Birmingham—Tap.
327. R. S. Harris, Leicester—Looped fabrics.

*Dated 13th February*, 1854.

329. S. Smith and M. Morris, Manchester—Spinning machinery.
331. A. Vallery, Rouen—Machinery for preparation of flax, hemp, &c.
333. G. Dalton, Lymington—Reverberatory furnaces.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed February 23rd*, 1855.

1883. George Burch, Waltham-cross, Cheshunt—Improvements in the manufacture of pulp.
1886. James Lamb Hancock, Milford Haven, Pembrokeshire—Improvements in machinery for draining land.
1889. Thomas McNally, William-street, Bridge-street, Blackfriars—Improvements applicable to window sashes or shutters.
1927. James Parker, Birmingham—An improvement or improvements in the smoke boxes of locomotive engines.
1966. Julian Bernard, Club-chambers, Regent-street—Improvements in the manufacture of boots and shoes or other coverings for the feet.
1974. Thomas Clowes, Beverley—Improvements in muzzles for horses, or apparatus to prevent horses from biting or sucking their cribs or mangers.
1980. Samuel Szontagh, Paris—Improvements in sewing machines.
1999. Alfred Wilson and George Wilson, Nottingham—Improvements in knitting machinery.
2041. William Hodson, Kingston-square, Hull—Improvements in apparatus for the manufacture of bricks, tiles, and other articles from plastic materials.
2158. William Johnson, 47, Lincoln's-inn-fields—Improvements in windlasses.
2180. Edward John Seville, Brixton—An improvement in the manufacture of hats.
2442. George Tomlinson Bousfield, Sussex-place, Loughborough-road, Brixton—Improvements in preventing incrustation in steam boilers.
2596. George Taylor, Liverpool—Improvements in regulating the action of governors of steam and other engines.
2624. Samuel Fisher, Birmingham—Improvements in ordnance, and in machinery and apparatus to be employed in manufacturing the same.
2627. Thomas Haimes, Melbourne, near Derby—Improvements in warp machinery.
2630. James Redgate, Sneinton, James Thornton, Nottingham, and Edwin Ellis, Sneinton—Improvements in machinery for the manufacture of lace and other fabrics.
2638. James Rose, Ashford, Kent—An improvement in constructing the fire-boxes of steam boilers.
2663. Robert Von Seckendorff, St. Helens—Improvements in concentrating and distilling sulphuric acid.
2726. John Nash, Market Rasen—Improvements in the means or process of drying malt, grain, or roots.
2730. William Edward Newton, 66, Chancery-lane—Improvements in looms for weaving.
2740. William Ward, Sheffield—Improvements in stoves.

*Sealed February 27th*, 1855.

1893. John Fisher Williams, 19, Artillery-place West, Bunhill-row —Improvements in joining cast-iron tubes.
1914. James Danks, Birmingham—An improvement or improvements in inkstands, which improvement or improvements may also be applied to the stoppers of bottles, the packing of pistons, and other like purposes.
1919. Henry Bernoulli Barlow, Manchester—Improvements in machinery for cleaning cotton and other fibrous materials.
1920. Nicholas Callan, Maynooth College—Improvements in certain galvanic batteries.
1930. William Hill, Congleton—Improvements in doubling or twisting net or raw silks.
1936. Jacques François Henry Hypolite Hervé de Lavaur, Paris—Improvements in securing waterproof wrappers or coverings used in packing goods.
1940. Samuel Stocker, Brighton—Coverings for various parts of the human body with a view to the preservation of health.
1958. John Jones, Sheffield—Improvements in metal dinner and dessert forks.
1982. Martin Billing, Birmingham—Improvements in manufacturing and ornamenting castors for furniture.
2008. Andrew Barclay, Kilmarnock—Improvements in refracting and reflecting telescopes.
2440. John Macadam, M.D., Glasgow—Improvements in the preparation or sizeing of paper or the materials used in the manufacture thereof.
2525. Joseph Whitworth, Manchester—Improvements in cannons, guns, and fire-arms.
2595. Joseph Alfred Nicholson, 10, Chapel-place, Bermondsey—Improvement in the manufacture of dinner and dessert or table forks.
2686. Richard Whytock, Edinburgh, and Thomas Preston, Nottingham—Improvement in the manufacture of fabrics by twist lace machinery.
2702. John Hunt, Birmingham—Improvements in illumination.
2736. John Cockcroft, New Accrington—Improvements in machinery or apparatus for printing woven or textile fabrics and yarns.
2739. James Murdoch, 7, Staple-inn—Improvements in waterproofing woven fabrics.

## EXTENSIONS SEALED.

*23rd February*, 1855.

8. George Lowe, Finsbury-circus—Improved methods of supplying gas under certain circumstances, and of improving its purity and illuminating powers.—Five years from 17th March, 1855.
9. Edward Foard, 39, Nicholas-street, Hoxton—An improved method or improved methods of supplying fuel to the fire-places or grates of steam-engine boilers, brewers' coppers, and other furnaces, as well as also to the fire-places employed for domestic purposes, and generally to the supplying of fuel to furnaces or fire-places in such a manner as to consume the smoke generally produced in such furnaces or fire-places.—Six years from 17th January, 1855.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address |
|---|---|---|---|---|
| 3685 | Feb. 20. | Price's Cooking Stove Lamp | Price's Patent Candle Co.... | Belmont, Vauxhall. |
| 3686 | " 21. | Handle and Socket for Carriage Lamp... | Oakes and Ward | Birmingham. |
| 3687 | " 22. | Cake Mill Frame | Smith and Ashby | Stamford. |
| 3688 | " 23. | Price's Cooking Stove Lamp | Price's Patent Candle Co.... | Belmont, Vauxhall. |
| 3689 | " 26. | Penholder | Hinks and Wells | Birmingham. |

Journal of the Society of Arts.

FRIDAY, MARCH 9, 1855.

## THIRTEENTH ORDINARY MEETING.

### Wednesday, March 7, 1855.

The Thirteenth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 7th inst., Colonel Challoner, in the Chair.

The following Candidates were balloted for and duly elected Ordinary Members:—

| | |
|---|---|
| Armison, George | Lermit, Rev. Gerald |
| Colman, Jeremiah | Rogers, Ebenezer |
| Dickins, Thomas | Spark, Henry King |
| Gibson, Ths. Field, F.G.S. | Vavasseur, James |
| Jaffray, Richard | Wooldridge, J. W. |

The Paper read was

## ON THE SEWAGE OF LONDON.

By J. B. Lawes, F.R.S., F.C.S.

Whoever undertakes to bring forward plans for the economical disposal of the sewage of the metropolis, is at once met by the difficulty arising from the enormous bulk of the material with which he has to deal. It is estimated, that between one and two hundred million tons of fluid pass through the sewers annually; and it is said, that solid matter amounting to nearly 200,000 tons, is suspended or dissolved in this liquid. Those who advocate the employment of the sewage by irrigation, must therefore seek for an extensive tract of land at no great distance from London on which to deposit this fluid; whilst those who propose to separate from it a solid manure, must produce a substance of sufficient productive value to bear the cost of carriage to all parts of Great Britain. Of late years much money has been uselessly expended in patents and inventions for converting the sewage into a portable manure, which might have been saved by a better knowledge of the true principles of manuring, and the wants of agriculture. The authors of these inventions, considering that farmers are willing to pay £10 or £12 per ton for foreign guano, are surprised to find that their British substitute is in no demand at one quarter the price; and they are inclined to tax the farmer with ignorance in the management of his business, and with prejudice in favour of a foreign commodity. It may safely be asserted, that agriculturists not only have no prejudice in favour of foreign manures, but that they would be only too glad to find some substitute which they could employ with advantage. They are, however, fast learning by experience, that a low-priced manure is not necessarily a cheap one. The question they are beginning to ask, is—*not* what is the price *per ton*, of this or that manure? But, in what manure can I most cheaply bring upon my land certain constituents which I require? The inability to answer this question satisfactorily has hitherto brought all the producers of sewage manure to a stand-still. Those who in future propose to deal in this manner with sewage, should consider well this question. The success or failure of their inventions will infallibly depend upon the answer they can give.

It should never be forgotten that it is the cost of carriage which regulates in a great measure the distribution of manures, and assigns to each a limit of area, beyond which it cannot profitably be employed. No one doubts the value of stable manure; yet its use is confined to a range which does not exceed a few shillings per ton for carriage; and a farmer who would have to cart it beyond this range would not accept it as a gift; and it is for a similar reason, that even, supposing the manufacture of a solid manure from the sewage of a small town could be carried on with profit, it might still be quite impracticable as applied to London. The local demand in the immediate neighbourhood of a small town, might, perhaps, absorb the whole supply, whilst the vast produce of the London sewage could only be disposed of by a general sale all over the country.

The term *manure* includes a great variety of substances, from the disgusting mass of corruption, the very idea of which is almost sickening, to the purest and most delicate crystallised salts. It is not one of the least of the many beautiful and economical arrangements which we see around us whereby the Almighty has endowed the same particles of matter with the property of entering into a variety of forms, at one time the most offensive, and at another the most attractive. In this ever changing circle, nothing is without its value, nothing is lost. Whilst, therefore, all matters in one sense waste and refuse, have their absolute value when considered in a scientific point of view, they have at the same time another and an independent value as articles of commerce; and to assign to each its proper money equivalent is a most important office of scientific and economic agriculture.

The crops grown by the farmer are found to be composed of a number of different elements; and if the soil were only a medium of support to the roots of the plants, and neither it nor the atmosphere furnished any of these elements, the art of manuring would be simple enough; it would be confined to replacing the elements contained in the crop exactly in the proportion in which they were removed from the land. It happens, however, that a certain portion of each of the elements which the plants produced contain, are furnished either by the normal soil or by the atmosphere, but some of them not in sufficient quantity for agricultural purposes. True economy in manuring consists, then, in adding those substances to the land of which the supplies of the soil and atmosphere will be deficient. In order to ascertain experimentally which of the various constituents of our agricultural plants it is most important to supply by manures, it is necessary to grow each particular crop for a series of years with different manurial mixtures, in some cases supplying the various constituents separately, and in others with two or more of them combined together. By following this course, and carefully weighing the produce obtained, a knowledge is by degrees acquired of the relative value and importance in a manure of the different ingredients. In illustration of the usefulness of this kind of inquiry, I propose to refer you to a few experiments of the sort in question, which have been conducted by myself on the wheat crop. The results I have selected for this purpose, are those of the seasons 1844 and 1854. Between these periods there is an interval of nine years, during which the same kind of experiments have been going on upon the same plots of land; but as these intermediate results are all in the same direction as those of last year, and I do not wish to inflict upon you more of detail than is necessary to explain my subject, I shall omit all reference to them now.

TABLE I.

*Selection from Experiments in which Wheat has been grown upon the same Land for 11 years in succession.*

| Plot Numbers. | Manures. | Bushels of Dressed Corn per Acre. | | Straw per Acre in lbs. | |
|---|---|---|---|---|---|
| | | 1844 | 1854 | 1844 | 1854 |
| 2 | 14 tons farm-yard manure every year ...... | 22 | 41 | 1476 | 4543 |
| 7 | Minerals in 1844, Minerals and Ammonia in 1854 ........................ | 16¾ | 45½ | 1172 | 5603 |
| 8 | ditto ditto ditto ditto | 16¼ | 47¼ | 1160 | 6134 |
| 10 | ditto Ammonia only in 1854 | 16¾ | 34¼ | 1112 | 3597 |
| 16 | Minerals, with 14 lbs. Ammonia, in 1844, with 180 lbs. in 1854 ........................ | 21¼ | 50 | 1480 | 5634 |

If you will turn to Table I. (*vide* preceding page), you will see that Nos. 7 and 8, when in 1844 they were manured with mineral substances only (alkalies and phosphate of lime), they produced between 16 and 17 bushels of wheat per acre. In 1854, with the employment of similar minerals with salts of ammonia also, the produce of corn is nearly three-fold, namely, in one case, 45 bushels, and in the other 47. There is, moreover, about five times as much straw as in the former season.

The plot No. 10, which yielded nearly 17 bushels of corn in 1844 with mineral manures, produced twice as much grain in 1854, and about three-times as much straw. The remarkable fact connected with this experiment No. 10 is, that since the use of minerals on that plot in 1844, ten successive crops of wheat have been taken from the land, by the aid of salts of ammonia alone. Thus, during this period, a gross produce of about 20 tons has been obtained by no other addition than about 800lbs. of ammonia.

The plot No. 16, you will see, produced in 1844 twenty-one bushels of wheat, that is 4 or 5 bushels more than the plots with mineral manures alone, it having received in addition to minerals the small amount of 14lbs. of ammonia. In fact, this was one of the few plots manured with ammonia at all in that year. In 1854, this plot 16 had received besides minerals, 180lbs. of ammonia to the acre. This is the highest proportion of ammonia that has ever been used in the course of these experiments, and with the favourable season of 1854 it also yielded the largest crop—namely, 50 bushels of corn, and 6,634lbs., or nearly 3 tons of straw.

Plot No. 2 has been manured every season for the last eleven years at the rate of 14 tons farm-yard manure per acre—amounting in all to 154 tons. The produce on this plot is increased from 22 bushels in 1844, to 41 bushels in 1854; but even this latter amount is much below that yielded by the plots 7, 8, and 16. This experiment affords a striking illustration of the fact that *bulk* of manure does not constitute value. Thus, in the 154 tons of farm-yard manure, there has been placed upon the land a larger amount of all the ultimate constituents of corn and straw than the crops removed contained. On the other hand, if we were to apply the same sort of calculation to the crops grown by means of minerals and ammonia, or ammonia alone, we should find that a very few per cent. of the produce had been actually supplied in the manure. In the case of No. 10, in fact where ammonia salts alone have been used for many years, not more than 1½ per cent. of the increased produce was really derived from the manure which has yielded it.

In regard to these experiments as a whole, when I tell you that with the most favourable combinations of minerals, and under the most favourable circumstances of the season of 1854, not more than from 23 to 24 bushels of wheat was in any case obtained, it will be obvious to you that the whole of the difference between these amounts and 45, 47, and even 50 bushels, as in the cases given in the table, must be entirely attributable to the ammonia which was employed. And I may add, that as far as my experience goes, there is no substance known which can be substituted for ammonia or some other compound of nitrogen with like effects.

Farm-yard manure is estimated to contain about ½ a per cent. of this ammonia; or about eleven lbs. in a ton. It would therefore require about 17 tons of farm-yard manure to supply to the land the amount of ammonia used in the experiment No. 16. Now my farm is situated 25 miles from London, and being inconveniently situated for conveyance by railway or canal, the cost of carriage from London upon one ton of manure is 15 shillings. Therefore, if I were to bring my 180lbs. of ammonia from London in the form of dung, the carriage alone would amount to £12 15s. 0d. I could obtain the same amount of ammonia in ½ a ton of guano, or in 7 cwt. of sulphate of ammonia, at the cost of one half of the carriage alone of the dung. This example clearly shows, that it would be cheaper for me to give £10 per ton for guano, or £14 per ton for sulphate of ammonia, than to have the dung as a gift. In the case of the guano and the salts of ammonia, pounds weight only of manure are brought upon the farm to produce tons of growth; in the other you bring tons to produce pounds. If time permitted, I could easily show, that with certain modifications the results obtained in the experimental growth of other cereal crops are in the main similar to those on wheat. And from such data, it is not difficult to decide the actual and relative values in a practical point of view, of the chief elements of manures. It will suffice to say, however, that whilst I consider ammonia is by far the most important and valuable constituent in an artificial manure, phosphoric acid is certainly the second in this respect. All my experiments lead to this conclusion; and it is, moreover, fully confirmed by the composition of all those manures in the market which have the most extended sale, and which are the most highly prized by the farmer. But no manure is entirely made up of ammonia and phosphoric acid, and the nature of the remaining ingredients has also to to be considered in fixing a value upon the compound. It is, however, not necessary to dwell upon this point beyond saying, that when the chemical composition of any manure is known, there is no difficulty whatever in fixing the price at which it will eventually sell compared with other manures. And this would apply more particularly to any manure manufactured from sewage, as the quantity alone would bring it into competition with those already in the market.

Having now pointed out what constitutes *value* in manure, I will next direct attention to the composition of sewage. It will readily be admitted, that leaving out of the question the enormous bulk of water, the chief source of its valuable constituents must be the excrements of the population. There is indeed no means of estimating with any degree of accuracy the amount and value of the other matters. They are, however, decreasing every year; a necessary result of the increasing cleanliness of the metropolis, and of the more rigid sanatory measures which are being enforced. In fact, the chief additional matters that could be permanently calculated upon, are those which are derived from the grinding down and washings of the streets; and, however useful these may be, they would certainly not be worth much carriage in a portable manure; nor would they materially enhance its value.

Assuming then as we may do for all practical purposes, that the great bulk of the excrements of horses, cows, &c., in the metropolis, will not find its way into the sewers—that the refuse of manufactures valuable as manure which will do so, will be comparatively limited—and that the matters abraded from the streets with their small admixture of the excrements of horses and other animals, will also be of comparatively little value—we recur to *Human Excrements* as the main items to be taken into calculation.

The questions arise, then, upon what data can we fairly estimate the amount and the chemical composition of the excrements of the total population of London? In what condition of solidity or solubility will these constituents be found, and through what bulk of sewage will they be distributed? What would be the actual value of the constituents if separated from their admixture with water? And finally, what are the most promising means of turning these constituents to economical account, in the state of solution and dilution in which we find them?

It might, perhaps, appear at first sight, that the most feasible way of estimating what constituents enter the sewers, would be to analyse the sewer water itself; but when we come to consider the very small average proportion which the valuable ingredients bear to the bulk of the water, and also the necessary irregularity of their admixture with it at different times and places, this is found to be by no means the case. It must in fact be a synthetic, rather than an analytic method, by which we

must determine the constituents of Human Excrements which can be calculated upon in the sewer water.

A perfect knowledge of the average amount of solid and liquid excrements voided per diem, or per annum, by each individual of a large population—and of the composition of these excrements—would suffice to this end; and there does, in point of fact, exist much more of recorded information bearing upon this subject, than perhaps would be supposed. This evidence is collected in Table IV., to which I shall refer again further on. Since, however, we know that the constituents of the food taken into the animal body, all reappear either in the increase of the body itself—in the solid and liquid excrements, or in the exhalations by the lungs and skin—it would obviously be a very important confirmation of any evidence as to the composition of one of these products of the food, namely, the excrements, if we found that the estimates arrived at by the direct analysis of them, were consistent with those of the amounts of the constituents consumed in the food, taken in connection with the quantities devoted to the growth of the body, to the respiration, perspiration, &c. It must be confessed, that there is still much to learn in reference to these points, but, at the same time it must be admitted, that the recorded information which we do possess is not only considerable, but very much confirmatory of the direct results obtained as to the amount and composition of the excrements, and it is, therefore, worthy of some consideration in a discussion of this question. It is, then, with the mixed purpose of bringing together much useful information as to the statistics of food—a subject of itself of the highest importance—at the same time of affording security to the evidence to be adduced as to the average composition of the excrements of a large population; and, further, of supplying a useful collection of material for the study of the physician and physiologist, that the tables which now follow have been arranged.

In Table II. are given estimates of the amounts of carbon and of nitrogen *consumed per day in the food* of individuals of different classes, ages, and sexes.

In Table III. are registered the amounts of carbon expired daily by the lungs, also by persons of different ages and sexes.

And, in Table IV., in like manner are given the registered daily amounts of solid and liquid excrements voided by different persons, and also, as far as practicable, the amount of the valuable constituents contained in those excrements.

## TABLE II.

*Ounces of Carbon and Nitrogen consumed in Food in 24 hours. Estimated from Dietaries, or by direct analysis of food.*

MALES.

(Chiefly Males, not exceeding 15 years.)

| Cases, Ages, &c. | Authority or Locality. | By whom estimated. | Carbon. | Nitrogen. | Nitrogen to 100 Carbon. | Notes. |
|---|---|---|---|---|---|---|
| School ... ... ... | Greenwich Hospital | Lawes and Gilbert | 8.22 | 0·39 | 4·74 | |
| Public Establishment, 646 Boys ... | Porter | ditto | 8·88 | 0·49 | 5·52 | |
| ,, both Sexes... ,, 10 Adults ... ,, 106 Children | ditto | ditto | 6·48 | 0·35 | 5·40 | |
| Public Establishment, 290 both Sexes ... ... ... | ditto | ditto | 7·26 | 0·36 | 4·96 | |
| Public Establishment, 365 Males ,, 67 Females ,, 5 Adults ... | ditto | ditto | 7·34 | 0·39 | 5·31 | |
| Blue Coat Boys ... ... | Playfair | Playfair | 6·71 | 0·39 | 5·81 | |
| Mean of schools, establishments of boys, &c. ... ... ... | | | 7.48 | 0·39 | 5·29 | |
| Prisoners, with labour, 1 to 2 months ... ... ,, no labour, 1 to 4 months | Swaffham | Lawes and Gilbert | 8·37 | 03·9 | 4·66 | |
| ,, with labour, 2 to 4 months ,, no labour, 4 and upwards | ditto | ditto | 8·74 | 0·42 | 4·80 | |
| ,, labour, exceeding 4 mon. | ditto | ditto | 9·12 | 0·43 | 4·71 | |
| Punished for prison offences ... | ditto | ditto | 7·00 | 0·33 | 4·71 | |
| Prisoners not exceeding 1 month | Cork | ditto | 6·15 | 0·30 | 4·80 | |
| Children with Troops embarked ... | ... | ditto | 3·84 | 0·17 | 4·37 | |
| Mean of boys in prisons, &c. ... ... ... ... ... | | | 7·20 | 0·34 | 4·67 | |
| Children in Workhouses, 1 to 3 yrs. | St. Alban's | Lawes and Gilbert | 3·15 | 0·16 | 5·08 | |
| ,, 3 to 10 yrs. | ditto | ditto | 4·90 | 0·34 | 6·94 | |
| ,, under 7 yrs. | Greenwich | ditto | 5·85 | 0·25 | 4·27 | |
| ,, 7 to 12 yrs. | ditto | ditto | 5·97 | 0·25 | 4·19 | |
| ,, 12 to 16 yrs. | ditto | ditto | 7·79 | 0·34 | 4·36 | |
| Mean of boys in workhouses ... ... ... ... ... | | | 5·53 | 0·27 | 4·97 | |
| Boy 6½ years, by direct analysis of food ... ... ... | Barral | Barral | 5·45 | 0·28 | 5·14 | |
| Mean of males not exceeding 15 years ... ... ... ... | | | 6·73 | 0·33 | 4·98 | |

TABLE II. (CONTINUED.)—*Ounces of Carbon and Nitrogen consumed in Food in 24 hours. Estimated from Dietaries, or by direct Analysis of Food.*

(MALES OVER 16 YEARS—VARIOUS CLASSES.)

| Cases, Ages, &c. | Authority or Locality. | By whom estimated. | Carbon. | Nitrogen. | Nitrogen to Carbon as 100. | Notes. |
|---|---|---|---|---|---|---|
| Scheme for victualling Navy ... | ... | Lawes and Gilbert | 16·54 | 0·80 | 4·86 | |
| General Naval Dietary ... ... | ... | ditto | 17·88 | 0·83 | 4·63 | |
| Sailors, on Troop Transports ... | ... | ditto | 14·72 | 0·65 | 4·41 | |
| Sailors, dragging boats over ice ... | Parry | ditto | 14·83 | 1·08 | 7·31 | |
| ,, ordinary ship duty, Polar regions ... ... | ditto | ditto | 11·13 | 0·81 | 7·31 | |
| ,, fresh meat diet ... ... | Playfair | Playfair | 10·08 | 0·79 | 7·84 | |
| ,, salt meat do. ... ... | ditto | ditto | 12·49 | 0·93 | 7·41 | |
| Mean of sailors ... ... ... ... ... | | | 13·95 | ·84 | 6·25 | |
| Soldiers, English, abroad, peace duty ... ... ... | ... | Lawes and Gilbert | 15·28 | 0·78 | 5·10 | |
| ,, ,, Field operations | ... | ditto | 19·20 | 0·98 | 5·10 | |
| ,, ,, embarked ... | ... | ditto | 11·83 | 0·52 | 4·38 | |
| ,, German ... ... | Liebig | Liebig | 13·90 | 0·65 | 4·65 | |
| ,, English ... ... | Playfair | Playfair | 9·47 | 0·82 | 8·65 | |
| ,, European in India and Jamaica ... ... ... | ditto | ditto | 9·47 | 0·77 | 8·18 | |
| ,, Dutch, in peace ... | ditto | ditto | 10·11 | 0·56 | 5·50 | |
| ,, ,, in war... ... | ditto | ditto | 10·58 | 0·80 | 7·55 | |
| ,, and Sailors, mean of ... | ditto | ditto | 10·46 | 0·74 | 7·04 | |
| Pensioners ... ... ... | Greenwich | ditto | 10·35 | 0·55 | 5·36 | |
| ,, ... ... ... | Chelsea | ditto | 11·15 | 0·68 | 6·10 | |
| ,, full diet ... ... | Greenwich | Lawes and Gilbert | 12·27 | 0·65 | 5·26 | |
| ,, half diet ... ... | ditto | ditto | 9·43 | 0·41 | 4·34 | |
| ,, mean of full and half ... | ditto | ditto | 10·85 | 0·53 | 4·86 | |
| Mean of soldiers and pensioners ... ... .. | | | 11·74 | 0·67 | 5·86 | |
| Prisoners, hard labour, 1 to 2 mon. | Swaffham | Lawes and Gilbert | 8·97 | 0·42 | 4·68 | |
| ,, ,, 2 to 4 mon. | ditto | ditto | 10·54 | 0·50 | 4·75 | |
| ,, ,, exceeding 4 m. | ditto | ditto | 11·37 | 0·52 | 4·63 | |
| ,, military, full, under 84 days ... ... ... | ... | ditto | 9·02 | 0·43 | 4·81 | |
| ,, ,, over 84 days | ... | ditto | 10.96 | 0·53 | 4·82 | |
| ,, German, with labour ... | Liebig | ditto | 10·50 | | | |
| Mean of prisoners with labour .. .. .. ... | | | 10·23 | ·48 | 4·74 | |
| Adult Lunatics ... ... | Hanwell | Dr. R. A. Smith | .. | 1·01 | ... | |
| M. Barral, age 29 years, summer... | Barral | Barral | 9·35 | 0·75 | 8·00 | |
| ,, ,, winter ... | ditto | ditto | 12·93 | 0·99 | 7·64 | |
| Man, 59 years, spring ... ... | ditto | ditto | 11·71 | 0·96 | 8·23 | |
| Dr. Dalton ... ... ... | Dalton | Dalton | 11·50 | 1·5 | 13·04 | |
| Mean of individual experiments ... ... ... | | | 11·37 | 1·05 | 9·23 | |
| Workhouse, ... ... ... | St. Albans | Lawes and Gilbert | 7·14 | 0·51 | 7·14 | |
| ,, ... ... ... | Bedford | ditto | 9·19 | 0·45 | 4·92 | |
| ,, ... ... ... | Pembroke | ditto | 8·80 | 0·42 | 4·82 | |
| ,, under 60 years ... | Greenwich | ditto | 7·91 | 0·35 | 4·42 | |
| ,, over 60 years ... | ditto | ditto | 8·25 | 0·55 | 6·67 | |
| ,, ... ... ... | Poor Law Commission. | ditto | 7·86 | 0·40 | 5·15 | |
| ,, average of ... ... | Playfair | Playfair | 8·34 | 0·38 | 4·56 | |
| Mean of adult males in workhouses .. .. ... | | | 8·21 | 0·44 | 5·38 | |
| Union Infirmary ... ... | St. Albans | Lawes and Gilbert | 6·15 | 0·47 | 7·64 | |
| Hospital do., low diet ... ... | Greenwich | ditto | 4·94 | 0·18 | 3·64 | |
| Mean of adult males in infirmaries ... ... ... | | | 5·55 | 0·33 | 5·64 | |

TABLE 2.—(Continued).—*Ounces of Carbon and Nitrogen consumed in Food in 24 hours. Estimated from Dietaries or by direct Analysis of Food. (Males over 16 years—various classes.)*

| Cases, Ages, &c. | Authority or Locality. | By whom estimated. | Carbon. | Nitrogen. | Nitrogen to Carbon as 100. | Notes. |
|---|---|---|---|---|---|---|
| Prisoners, close confinement ... | Swaffham | Lawes and Gilbert | 8·80 | 0·42 | 4·77 | |
| ,, prison offences, 3 days ... | ditto | ditto | 6·40 | 0·30 | 4·69 | |
| ,, not exceeding 1 month | Cork | ditto | 7·66 | 0·36 | 4·72 | |
| ,, military, under 84 days, reduced diet ... ... | ... | ditto | 7·88 | 0·38 | 4·82 | |
| ,, ,, over 84 days, reduced diet ... ... | ... | ditto | 9·02 | 0·43 | 4·77 | |
| ,, German ... ... | Liebig | Liebig | 8·50 | ... | ... | |
| Mean of adult male prisoners without labour ... ... ... | | | 8·04 | ·38 | 4·75 | |
| Mean of the *cases* of adult males ... ... ... ... ... | | | 10·51 | 0·65 | 5·89 | |
| Mean of the *classes* of adult males ... ... ... ... | | | 9·87 | 0·59 | 5·98 | |
| **FEMALES.** | | | | | | |
| Chiefly Females—not Exceeding 16 Years. | | | | | | |
| Asylum, 158 girls, 9 adults ... | Porter | Lawes and Gilbert | 6·43 | 0·32 | 4·98 | |
| Establishment of both sexes, 106 children, 10 adults ... ... | ditto | ditto | 6·48 | 0·35 | 5·40 | |
| Workhouse, 1 to 3 years ... | St. Albans | ditto | 3·15 | 0·16 | 5·08 | |
| ,, 3 to 10 years ... | ditto | ditto | 4·90 | 0·34 | 6·94 | |
| ,, under 7 years ... | Greenwich | ditto | 5·85 | 0·25 | 4·27 | |
| ,, 7 to 12 years ... | ditto | ditto | 5·97 | 0·25 | 4·19 | |
| ,, 12 to 16 years ... | ditto | ditto | 7·79 | 0·34 | 4·36 | |
| Children with troops embarked under 10 years ... ... | ... | ditto | 3.84 | 0·17 | 4·37 | |
| Mean of Females under 16 years ... ... ... ... | | | 5·55 | 0·27 | 4·95 | |
| Adult Females. | | | | | | |
| Woman 32 years ... ... | Barral | Barral | 10·34 | 0·79 | 7·64 | |
| Women with troops embarked ... | ... | Lawes and Gilbert | 7·69 | 0·34 | 4·37 | |
| Workhouse, scheme for ... | Poor Law Commission. | Lawes and Gilbert | 6·68 | 0·32 | 4·83 | |
| ,, ... ... ... | Bedford | ditto | 7·87 | 0·40 | 5·05 | |
| ,, average of ... | Playfair | Playfair | 7·73 | 0·37 | 4·79 | |
| Mean of Women in workhouses ... ... ... ... | | | 7·43 | ·36 | 4·89 | |
| Prisoners, hard labour, 1 to 2 mon. ,, no labour, 1 to 4 months | Swaffham | Lawes and Gilbert | 8·37 | 0·39 | 4·66 | |
| ,, hard labour, 2 to 4 mon. ,, no labour, 4 months and upwards ... ... ... | ditto | ditto | 8·74 | 0·42 | 4·80 | |
| ,, hard labour, over 4 mon. | ditto | ditto | 9·12 | 0·43 | 4·71 | |
| ,, close confinement for prison offences ... ... | ditto | ditto | 7·00 | 0·33 | 4·71 | |
| ,, not exceeding 1 month | Cork | ditto | 6·58 | 0·31 | 4·73 | |
| Mean of Women in prisons ... ... ... ... | | | 7·96 | 0·38 | 4·72 | |
| Families, &c.—Mixed Ages and Sexes. | | | | | | |
| Fashionable Family in Town, 6 male adults, 6 female adults, and 6 children ... ... ... | Porter | Lawes and Gilbert | 9·86 | 0·53 | 5·37 | |
| Fashionable Family in Town, 5 male adults, 6 female adults, 6 children ... ... ... | ditto | ditto | 8·73 | 0·47 | 5·38 | |
| Trading Establishment in the City, male and female adults, 114 ... | ditto | ditto | 8.69 | 0·49 | 5·64 | |
| Family at Giessen, 5 adults, 4 children ... ... ... | Liebig | ditto | 9·50 | ... | ... | |
| Mean of Families, &c.—Mixed ages and sexes ... ... | | | 9·19 | 0·50 | 5·46 | |
| Mean of Females under 16 years .. ... ... ... | | | 5·55 | 0·27 | 4·95 | |
| Mean of Adult Females ... .. .. ... .. | | | 8·01 | 0.41 | 5·03 | |

The difference between the amounts of certain constituents consumed in the food, and the sum of those of them given off by the respiration and in the solid and liquid excrements, should, of course, represent that which goes to the increase of the body, and to the indeterminate exhalations.

It might have been well, in a more extended treatment of the subject, to have traced other constituents of the food than merely the carbon or the nitrogen. But the reason that these two are selected as of the most importance is, that the former, namely, carbon, is one of the most characteristic and most easily traced of the constituents, both of the food and of the products of respiration, and thus the facts relating to it in these, afford the best check upon the amount determined in the excrements. The nitrogen, on the other hand, is undoubtedly the most important *manurial* constituent in the excrements, and it is certainly the one which will measure—though not to the exclusion of other matters—their economical value. Our recorded results respecting the probable amounts of the latter which are exhaled by the respiration and perspiration, and therefore lost to the manure, are by no means so satisfactory as could be wished; but such is the importance of this question—one which most intimately affects the economy of the feeding of stock—that it is, perhaps the more desirable to sift such evidence as we do possess respecting it, and thereby, at any rate, indicate a useful path for future inquiry. This subject, so far as the animals of the farm are concerned, has been more laboriously investigated at Rothamsted, than perhaps any other, though, owing to the practical difficulties involved in it, without that success which had been hoped for.

But to return to the question of what is our evidence respecting the consumption, and the appropriation, of the constituents of the food of a human population of mixed sexes and ages—and what is the probable proportion of the nitrogen of the food which finds its way into the sewers?

In Table II., as has been stated, are given the estimates of the amounts of carbon and of nitrogen consumed in food in 24 hours, in 86 different cases, which are again arranged in 15 classes, according to sex, age, activity of mode of life, and other circumstances. Most of these estimates have been made by calculating the known average amounts of carbon and nitrogen in the articles composing the dietary in each particular case; the particulars of the dietaries themselves having been obtained some years ago with a special view to this question of sewage. Some of the estimates in the table have, however, been kindly provided by Dr. Lyon Playfair; whilst a few of them, as will be seen by reference to the columns of "authority," have been made by other individuals; and generally in these latter cases, the food actually consumed within a given time, has being weighed, and its constituents determined in some instances by estimation, and in others by direct analysis.

It cannot of course be pretended, that the classes of individuals whose dietaries constitute the main bulk of those in the table, represent, so far as exact form of food or cookery is concerned, all the various grades of society in the metropolis. But it may safely be assumed that, provided the sex, age, constitution, and habits of life as to air and exercise are the same, the amounts of the important *ultimate constituents* of food will not materially differ. It would seem, that the main difference in this particular respect, will be, that the more luxurious the quality of the food, the more concentrated will be the supply of carbon and of nitrogen in a given weight of the dry substance of the food, and the larger will be the proportion of hydrogen and the less of oxygen in that dry substance.

With regard to the numerical indications of this table of dietaries, independently of their connection with those on respiration and of excrements, it may be noticed that the average relation of the nitrogen to the carbon of the food, is 5¼ of the former to 100 of the latter.

In applying the results of this table to elucidate our main question, namely, the composition of the excrements of the population of London—the latter is taken at 2½ millions; and this number is supposed to comprise males and females of various ages in the proportions given in the last census. It has next been assumed, that all males under 15 years consume the amounts of carbon and nitrogen given in the dietary table for males under that age, in schools, in public establishments of boys, in prisons, in workhouses, &c., and in any cases of individual experiment. The various classes of males *over* 15 in the metropolis are supposed to be represented, so far as the carbon and nitrogen they consumed is concerned, by the average of sailors, of soldiers, and pensioners, of prisoners with labour, of prisoners without labour, of men in workhouses, in infirmaries, as well as of certain individual cases of direct experiment. And again, the average given in the table of children in workhouses under 16 years, and of girls in various asylums and public establishments, &c., is applied to the female inhabitants under 15 years. That, on the other hand, given of women in workhouses, in prisons with and without labour, with soldiers embarked, and of a case of individual experiment, is supposed to apply to the adult female population. There are also given, the calculated dietaries of several families and other establishments, of mixed ages and sexes, of different grades of society, the results of which fully confirm the indications of those of the other classes, and at the same time justify the appropriation, for our present purpose, of the figures given for the various classes in the manner above-mentiond. The *average*, thus taken of the amounts of carbon and nitrogen consumed per head per day for each of the divisions as to sex and age, is multiplied by the number of indivduals of each such division, and the figures thus obtained for the several division being added together, we obtain, of course, the amounts of carbon and of nitrogen consumed by the total population in one day; and from this is easily ascertained the annual consumption.

Before leaving the question of the amount of the constituents consumed in food, it may be well to notice a point of some national interest and importance, which the calculation of the various dietaries may help to elucidate, namely, the probable average consumption of wheat by each individual of the population. This has been variously estimated at from six to eight bushels per head per annum. The amounts of bread, flour, &c., registered in the dietaries, which have been calculated, lead to the conclusion that 6½ to 6¾ bushels is about the average amount so consumed. Another point illustrated by the calculations is, that the average quantity of the *dry substance of food*—that is, excluding the water it naturally contained—is, within a very small fraction, one pound per head per day, including both sexes and all ages.

We now come to the second main element in our calculation, namely, to a consideration of what amount of the carbon of the food escapes by the lungs. And when it is borne in mind that this expiration by the lungs in the form of carbonic acid, is the chief destination of that constituent in the food, and, therefore, that the amount thus traced, together with that found in the excrements, should very nearly make up the quantity taken in the food, the important bearing of results of this kind will at once be obvions. On this point, then, we have, in Table III., the amounts of the carbon of the food expired in a given time by persons of different sexes and ages, according to the results of direct experiments on respiration made by various chemists and physiologists. The chief labourers in this field of inquiry have been Messrs. Allen and Pepys, Dr. Dalton, MM. Dumas, Dulong, and Despretz, Mr. Coathupe, M. Scharling, and MM. Andral and Gavarret. To the latter gentlemen—namely, MM. Andral and Gavarret—we are indebted for a very extensive series of determinations of the amount of carbon expired by the lungs in a given time by persons of both sexes and at different ages. These experiments were made

## TABLE III.

*Ounces of Carbon expired in 24 hours. Estimated by direct experiment on Human Respiration.*

| | Ages, Cases, &c. | By whom estimated. | Males. | Females. |
|---|---|---|---|---|
| Not over 15 years. | 8 years | Andral and Gavarett | 4·24 | |
| | 10 do. | do. | 5·76 | 5·08 |
| | 11 do. | do. | 6·44 | 5·35 |
| | 12 do. | do. | 6·27 | |
| | 12 do. | do. | 7·03 | |
| | 13 do. | do. | | 5·34 |
| | 14 do. | do. | 6·95 | |
| | 15 do. | do. | 7·37 | |
| | 15 do. | do. | | 6·01 |
| | 9½ do. | Scharling. | 4·70 | |
| | 10 do. | do. | | 4·43 |
| | Average under 16 years | | 6·09 | 5·24 |
| 15 to 20 years. | 16 years | Scharling. | 7·92 | |
| | 19 do. | do. | | 5·84 |
| | 15½ do. | Andral and Gavarret | | 5.34 |
| | 16½ do. | do. | 8·64 | |
| | 17 do. | do. | 8·64 | |
| | 18 do. | do. | 9·40 | |
| | 19 do. | do. | 9·49 | 5·93 |
| | 20 do. | do. | 9·49 | |
| | Average from 15 to 20 years | | 8·93 | 5·71 |
| 20 to 30 years. | 22 years | Andral and Gavarret. | | 5·68 |
| | 24 do. | do. | 9·40 | |
| | 24 do. | do. | 9·83 | |
| | 26 do. | do. | 11·95 | 5·08 |
| | 26 do. | do. | 9·32 | 5·34 |
| | 27 do. | do. | 10·00 | |
| | 28 do. | do. | 10·50 | |
| | Dr. Dalton | Dalton. | 10·25 | |
| | M. Dumas, 20 years | Dumas. | 5·88 | |
| | A Soldier, 28 years | Scharling. | 8·46 | |
| | Average from 20 to 30 years | | 9·51 | 5.37 |
| 30 to 40 years. | 31 year . | Andral and Gavarret. | 9·49 | |
| | 32 do. | do. | 9·74 | 5·25 |
| | 33 do. | do. | 9·06 | |
| | 37 do. | do. | 9·06 | |
| | 38 do. | do. | | 6·61 |
| | 40 do. | do. | 10·25 | |
| | 38 do. | Allen and Pepys. | 11.00 | |
| | 33 do. | Coathupe. | 5·45 | |
| | 35 do. | Scharling. | 7·75 | |
| | Average from 30 to 40 years | | 8·97 | 5·93 |
| 40 to 50 years. | 41 years. | Andral and Gavarret. | 8·81 | |
| | 42 do. | do. | | 7·03 |
| | 43 do. | do. | | 7·29 |
| | 44 do. | do. | | 8·39 |
| | 45 do. | do. | 7·33 | 5.25 |
| | 48 do. | do. | 8·90 | |
| | 49 do. | do. | | 6·27 |
| | 50 do. | do. | 9·06 | |
| | Average from 40 to 50 years | | 8·52 | 6·85 |
| 50 to 60 years. | 51 years | Andral and Gavarret. | 8·56 | |
| | 52 do. | do. | | 6·35 |
| | 54 do. | do. | 8·98 | |
| | 56 do. | do. | | 6·01 |
| | 59 do. | do. | 8·47 | |
| | Average from 50 to 60 years | | 8·67 | 6·18 |
| 60 to 70 years. | 64 years. | Andral and Gavarret. | 7·37 | 5·85 |
| | 66 do. | do. | | 5·76 |
| | 68 do. | do. | 8.13 | |
| | Average from 60 to 70 years | | 7·72 | 5.80 |
| 70 & upwards. | 76 years. | Andral and Gavarret. | 5·08 | 5·59 |
| | 82 do. | do. | | 5·08 |
| | 92 do. | do. | 7·45 | |
| | 102 do. | do. | 5·00 | |
| | Average from 70 upwards | | 5·84 | 5.33 |
| | Average from 15 to 40 years | | 9·17 | 5·63 |
| | Average from 40 upwards | | 7·76 | 6·26 |
| | Average from 15 to 50 years | | 9 07 | 6·10 |
| | Average from 50 upwards | | 7·38 | 5·77 |

upon more than seventy individuals, half of them of the male, and half of the female sex. It would be out of place here to dwell on certain most important physiological bearings of these experiments; but it may be submitted, in passing, that a careful study of them would well repay the intelligent physician, and especially those who devote themselves more exclusively to diseases of the respiratory organs. Such a study might, at least give a very useful turn to future observation and inquiry; if not, indeed, at once suggest valuable practical conclusions.

With regard to the applicability of experiments of this kind to a practical discussion as to the average amount of carbon expired by a mixed population within a given time, such, for instance, as the entire period of twenty-four hours, or of a whole year, it may be said, that, as such experiments are made only during a state of wakefulness, their indications must be too high for the period of the night. On the other hand, since they are, also, only made whilst the individual is at rest, their results would be too low for the periods of exposure and exercise. These two sources of error tend to balance each other therefore, and in point of fact, the very obvious and uniform relation of the amounts of carbon shown to be expired to those consumed in the food, would indicate that the resultant error cannot be very great. And if any judgment were to be formed of the *direction* of the discrepancy from the comparison with the amounts consumed, and a consideration of the amounts appropriated by the other requirements of the body, it would be concluded that, upon the whole, the figures indicating the quantity expired by the lungs are, perhaps, somewhat too low.

An inspection of Table III. shows that, up to the age of about 15 or 16 years there is a gradual increase in the amount of carbon consumed by both sexes, the actual quantity being always rather higher for the male. From this period the quantity still increases in the case of the male until past middle, or to comparative old age, when it begins gradually to diminish. With the female, on the other hand, this consumption by the lungs remains stationary in amount from the age of 15 or 16 years to about 40. It then for a time somewhat increases; and finally, as in man decreases with old age—the female, however, always keeping an average somewhat below that of the male.

A comparison of the amounts of carbon consumed in food in 24 hours with those of it expired by the lungs during the same period, shows a general average of from one to one and half ounces more in the food than is expired. It will presently be seen that a large portion of this difference is accounted for by the carbon contained in the excrements, leaving an average of something less than three-fourths of an ounce for the daily growth of the body, for nasal and other incidental excretions, and for the perspiration. The consistency of the indications in experiments of so opposite a kind, and made with such opposite views, is at any rate surprising, and such as to leave no doubt of the general practical utility of the evidence on the several points. This brings us to the third element in the calculation, namely, a consideration of the recorded amounts of the liquid and solid excrements voided by persons of different sex and ages within a given period, and of the amounts of some of the constituents of those excrements.

In Table IV are arranged the amounts of fresh excrements, or of certain of their constituents, voided in 24 hours by persons of different sex and ages, as recorded by various experimenters. The columns in the Table are headed respectively—"Fresh Excrements," "Dry Substance," "Mineral Matter," "Carbon," "Nitrogen," and "Phosphates," and the quantities given by the various experimenters of any or of all these substances, as the case may be, are entered in these columns. In all cases, however, in whatever weights or measures the experiments are originally stated, they have been reduced to the uniform denomination of ounces (tenths, &c.) in our Table. In many cases, too, the amount of certain *compounds only* of nitrogen which the excrements con-

## TABLE IV.

OUNCES OF HUMAN EXCREMENTS, AND THEIR CONSTITUENTS, IN 24 HOURS. QUOTED OR CALCULATED FROM VARIOUS EXPERIMENTERS.

| Cases, Ages, &c. | Duration of Experiment. | Authority. | Fresh Excrements. | | | Dry Substance. | | | Mineral Matter. | | | Carbon. | | | Nitrogen. | | | Phosphates. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fæces. | Urine. | Total. | Fæces. | Urine. | Total. | Fæces. | Urine. | Total. | Fæces. | Urine. | Total. | Fæces. | Urine. | Total. | Fæces. | Urine. | Total. |
| MALES UNDER 15 YEARS. | | | | | | | | | | | | | | | | | | | | |
| Boy, 6½ years | 5 days | Barral | 2·96 | 18·36 | 21·32 | 0·760 | 0·560 | 1·320 | 0·101 | 0·181 | 0·282 | 0·343 | 0·155 | 0·498 | 0·064 | 0·110 | 0·174 | ... | ... | ... |
| Child, 3 years | 3 ,, | Lecanu | ... | 13·71* | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·109* | ... | ... | ... | ... |
| Child, 4 years | 1 ,, | ,, | ... | 14·65* | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·138* | ... | ... | ... | ... |
| Boy, 8 years | 4 ,, | ,, | ... | 28·44 | ... | ... | ... | ... | ... | 0·355 | ... | ... | ... | ... | ... | 0·237 | ... | ... | ... | ... |
| do. do. | 4 ,, | ,, | ... | 22·51 | ... | ... | ... | ... | ... | 0·355 | ... | ... | ... | ... | ... | 0 235 | ... | ... | ... | ... |
| Mean of Males under 15 years | . . . . . . | . . . . . | 2·96 | 19·53 | 22·49 | 0·760 | 0·560 | 1·320 | 0·101 | 0 297 | 0·398 | 0·343 | 0·155 | 0·498 | 0·064 | 0·166 | 0·230 | ... | ... | ... |
| MALES FROM 15 TO 50 YEARS. | | | | | | | | | | | | | | | | | | | | |
| Dr. J. Lining | Entire year | Lining | 3·97 | 59 10 | 63·07 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Man, 29 years, Winter | 5 days | Barral | 4·99 | 39·62 | 44 61 | 1·240 | 1·820 | 3·060 | 0·200 | 0·513 | 0·713 | 0·540 | 0·537 | 1·077 | 0·099 | 0·380 | 0·479 | ... | ... | ... |
| do. do. Summer | 5 ,, | ,, | 2·66 | 36·12 | 38·78 | 0·730 | 1·620 | 2·350 | 0·130 | 0·438 | 0·568 | 0·314 | 0·484 | 0·798 | 0·046 | 0·350 | 0·396 | ... | ... | ... |
| do. 20 do. | 12 ,, | Lecanu | ... | 35·19 | ... | ... | ... | ... | ... | 0·596 | ... | ... | ... | ... | ... | 0·471 | ... | ... | ... | ... |
| do. 22 do. | 12 ,, | ,, | ... | 34.02 | ... | ... | ... | ... | ... | 0·596 | ... | ... | ... | ... | ... | 0 472 | ... | ... | ... | ... |
| do. 35 do. | 6 ,, | ,, | ... | 61·18 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·503 | ... | ... | ... | ... |
| do. 38 do. | 12 ,, | ,, | ... | 33·61 | ... | ... | ... | ... | ... | 0·596 | ... | ... | ... | ... | ... | 0·444 | ... | ... | ... | ... |
| do. 38 do. | 10 ,, | ,, | ... | 70·60 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·339 | ... | ... | ... | ... |
| do. 43 do. | 12 ,, | ,, | ... | 99·44 | ... | ... | ... | ... | ... | 0·596 | ... | ... | ... | ... | ... | 0 500 | ... | ... | ... | ... |
| Young Man on Mixed diet | 13 ,, | Lehmann | ... | 37·34 | ... | ... | 2·390 | ... | ... | 0·538 | ... | ... | ... | ... | ... | 0·550 | ... | ... | 0·184 | ... |
| do. Purely Animal diet | 12 ,, | ,, | ... | 40·21 | ... | ... | 3·010 | ... | ... | ... | ... | ... | ... | ... | ... | 0·895 | ... | ... | 0·321 | ... |
| do. Purely Vegetable diet | 12 ,, | ,, | ... | 31·99 | ... | ... | 2·090 | ... | ... | ... | ... | ... | ... | ... | ... | 0·381 | ... | ... | 0·153 | ... |
| do. Non-Nitrogenous diet | 2 ,, | ,, | ... | 36·89 | ... | ... | 1·470 | ... | ... | ... | ... | ... | ... | ... | ... | 0·260 | ... | ... | 0·136 | ... |
| do. Daily severe exercise | | ,, | ... | 34·69 | ... | ... | 2·920 | ... | ... | ... | ... | ... | ... | ... | ... | 0·745 | ... | ... | 0·201 | ... |
| | | ,, | 4·24 | ... | ... | 1·06 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | ,, | 6·35 | ... | ... | 1·59 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 24 men—20 to 25 years | | Chambert | ... | 40·15 | ... | ... | ... | ... | ... | 0·524 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Healthy middle aged man | Several days | Thomson | ... | 53 30 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·592 | ... | ... | 0·143 | ... |
| Normal adult | | Rayer | ... | 44·34 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| do. do. | | Haller | ... | 53·31 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| do. do. | | Bostock | ... | 45·15 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| do. do. | | Prout | ... | 36·80 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| German soldier | | Playfair | 5·50 | ... | ... | 1·375 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Man, 28 years | 7 days | Way | 3·23 | ... | ... | 0·831 | ... | ... | 0·095 | ... | ... | ... | ... | ... | 0·046 | ... | ... | 0·077 | ... | ... |
| do. 19 do. | 2 ,, | ,, | 3·07 | ... | ... | 0·821 | ... | ... | 0·094 | ... | ... | ... | ... | ... | 0·035 | ... | ... | 0·076 | ... | ... |
| do. 17 do. | 2 ,, | ,, | 2·73 | ... | ... | 0·557 | ... | ... | 0·064 | ... | ... | ... | ... | ... | 0·039 | ... | ... | 0·052 | ... | ... |
| Dr. Dalton | 14 ,, | Dalton | 4·85 | 48·50 | 53·35 | 1·210 | 3·250 | 4·460 | ... | ... | ... | 0·485 | 0·610 | 1·095 | ... | ... | ... | ... | ... | ... |
| do. | 7 ,, | ,, | 4·33 | 42·00 | 46·33 | 1·080 | 2·810 | 3·390 | ... | ... | ... | 0·433 | 0·525 | 0·958 | ... | ... | ... | ... | ... | ... |
| Mean of 4 men | | Becquerel | ... | 44·73 | ... | ... | 1·390 | ... | ... | 0·350 | ... | ... | ... | ... | ... | 0·294 | ... | ... | ... | ... |
| Person No. 1 | | Chossat | ... | ... | ... | ... | 0·700 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| do. No. 2 | | ,, | ... | ... | ... | ... | 0·890 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| do. No. 3 | | ,, | ... | ... | ... | ... | 0·890 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| do. No. 4 | | ,, | ... | ... | ... | ... | 1·140 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| do. No. 5 | | ,, | ... | ... | ... | ... | 1·170 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| do. No. 6 | | ,, | ... | ... | ... | ... | 1·2 20 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| do. No. 7 | | ,, | ... | ... | ... | ... | 1·170 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| do. No. 8 | | ,, | ... | ... | ... | ... | 1·290 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Mean of Males from 15 to 50 years | . . . . . . | . . . . . | 4·17 | 46·01 | 50·18 | 1·041 | 1·735 | 2·776 | 0·116 | 0·527 | 0·643 | 0·443 | 0·539 | 0·982 | 0·053 | 0·478 | 0·531 | 0·068 | 0·189 | 0·257 |

TABLE 4.—(Continued).—*Ounces of Human Excrement, and their Constituents, in 24 Hours. Quoted, or Calculated, from Various Experimenters.*

| Cases, Ages, &c. | Duration of Experiments. | Authority. | Fresh Excrements. | | | Dry Substance. | | | Mineral Matter. | | | Carbon. | | | Nitrogen. | | | Phosphates. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fæces. | Urine. | Total. | Fæces. | Urine. | Total. | Fæces. | Urine. | Total. | Fæces. | Urine. | Total. | Fæces. | Urine. | Total. | Fæces. | Urine. | Total. |
| Males from 50 Years upwards. | | | | | | | | | | | | | | | | | | | | |
| Healthy person, 50 to 60 years | 10 days | Thomson | ... | 52·91 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·587 | ... | ... | 0·142 | ... |
| Man, 53 years | 12 ,, | Lecanu | ... | ... | ... | ... | ... | ... | ... | 0·248 | ... | ... | ... | ... | ... | 0·500 | ... | ... | ... | ... |
| Do. 85 years | 4 ,, | ,, | ... | 29·37 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·194 | ... | ... | ... | ... |
| Do. 86 years | 6 ,, | ,, | ... | 22·86 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·092 | ... | ... | ... | ... |
| Do. 59 years, Spring | 5 ,, | Barral | 6·20 | 63·06 | 69·26 | 1·160 | 2·260 | 3·420 | 0·228 | 0·432 | 0·660 | 0·480 | 0·748 | 1·228 | 0·088 | 0·540 | 0·628 | ... | ... | ... |
| Mean of males from 50 years upwards | . . . . | . . . . | 6·20 | 42·05 | 48·25 | 1·160 | 2·260 | 3·420 | 0·228 | 0·340 | 0·568 | 0·480 | 0·748 | 1·228 | 0·088 | 0·383 | 0·471 | ... | 0·142 | ... |
| Females not over 16 Years | | | | | | | | | | | | | | | | | | | | |
| Child, 3 years | 3 days | Lecanu | ... | 13·71* | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·109* | ... | ... | ... | ... |
| Child, 4 years | 1 ,, | ,, | ... | 14·65* | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·138* | ... | ... | ... | ... |
| Girl, 16 years | 8 ,, | ,, | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·288 | ... | ... | ... | ... |
| Mean of females not over 16 years | . . . . | . . . . | ... | 14·18 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·179 | ... | ... | ... | ... |
| Adult Females. | | | | | | | | | | | | | | | | | | | | |
| Woman, 19 years | 4 days | Lecanu | ... | 32·98 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·382 | ... | ... | ... | ... |
| Do. 19 years | 4 ,, | ,, | ... | 25·67 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·295 | ... | ... | ... | ... |
| Do. 28 years | 8 ,, | ,, | ... | 50·44 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·289 | ... | ... | ... | ... |
| Do. 43 years | 3 ,, | ,, | ... | 21·59 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·187 | ... | ... | ... | ... |
| Do. 32 years | 5 ,, | Barral | 1·24 | 40·85 | 42·09 | 0·330 | 1·550 | 1·880 | 0·044 | 0·350 | 0·394 | 0·148 | 0·495 | 0·643 | 0.028 | 0·350 | 0·378 | ... | ... | ... |
| Mean of 4 women | | Becquerel | ... | 48·42 | ... | ... | 1·210 | ... | ... | 0·297 | ... | ... | ... | ... | ... | 0·262 | ... | ... | ... | ... |
| Mean of adult females | . . . . | . . . . | 1·24 | 36·66 | 37·90 | 0·330 | 1·380 | 1·710 | 0·044 | 0·323 | 0.367 | 0·148 | 0·495 | 0·643 | 0.028 | 0·294 | 0·322 | ... | ... | ... |
| Summary. | | | | | | | | | | | | | | | | | | | | |
| Mean of males under 16 years | | | 2·96 | 19·53 | 22·49 | 0·760 | 0·560 | 1·320 | 0·101 | 0·297 | 0·398 | 0·343 | 0·155 | 0·498 | 0·064 | 0·166 | 0·230 | ... | ... | ... |
| Do. from 16 to 50 years | | | 4·17 | 46·01 | 50·18 | 1·041 | 1·735 | 2·776 | 0·116 | 0·527 | 0·643 | 0·443 | 0·539 | 0·982 | 0·053 | 0·478 | 0·531 | 0·068 | 0·189 | 0·257 |
| Do. from 50 years upwards | | | 6·20 | 42·05 | 48·25 | 1·160 | 2·260 | 3·420 | 0·228 | 0·340 | 0·568 | 0·480 | 0·748 | 1·228 | 0·088 | 0·383 | 0·471 | ... | 0·142 | ... |
| Do. all ages | | | 4·24 | 41·38 | 48·10 | 1·034 | 1·703 | 3·083 | 0·130 | 0·451 | 0·556 | 0·432 | 0·510 | 0·942 | 0·059 | 0·397 | 0·419 | ... | ... | ... |
| Mean of females not over 16 years | | | ... | 14·18 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·179 | ... | ... | ... | ... |
| Mean of adult females | | | 1·24 | 36·66 | 37·90 | 0·330 | 1·380 | 1·710 | 0.044 | 0·323 | 0·367 | 0·148 | 0·495 | 0·643 | 0·028 | 0·294 | 0·322 | ... | ... | ... |
| Mean of females of all ages | | | 1·24 | 31·04 | 32·28 | 0·330 | 1·380 | 1·710 | 0·044 | 0·323 | 0·367 | 0·148 | 0·495 | 0·643 | 0·028 | 0·255 | 0·283 | ... | ... | ... |
| Calculated average per head of total population of London | | | | | | | | 2·010 | | | 0·453 | | | 0·739 | | | 0·348 | | | 0·201 |
| Direct Experiments at Rothamsted. | | | | | | | | | | | | | | | | | | | | |
| Man, 46 years | 8 days | Lawes and Gilbert | 7·072 | 64·925 | 71·997 | 1·482 | 1·485 | 2·967 | 0·175 | 0·652 | 0·827 | ... | ... | ... | ... | ... | ... | 0·147 | 0·178 | 0·325 |
| Do. 50 years | 8 ,, | ,, | 6·700 | 54·600 | 61·300 | 1·469 | 1·517 | 2·986 | 0·180 | 0·678 | 0·858 | ... | ... | ... | ... | ... | ... | 0·148 | 0·213 | 0·361 |
| Mean of 3 boys—5, 10, & 12 years | 4 ,, | ,, | 4·815 | 22·952 | 27·767 | 0·920 | 0·904 | 1·824 | 0·090 | 0·382 | 0·472 | ... | ... | ... | ... | ... | ... | 0·157 | 0·076 | 0·133 |

* These quantities are one-half more than given by M. Lecanu, as he states that that proportion or more was lost.

tained, have been given, such as urea and uric acid, and in these instances the amounts of nitrogen as entered in the Table, have been calculated according to the known composition of those two substances. In the event, therefore, of the urine containing any small amount of other compounds of nitrogen, the quantities thus arrived at will be rather too low, though any error arising from this source can be but comparatively insignificant. The figures indicating the amount of phosphates, again, is in many cases only deduced from that of phosphoric acid or various compounds of it, originally recorded. In these cases the amount is represented as the earthy phosphate of lime. Such, then, are the best data respecting the amount and composition of human excrements at our command. It is seen that there are many more determinations of the amount and of the constituents of urine than of fæces; and since the urine not only contains by far the larger part of the nitrogen of the excrements—indeed, seven or eight times as much as the fæces, but it is also more liable to variation according to sex, age, diet, exercise, and other causes—this is so much the better for the purposes of obtaining a general average. There are very few experiments at all referring either to boys or girls not exceeding 15 or 16 years; and there are much fewer for adult women than for men. The number of experiments on adult males is, however, sufficient both as to urine and fæces. On adult females they are so, perhaps, so far as urine is concerned, but we have only one recorded experiment of the amount of fæces voided by woman in a state of health, though there are some under disease, and the one in question is obviously very low, judging by the relative amounts of food consumed by the two sexes. It is possibly owing to the comparatively limited number of the experiments on the excrements of women, that we find a somewhat larger average proportion of loss of nitrogen indicated for the female, than for the male part of the population. When, however, we consider that the nitrogenous contents of the urine depend much upon the activity of the person, we might expect, on this ground, to find a larger proportion so voided by men than by women. On the other hand, it must be admitted, that we have no sufficient means of deciding in what manner the exhalation in the gaseous form of nitrogen, derived from the food—and, therefore, lost to the excrements—is affected by the degree of rest or activity of the body.

Whilst referring to the question of the proportion of nitrogen lost to the excrements beyond the amount which is devoted to the increase of the body, we may briefly notice the state of our knowledge on the subject of the exhalation of nitrogen derived from the food by the lungs and skin.

Many experiments have from time to time been made, to determine whether or not part of the nitrogen of the food is exhaled by the lungs. Some of the results on this head appear to carry with them their own refutation. Thus, for instance, the amounts estimated to be exhaled by MM. Dulong and Despretz, in some instances would far exceed the total average proportion of nitrogen to carbon in the food consumed by the animal. Some of the results of M. Edwards exhibit a similar anomaly. It should be stated, that the amount of nitrogen evolved by an animal under experiment is, according to the method of the experimenter, represented either in relation to the total oxygen consumed by the respiration in the same period of time—to the amount of oxygen given off in combination with carbon as carbonic acid—or to the amount of carbonic acid itself evolved. It will be more convenient, however, for our purpose, to speak of this evolution in relation to the amount of *carbon* expired, or contained in the food, or to the *total amount of nitrogen* itself consumed in the food. Reduced to the above standards of comparison, the amounts of nitrogen which Marchand found evolved by the respiration of small herbivorous animals, were about 2 to every 100 of carbon expired. According to the results of MM. Regnault and Reiset, which are perhaps the best series on this subject, they consider that there are seldom 3 parts of nitrogen evolved to 100 of carbon—and never double that amount. They estimate that less is evolved on an animal than a vegetable diet. This latter point accords in the main with the direction of the results of MM. Dulong, Despretz, and Edwards, and also with conclusions arrived at by Bischoff, derived from a totally different class of experiments, namely, those on the circumstances affecting the amounts of nitrogen voided in the urine. Magnus also considers that nitrogen is evolved. Pfaff and others, however, confute this opinion.

Upon the whole, it must be admitted, that the bulk of our testimony goes to establish that there is frequently, at least, a loss of some part of the nitrogen of the food in the gaseous form; yet, that as to the amount of this loss under any given circumstances, or its variation, according to diet, class of the animal, age, sex, &c., we have still much to learn.

Experiments of another kind, however, have been made to determine the question indirectly, Thus—M. Boussingault fed a cow and a horse for a certain length of time on food just sufficient to keep their weights constant, and weighed and analysed both their food and their solid and liquid excrements. By this method he found the proportion of the nitrogen of the food which was lost by exhalation, to amount to—

| | |
|---|---|
| For the Cow . . . | 13·37 per cent. |
| For the Horse . . . | 16·55 do. |

As before stated, very many experiments of this kind have been made at Rothamsted, the results of which, however, do not justify us in pronouncing an opinion upon what is the range of this gaseous exhalation of nitrogen, or what are the circumstances which increase or diminish it.

So much, then, for the results of direct experiments on respiration made upon small animals, and for those on the food and excrements of the animals of the farm, to determine the gaseous exhalation of nitrogen by the vital processes.

The only experiments of this kind pretending to any detail or accuracy, which have been made upon the human subject, are those by M. Barral, of Paris. M. Barral analyzed the food and the excrements of himself during two periods of five days each, as well as of an elderly man, a woman of 32 years of age, and a boy of 6¼ years, each for a like period of time. These experiments were, however, not conducted so much in special reference to nitrogen as to certain other constituents; and there are, moreover, some points in M. Barral's method of treating the excrements which open reasonable doubt whether a portion of their nitrogen was not lost in the process of analysis. The proportions of the nitrogen consumed in the food, which in these experiments were not recovered in the excrements, and which consequently are supposed to be exhaled, were as follows:—

| | |
|---|---|
| Man, 29 years, in Winter . . | 51·01 per cent. |
| Ditto ditto, in Summer . . | 47·59 ditto. |
| Boy, 6½ years, in February . . | 37·97 ditto. |
| Man, 59 years, in March . . | 35·17 ditto. |
| Woman, 32 years, in May . . | 51·83 ditto. |
| Mean of 5 experiments . . | 44·72 per cent. |

The results, then, of these direct experiments on the human subject show an apparent exhalation, and therefore loss of nitrogen to the excrements, amounting to nearly 45 per cent. of the nitrogen consumed in the food. It will presently be seen, that this proportion of loss is about twice as great as that arrived at by our method of computing the amounts of nitrogen contained in the food, and in the excrements respectively, of the population of London.

In Table V., the average amounts of carbon expired by the respective sexes at different ages, as given in Table III., are calculated for the number of each of these classes constituting the population of London. We have

# TABLE V.

CONSUMPTION OF CARBON AND NITROGEN BY THE TOTAL POPULATION OF LONDON ($2\frac{1}{2}$ MILLIONS). POUNDS PER ANNUM, &c.

| Ages. | Population of London. | | Carbon Expired. Estimated by Direct Experiments on Respiration. Ounces (tenths, &c.) per head in 24 hours. | | Carbon Expired. Total in lbs. per annum. | | Carbon Consumed in Food. Estimated from Dietaries. Ounces (tenths, &c.) per head in 24 hours. | | Carbon Consumed in Food. Total in lbs. per annum. | | Nitrogen Consumed in Food. Estimated from Dietaries. Ounces (tenths, &c.) per head in 24 hours. | | Nitrogen Consumed in Food. Total in lbs. per annum. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males. | Females. | Males. | Females | Males. | Females. | Males. | Females. | Males. | Females. | Males. | Females | Males. | Females. |
| Under 15 years | 396,799 | 400,727 | 6·09 | 5·24 | 55,120,500 | 47,896,655 | 6·73 | 5·55 | 60,913,131 | 50,730,234 | ·33 | ·27 | 2,986,823 | 2,467,957 |
| 15 to 20 „ | 104,865 | 12[illegible],299 | 8·93 | 5·71 | 21,360,298 | 15,798,601 | | | | | | | | |
| 20 to 30 „ | 222,223 | 273,116 | 9·51 | 5·37 | 48,205,302 | 33,453,899 | | | | | | | | |
| 30 to 40 „ | 180,268 | 207,168 | 8·97 | 5·93 | 36,883,861 | 28,022,222 | | | | | | | | |
| 40 to 50 „ | 125,997 | 143,647 | 8·52 | 6·85 | 24,486,407 | 22,444,629 | } 10·56 | 8·01 | } 186,510,596 | 169,583,746 | } ·63 | ·41 | } 11,127,053 | 8,680,573 |
| 50 to 60 „ | 77,369 | 93,915 | 8·67 | 6·18 | 15,300,697 | 13,238,810 | | | | | | | | |
| 60 to 70 „ | 43,580 | 57,468 | 7·75 | 5·80 | 7,703,963 | 7,602,901 | | | | | | | | |
| 70 upwards | 20,007 | 31,582 | 5·84 | 5·33 | 2,665,143 | 3,839,655 | | | | | | | | |
| Total—all ages | 1,171,108 | 1,328,922 | | | 211,726,171 | 172,297,372 | | | 247,423,727 | 220,318,980 | | | 14,113,876 | 11,148,530 |
| SUMMARY. | | | | | | | | | | | | | | |
| Average lbs. per head per annum | | | | | $180\frac{3}{4}$ lbs. | $129\frac{1}{2}$ lbs. | | | $211\frac{1}{4}$ lbs. | $165\frac{3}{4}$ lbs. | | | 12·05 lbs. | 8·39 lbs. |
| Average ozs. per head per day | | | | | 7·92 ozs. | 5·68 ozs. | | | 9·26 ozs. | 7·27 ozs. | | | 0·53 ozs. | 0·37 ozs. |
| Total—both sexes, and all ages—lbs. | | | | | 384,023,543 lbs. | | | | 467,742,707 lbs. | | | | 25,262,406 lbs. | |
| Average lbs. per annum—both sexes, and all ages | | | | | $153\frac{1}{2}$ lbs. | | | | 187 lbs. | | | | 10·10 lbs. | |
| Average ozs. per day—both sexes, and all ages | | | | | 6·73 ozs. | | | | 8·20 ozs. | | | | 0·44 ozs. | |

# TABLE VI.

ESTIMATED CONSTITUENTS IN THE EXCREMENTS OF THE TOTAL POPULATION OF LONDON ($2\frac{1}{2}$ MILLIONS). POUNDS PER ANNUM, &c.

| Ages, &c. | Total Population of London. (Taken at $2\frac{1}{2}$ millions.) | | Dry Substance. | | Mineral Matter. | | Carbon. | | Nitrogen. | | Phosphates. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males. | Females. | Males. | Females. | Males. | Females. | Males. | Females. | Males. | Females. | Males. | Females. |
| 0 to 16 years | 396,799 | 400,727 | 11,947,300 | ...... | 3,602,292 | ...... | 4,507,390 | ...... | 2,081,727 | ...... | ...... | No estimates given, assumed at $\frac{2}{3}$ amount of males. |
| 16 to 50 years | 633,353 | } 928,195 | 40,104,267 | } 36,204,339 | 9,289,281 | } 7,770,171 | 14,186,740 | } 13,613,678 | 7,671,241 | } 6,817,425 | 3,712,823 | |
| 50 upwards | 140,956 | | 10,996,006 | | 1,826,237 | | 3,948,273 | | 1,514,362 | | ...... | |
| Total all ages | 1,171,108 | 1,328,922 | 63,047,573 | 51,824,735 | 14,717,810 | 11,124,765 | 22,642,463 | 19,491,073 | 11,267,330 | 8,578,497 | 6,865,233 | 4,576,822 |
| SUMMARY. | | | | | | | | | | | | |
| Average per head per annum | | | 53·84 lbs. | 39·0 lbs. | 12·57 lbs. | 8·37 lbs. | 19·33 lbs. | 14·67 lbs. | 9·62 lbs. | 6·45 lbs. | 5·86 lbs. | 3·44 lbs. |
| Average per head per day | | | 2·36 ozs. | 1·71 ozs. | 0·55 ozs. | 0·367 ozs. | 0·847 ozs. | 0·643 ozs. | 0·422 ozs. | 0·283 ozs. | 0·257 ozs. | 0·151 ozs. |
| Total, both sexes and all ages | | | 114,882,308 | | 25,842,575 | | 42,133,476 | | 19,845,827 | | 11,442,055 | |
| Average per head per annum, both sexes and all ages | | | 45·95 lbs. | | 10·34 lbs. | | 16·85 lbs. | | 7·94 lbs. | | 4·58 lbs. | |
| Average per head per day, both sexes and all ages | | | 2·01 ozs. | | 0·453 ozs. | | 0·739 ozs. | | 0·348 ozs. | | 0·201 ozs. | |
| Total per annum, both sexes and all ages | | | $51,286\frac{3}{4}$ tons | | $11,536\frac{3}{4}$ tons | | $18,809\frac{1}{2}$ tons | | $8,859\frac{3}{4}$ tons* | | 5,108 tons | |
| Per cent. in dry substance of mixed excrements, both sexes and all ages | | | | | 22·495 | | 36·675 | | 17·274 | | 9·956 | |
| Per cent. if with 50 per cent. water and impurity | | | | | ...... | | ...... | | 8·637 | | 4·978 | |
| Per cent. in Mr. Herapath's sewage manure | | | | | ...... | | ...... | | 1·125 | | 4·10 | |
| Per cent. in sewage manures (with lime), analysed by Professor Way—mean of 3 | | | | | ...... | | ...... | | 1·413 | | 4·69 | |

* Equal $10,758\frac{1}{4}$ tons ammonia.

thus, in the upper portion of this Table V., the amounts of carbon expired per annum, by the number of individuals included in each division according to age and sex. In the other two main divisions of the Table, the average amounts of carbon and nitrogen *consumed in food*, as deduced from Table II., are as far as practicable, in like manner, applied to the different ages and sexes of the population. And, in the same way in Table VI., the amounts and constituents of the excrements voided in 24 hours, as given in Table IV., are also calculated to their respective divisions of the population. In the lower portions of each of these Tables (V. and VI.), a summary is given, showing the average amounts of the respective constituents consumed, expired, or voided, as the case may be, in 24 hours, and per annum—for each individual of each of the separate sexes—for each individual of the mixed population—and also the total amounts for the total population of the metropolis.

Before entering upon a discussion of the information afforded in Table VI., as to the amounts of the various manurial constituents contained in the excrements of the population of London, it may be well to call attention to a comparative view of the average amounts of carbon and nitrogen consumed in food, exhaled, or voided in excrements, in 24 hours, as indicated by the results arrived at in these Tables (V. and VI.). This comparison is afforded in the following Summary Table :—

TABLE VII.

*Ounces (tenths, &c.) of Carbon and Nitrogen per head per day—Consumed in Food—Expired by the Lungs—Voided in Excrements — in Growth, Perspiration, Loss, &c. Average for all Ages of each Sex separately, and for both Sexes collectively.*

| Sexes, Ages, &c. | Carbon. | | | | Nitrogen. | | | |
|---|---|---|---|---|---|---|---|---|
| | In Food. | Expired by Lungs. | In Excrements. | In Growth, Perspiration, &c. | In Food. | In Excrements. | In Growth, Exhaled, &c. | Per Cent. in Growth and Loss. |
| Average of Males of all ages ...... | 9·26 | 7·92 | 0·847 | 0·493 | 0·528 | 0·422 | 0·106 | 20·07 |
| Average of Females of all ages | 7·27 | 5·68 | 0·643 | 0·947 | 0·367 | 0·283 | 0·084 | 22·86 |
| Average of both sexes and all ages ............ | 8·20 | 6·73 | 0·739 | 0·731 | 0·440 | 0·348 | 0·092 | 20·91 |
| Average of Families, &c. ......... | 9·19 | | | | 0·500 | | | |

It is seen, that the sum of the carbon expired and in the excrements, deducted from that in the food, leaves for the growth of the body, for the perspiration, and other minor outlets, an average of about three-quarters of an ounce of carbon per day for each individual of the population. On this point it need only be further stated, that, having taken the weights of several hundred individuals of both sexes and all ages, with a view to calculating the average annual growth of the body, it can safely be affirmed that this amount of carbon is more than sufficient to supply this growth, and that it leaves a considerable margin for the perspiration, and the other demands upon it, which have been referred to; and even after this, a further allowance supposing that there will be a certain waste of food, that is to say, that the amounts registered in a dietary will be somewhat in excess by a certain amount of offal, of the quantity actually consumed.

The same may be said of the nitrogen, namely, that the amounts given in the table as remaining for growth, exhalation, &c., are much more than sufficient to meet the exigencies of the former, and they bespeak, indeed—so far as the figures can be taken as a true representation of the facts—a considerable gaseous exhalation or loss to the manure of that valuable element. The proportion of the loss to the excrements by growth and exhalation, as indicated by this method of computation, is seen to be for the average of males about 20, for the average of females, 22¾, and for the average of both sexes, and all ages, about 21 per cent. of the amount of nitrogen estimated as supplied in the food. This loss, as has been before stated, is only about half that found in the direct experiments of M. Barral. It is worthy of remark, however, that the amounts of loss indicated by our method of calculation agree much more nearly than those of M. Barral, with the determinations of the same kind made by M. Boussingault, and at Rothamsted, on the lower animals. It should be remembered, too, that the conclusion arrived at by MM. Regnault and Reiset, from their experiments on the gaseous products of the respiration of small animals was, that the proportion of nitrogen exhaled to that of oxygen consumed, seldom amounted to 1 per cent. Now, supposing we assume half this proportion of nitrogenous exhalation to represent the average, this would amount to about 1·46 per cent. of nitrogen evolved to 100 of carbon expired, on the supposition that 9-10ths only of this consumed oxygen are evolved as carbonic acid. And if we further suppose that there will be 1-5th more carbon in the food than is exhaled, and that, as indicated in our dietary tables, the proportion of nitrogen to carbon in the food, will be 5·5 per cent.—this would give us an exhalation of 22·14 per cent. of the total nitrogen consumed in the food—an amount, it will be seen, which agrees very closely with the indications of the table. It is true that our computations of the average quantity of nitrogen consumed in food, and voided in excrement, are not deduced, like those of M. Barral, from experiments as to both, made on the same individual at one and the same time. Yet the results we have brought to bear on these points are so numerous, and the confirmation of them afforded by other considerations is so striking, that we are inclined to adopt the view more favourable to the quality of the sewer water.

After this full discussion of the nature of the evidence at command for the estimation of the composition of the excrements of a large mixed population, let us see what are the results to which it has brought us. In Table VIII. is given at one view an abstract of the results more copiously stated in Table VI.

TABLE VIII.

*Showing the Estimated Constituents of the Human Excrements of London.*

| Constituents. | Ounces per head per day. Average of both sexes and all ages | Pounds per head per annum. Average of both sexes and all ages | Tons per Annum. Total for both sexes and all ages |
|---|---|---|---|
| Total dry substance. . . | 2·01 | 45·95 | 51,286¾ |
| Mineral matter . . . . | 0·45 | 10·34 | 11,536¾ |
| Carbon . . . . . . . | 0·74 | 16·85 | 18,809½ |
| Nitrogen . . . . . . | 0·35 | 7·94 | 8,859¾ |
| Nitrogen=ammonia . . | 0·42 | 9·64 | 10,758¼ |
| Phosphates. . . . . . | 0·20 | 4·58 | 5,108 |

The average amount of real dry substance voided in the excrements of each individual of the population in 24 hours, is thus seen to be only two ounces; or equal to about 46lbs. per annum. This 2 ounces of dry substance will contain rather less than half an ounce of mineral matters, and the annual amount of these per head will be about 10⅓lbs.; and about ⅖ths of the mineral matters voided, or about 1/10th of the total dry substance will be phosphates. Of carbon in the excrements, there is about ¾ of an ounce per head per day, equal to about 17lbs. per annum. Of the valuable constituent nitrogen, there is an average of rather more than ⅓rd of an ounce per day, or about 8lbs. per annum; and these amounts of nitrogen

are equal to ·42 of an ounce per day, and nearly 10lbs. per annum of ammonia.

The amount of the constituents voided by the total population in one year, if entirely freed from water, is seen to be 51,286¾ tons. Of this about ⅕th is mineral matter; and the *nitrogen* it contains amounts to about ⅙th of the whole, namely, 8,859¾ tons, which is equal to 10,758¼ tons of ammonia. Now little more than ½ a cwt. of ammonia is the usual artificial dressing for an acre of cereal grain, and it might be calculated to yield an increase of crop of 10 to 12 bushels of wheat, or this 10,758¼ tons of ammonia would afford a produce of about 600,000 quarters, if it could be conveniently applied for such a purpose. The intrinsic value of the sewage of London considered in this merely chemical point of view is therefore enormous. Indeed, according to the above supposition, it would return to the metropolis nearly one-third of the wheat consumed by its population. If, however, it were thus devoted exclusively to the growth of corn, it would, at the rate above mentioned, extend over more than 400,000 acres of land. But this ammonia in the sewage of London is unfortunately distributed through an enormous bulk of water, and Mr. Wicksteed has shown us how immense would be the cost of distributing this material over any enormous area of land in the liquid form.

This leads me to a consideration of Mr. Wicksteed's alternative of a solid manure; and also to a closer calculation of the amount of fluid through which the manurial constituents which have been named are distributed in the metropolitan sewage. And, I shall endeavour to show, that for other purposes much more needed than corn-growing, in the immediate neighbourhood of a large city, the area of land over which such an amount of fluid, and such amounts of manurial constituents may be employed, can be very considerably reduced; so much so, indeed, that whilst I consider the application over so large an area quite impracticable, I am of opinion that the fluid might be applied over the more limited one, at a cost which would be small compared with the vast sanatory objects, and other advantages which are in view.

MR. WICKSTEED'S PROCESS.

Last year Mr. Thomas Wicksteed was requested by the Metropolitan Commission of Sewers to furnish a report upon a process patented by him, for obtaining a solid manure from sewage. This report is very ably drawn up, and gives estimates of the expence of carrying out his process for the London districts, and it also includes calculations to show the impossibility of employing such a large amount of liquid profitably by irrigation. As I am compelled to differ from Mr. Wicksteed as to the applicability of his process, and as he states that it would require a capital of one million to apply it to the metropolitan sewage, I feel that a few remarks on his data and calculations will not be out of place. Mr. Wicksteed's method consists in adding a certain quantity of lime to the sewage, by which the insoluble and suspended matters, and also some small portion of those in solution, are carried down in the form of a liquid mud. This mud, after proper subsidence, is removed into a centrifugal machine, by the rapid revolution of which a certain portion of the remaining water is thrown off. The manure is afterwards further dried by exposure to a current of air in sheds. The value of this solid product Mr. Wicksteed estimates at from £2 to £2 13s. per ton. He does not, however, give any analysis of it, and consequently the Commissioners have not the means of judging how far this estimated value is justified, or whether it is subject to correction.

I have already shown you how entirely the value of a manure must depend upon its containing certain ingredients, and that it is useless to attempt to put a value on any manure irrespective of its composition. I will, therefore, now inquire, first, what would be the chemical composition of such a sewage manure?—and secondly, what would be its probable money value?

Mr. Wicksteed has stated in his Report, that although the manure he had sent out, owing to some irregularity in the manufacture, contained 60 to 70 per cent. of water, it would, when properly prepared, contain only about 20 per cent. Now, to this 20 per cent. of water must be added the lime employed to precipitate the sewage matter. His calculation is, that 47,631 tons of lime will be required for the whole sewage of London, and that this will yield a produce of 220,451 tons of manure. Thus it would contain about 21½ per cent. of lime, and as the lime when mixed with the sewage, would for the most part be converted into carbonate, we must add 16½ to the 21½ of lime, which would give us about 38 per cent. of carbonate of lime or chalk. Chalk and water will, therefore, constitute about 58 per cent. of the manure. It is not difficult to estimate the composition of the remaining 42 per cent. It can contain but a very small portion of the ammonia of the excrements, for 8 or 9 tenths of the whole of this would be perfectly dissolved in the water; and it is well known to chemists that the addition of lime will not precipitate ammonia from solution. Almost the whole, therefore, of this, the most valuable constituent of the excrements, will remain in some form or other in the liquid. It cannot, either, contain much phosphoric acid, because the amount of this in the total sewage would be but small in proportion to the sedimentary matters, and to the chalk and water of the manure so made. This remaining 42 per cent. must consist, therefore, of a small quantity of organic matter, with sand and clay, together with some little sulphate of lime or gypsum, and a very insignificant amount of the alkalies potash and soda.

But we are not left to conjecture merely, as to the composition of a sedimentary sewage manure, such as that which would be the result of Mr. Wicksteed's process. Professor Way, in his valuable paper upon the composition of sewage, published in the Journal of the Royal Agricultural Society of England, has given us three analyses of manures made by adding charcoal and lime to sewage water, and in none of these does the ammonia amount to 2 per cent., whilst the average amount of phosphate of lime is less than 5 per cent., equal to about half that quantity of phosphoric acid. Yet the manures yielding these results were analyzed in a much drier, and therefore more concentrated state, than it would be possible to produce them on the large scale. The quantity of chalk amounted to from 30 to 40 per cent.; but as charcoal as well as lime was employed in the manufacture, the proportion of chalk in the manure would be less than by Mr. Wicksteed's process, in which lime alone is used. Mr. Herapath, of Bristol, has, however, published an analysis of manure made from sewage by lime alone. He states that it is prepared by the prisoners in Cardiff gaol, by adding lime-water in just sufficient quantity to precipitate the fæcal matters from the sewage. When stove-dried, so as to contain less than 5 per cent. of water, the amount of ammonia was only 1⅓, and that of phosphoric acid only 2 per cent. The remainder consisted of nearly 70 parts chalk, about 3 of gypsum, some insoluble siliceous matter, and about 16 of organic substance, in which latter was contained the small amount of ammonia or nitrogen above mentioned. This analysis of the Cardiff manure agrees very closely, in all essential points, with those of Professor Way—the chalk in the former being about equal to the charcoal and chalk in the latter. Mr. Herapath remarks, that his analysis shows about three times as much nitrogen or ammonia in this manure as there is in farm yard dung; but it may be observed, that if farm-yard manure were dried to the same extent as the sewage compost, it would in that state contain as much ammonia as the latter.

In the following Table (IX.), is given a summary of these analyses by Mr. Way and Mr. Herapath; and by their side a column showing what constituents would be supplied in a ton of the lime-produced manure, if it contained 20 per cent. of water, as supposed by Mr. Wick-

steed; and in the fourth column, for the sake of comparison, is shown what is the per-centage of nitrogen, phosphates, &c., in the pure dry substance of mixed human excrements.

## TABLE IX.

| | Mean of 3. Way. | Made with lime only. Herepath. | In 1 ton, lime, sewage, manure, with 20 per cent water. cwts | qrs | lbs | Dry human excrements. |
|---|---|---|---|---|---|---|
| Water ........................ | 4·6 | 4·7 | 4 | 0 | 0 | ... |
| Organic matter (chiefly charcoal* ........................ | *30·4 | 15·9 | 2 | 2 | 0 | 77·5 |
| Earthy phosphates.......... | 4.7 | 4·1 | 0 | 3 | 0 | 9·9 |
| Other mineral matters. Carbonate lime (with magnesia) | 38·0 | 69·3 | 11 | 2 | 0 | 12·6 |
| Other mineral matters. Oxide iron and alumina ......... | 2·3 | ... | 1 | 1 | 0 | |
| Other mineral matters. Siliceous matter | 12·4 | 2·7 | | | | |
| Other mineral matters. Sulphate of lime | 6·7 | 3·3 | | | | |
| Other mineral matters. Alkaline salts... | 0·9 | a little | | | | |
| | 100·0 | 100·0 | 20 | 0 | 0 | 100·0 |
| Nitrogen ........................ | 1·4 | 1·12 | 0 | 0 | 21 | 17·3 |
| Nitrogen = Ammonia ...... | 1·7 | 1·36 | 0 | 0 | 26 | 21·0 |

Such, then, are the constituents which it may be calculated would be contained in 1 ton of Mr. Wicksteed's sewage manure at a cost of £2, this being the price upon which he bases his estimate of 22 per cent. profit upon a capital of 1 million. Now, as I have already said, my farm is situated 25 miles from London, and the cost of bringing from thence 1 ton of manure is 15 shillings. But before purchasing any manufactured manure, I should sit down to calculate at what price I could purchase the constituents it contained? I find 1¾ cwts. Peruvian guano would supply all the nitrogen or ammonia, and the phosphoric acid of such a sewage manure; 3 or 4 cwts. of rotted straw would supply all its organic matter; and the residue I could obtain from the chalk and sand pits. Thus, for about 25 shillings, I could bring upon my land the constituents of a ton of this manure, and for 30 shillings less money. Again, to supply the amount of ammonia put upon the experimental plot No. 16 in 1854, I should require nearly 7 tons of the sewage manure at a cost, including carriage, of about £19. I could obtain the same amount in 7 cwt. of sulphate of ammonia, at a cost of £5. Such, then, is the nature of the facts which lead me to the conclusion, that a *sedimentary sewage manure* cannot be profitably made by Mr. Wicksteed's process, or, I may add, by any known process.

Compare this composition and rate of value of a sedimentary sewage manure, with those of pure and dry human excrements, as given in the fourth column of the last table. Supposing it were possible, which it certainly is not, so to separate the constituents from sewage, as to get a manure of such a composition as this, there is no doubt it would sell for about £15 per ton; and since the excrements of each individual of the population contain in one year 46 lbs. of such dry substance, it would take 48 persons to produce 1 ton of it per annum; and this would give an annual value of about 6 shillings for the excrements of each person; and at these rates, the total value of our 51,635 tons of dry substance contained in the excrements of the total population of the metropolis, would realise the sum of £774,525. And even assuming that it could be obtained, mixed with its own weight of water and the extraneous solid matters of sewage, it would still contain nitrogen equal to rather more than 10 per cent. of ammonia. Such a manure as this would bear cost of carriage to a considerable distance, and would be worth but little less than half as much per ton, as the unmixed dry excrements. The mixed solid and liquid excrements, in the condition in which they leave the body, contain as much as 94 or 95 per cent. of water, and it is possible, that in that state it might be profitable to evaporate or otherwise manufacture them into a solid manure; even then, however, it would require 16 or 17 tons of fresh excrements to produce 1 ton of portable manure. But it is not thus that we have to deal with them in sewage; there can be little doubt, that as so diluted, about 9-tenths of their most valuable constituent nitrogen, will be perfectly dissolved in the water, and will remain so after the separation of a sedimentary manure by any process known.

Considering, then, the profitable manufacture of a solid sewage manure quite impracticable with our present knowledge, I now turn to the question of the employment of sewage in the liquid form by irrigation; and I will first make a few remarks on Mr. Wicksteed's elaborate calculations on the cost of distributing the sewage of London in this manner. When I tell you that he estimates the capital required for this purpose would be nearly twelve millions, and the area over which it would extend at 3,500 square miles, or more than two million acres, I need hardly say that, unless some error is to be found in his estimates, the employment of sewage by irrigation is altogether impossible.

I think that such an error does exist, and, as it occurs at the basis of his edifice, it materially affects the whole superstructure. Mr. Wicksteed founds his calculation upon a supply of 150 tons of sewage to an acre of land annually; and on this point quotes the authority of the late Mr. Smith, of Deanston, who estimated from 80 to 160 tons as a proper quantity. This 150 tons of sewage is estimated to contain 6 cwt. of solid matter; the calculation being made from the analysis of Professors Brand and Cooper, who found one part of dry substance in 500 parts of sewage. This analysis, however, was made some time ago, when the supply of water was supposed to be about 20 gallons per head daily; but Mr. Wicksteed has founded his other calculations upon a supply of 36 gallons, which would, of course, reduce the estimated quantity of solid matter in 150 tons of liquid, by nearly half. Now, 36 gallons per head per day is about 60 tons per head per annum; so that the excrements of 2½ individuals only of the population, would be supplied to each acre of land, and the amount of dry substance contained in the excrements of these 2½ persons would be rather less than 1 cwt. It would be obviously little less than absurd to be at the expense of laying down pipes to supply an acre of land with such a minute quantity of sewage matter as this. You cannot call a field irrigated which receives, in the course of a year, little more fluid than might fall upon it in one day's rain. If sewage is to be turned to any profitable account, it obviously cannot be by sending a pipe into Oxfordshire, another into Bedfordshire, into Essex, and into Surrey, and selling it out by the gallon, as you would ale or porter. So far, then, I quite agree with Mr. Wicksteed, that if the area of land he supposes be required, it is quite impracticable so to apply the metropolitan sewage.

With regard to what is, probably, the amount of fluid that would have to be disposed of, in dealing with London sewage, I will say a few words. By a return presented to the Houses of Parliament last July, it appears that the water delivered into the metropolis by the nine water companies, gives an average of from 24 to 25 gallons per head per day on a population of 2½ millions. I find, also, that the average fall of rain over the area supplied by the water companies will give almost exactly a similar amount per head, namely, between 24 and 25 gallons. The supply of the companies and the rain-fall taken together, therefore, give a gross amount of nearly fifty gallons per head per day. But, from this a considerable portion must be deducted for evaporation. Mr. Wicksteed estimates, however, that the supply of the companies will very shortly be 36 gallons per head; and, as there is no doubt that they are preparing generally to increase the present amount, I am inclined to think that, by the time any comprehensive scheme for the disposal of the London sewage can be brought into

operation it will not amount to much less than 50 gallons per day for each individual of the population.

Fifty gallons per head per day would amount to $81\frac{1}{2}$ tons per head per annum, and, as it has been seen that the dry substance of the excrements of one individual is 46lbs. per annum, it follows that a ton of sewage would only contain 9 ounces of these excrementitious matters. It is not to be wondered at, therefore, that when lime, sulphate of alumina, or other matters are added to sewage, it should run off from the sediment clear and tasteless. It may do so, and still retain, as undoubtedly it does, almost the whole of the most valuable constituents of the excrements. On this point it may be remarked that Mr. Wicksteed states, that the lime process does not act properly when the sewage is not very dilute; and I myself noticed last year, that the sewage, after being submitted to Mr. Stoddart's process, had a strong urinous odour.

In conclusion, there can be little doubt, that if the sewage of London is to be turned to some useful purpose, it must be applied in the liquid form in such quantities as to yield the greatest possible growth that land and season are capable of. And, certainly the enormous amounts of produce of Rye-grass, which have lately been recorded as the produce of irrigation, and which there is no reason to doubt—were never obtained by such small amounts of liquid as the late Mr. Smith, of Deanston, supposed sufficient.

For corn crops an enormous supply of liquid manure is certainly not well suited, for the influence of season fixes an easily reached limit to the produce of grain, the gross value of which cannot much exceed £12 or £14 per acre. For market gardens, again, liquid sewage does not seem well adapted, as with its use the surface of the land is liable to become crusted, which is injurious in the growth of the vegetables. There is, however, another objection to any extensive application of sewage to this purpose, in the unlimited amount of good stable manure which is easily carried back by the carts which convey the produce to London. It could, moreover, be easily shown, that the dung which was so comparatively inefficient a manure for the growth of wheat, is, nevertheless, peculiarly adapted for the production of vegetables.

I return, therefore, to *grass* as the most suitable crop for the application of liquid sewage. But that its use, even for this purpose, should be attended with advantage, it must, as I said before, be employed in the most liberal quantities that the capabilities of land and season will admit of; and, in this way, it is not impossible that in the neighbourhood of a large city a rental of £20 to £30 per acre might be obtained. Experience alone can decide what is the minimum area of land which would yield the maximum produce and rental from the sewage of London, but there can be little doubt that it would require many thousand tons of sewage per acre to yield the rental I have supposed. I may mention, however, that if 10,000 tons of sewage were annually applied to each acre, it would take about 20,000 acres to absorb the whole sewage of London, upon the estimate of 50 gallons per head per day. But it is even possible that so far as the *quantity of liquid is concerned* the area might be reduced below that which is here assumed. It will be said, perhaps, that such an amount of sewage is much more than would be usefully applied in furthering growth, or even that it would be wasteful or injurious. The point, however, to which I wish particularly to call attention is, that up to the limit at which either the amount of liquid or of manurial constituents becomes positively injurious, an apparent extravagant supply of ingredients on a limited area of land, will, there is little doubt, yield a more profitable result than a saving of manure with a more extended area.

There would surely be no great difficulty in appropriating a few thousand acres at no great distance from the Thames to the purpose in question. And grass being the produce grown, so milk and cream should be the chief products obtained in return. Irrigated grass appears to supply food peculiarly adapted for the production of milk; and there are certainly few articles with which the inhabitants of the metropolis are so inadequately supplied. Whilst, therefore, they must be justly charged for the removal of the sewage on sanatory grounds, they might surely demand, that the cost should be lessened by a proper application of the sewage; and it appears to me, that a liberal distribution of it on grass, is the most promising means of attaining this result.

## DISCUSSION.

After the reading of the paper, Mr. P. Le Neve Foster, the Secretary, stated that he had that morning received a communication from

Mr. T. WICKSTEED, who, after regretting his inability to attend the meeting, proceeded to say, "I am *now* enabled to say that I feel assured a few weeks will see the completion of our works at Leicester, and then we shall be prepared to make and continue making quantities of manure sufficiently large to enable practical agriculturists to give us practical opinions, which, with all respect, and great is mine, for chemists, I shall consider in a *commercial* point of view, the best test of the value of the manure we propose to supply. In saying so, it must not be considered that I am undervaluing in any degree the labours of the practical chemist, to whose advice I owe so much, but I was warned both by a late great chemist and one now living, that after all their analyses, useful as they were in affording me the information which determined me and my coadjutors to undertake this great work, its value at last would have to depend upon the test the agriculturist would put it to, for although in a manure like guano, with certain predominant salts, analysis would directly detect the true from the adulterated article, and very accurately determine its value, nevertheless, in one containing most of the valuable fertilising salts, but in which it appeared that none were in unusual excess, although there could be no doubt of its value, the extent of that value would depend in a great measure upon the price at which it could be offered to the farmer, and also at which it could be made so as to yield a sufficiently remunerative profit to the manufacturer. The result has hitherto shown in this, as in other instances that might be mentioned, that the prognostications of these gentlemen were correct. We have made during the last two years, at our Experimental Works, about 100 tons of manure in different stages of dryness; the last has been as dry as guano, containing from 20 to 25 per cent. of moisture; in this state if left in heaps it *heats*, and this, although a very good practical test of its goodness, is disadvantageous where large quantities are made; it is, therefore, proposed to keep it in damp solid heaps, and, as wanted, to spread it and let it dry, as we have proved it will do upon floors, without the necessity of using *artificial* heat, which *might* reduce its value. I have but few reports of its value which at present can be placed before men of science, because all the conditions as to area manured, as to the cost of the manure with which it was compared, and other data, have not been properly attended to or recorded—but in two instances, with different crops and in different soils, and under different conditions of weather, the results were, in the most unfavourable instances, a value of 53s. 4d. per ton as compared with guano, and in the other 130s. per ton, making an average, not, however, one to be relied upon, as they were both probably extreme cases, of £4 11s. 8d. per ton. Now we have proved, in our practical trials during the last two years, that we can manufacture it upon the large scale for less than 20s. per ton, and, therefore, 35s. or 40s. per ton would pay for the outlay, and if this be the case, there can be no doubt, that out of very dilute sewage a sufficient quantity, although not amounting to above $\frac{1}{1000}$th part of valuable matter, may be extracted at such a cost that it will pay the manufacturer. But although to those who are risking

thousands upon these works the question of remuneration may be most important, nevertheless, that of being enabled to disinfect the sewage water of any town, is one that I consider our experiments have settled for ever, and that if it did nothing more than pay the community who adopted the process, it would be a great public benefit; but I am entering into matters which I intended, and wish to abstain from entering into for a short time longer. As far as my own experience is concerned, and I have sacrificed much of my professional business for the last few years in working out the question, I have no doubt of being able to show that the sewage of towns may be reduced not only innoxious, but may be converted into a profitable and most useful article of commerce, and especially as a stock manure. Before concluding these remarks, which you are at liberty to use *as a whole*, in any way you please, but not to extract from, I may state that we are providing works for a population of about 100,000, looking to the future increase of Leicester, at present having a population of between 60,000 and 70,000—that our pumping engines are of about forty horses power, and our machinery engines about eighty horses power—we have five engines in the whole—that our reservoirs in duplicate are together equal to an area of less than half an acre, and are under cover—that we have at work two large agitators for lime, twenty agitators for mixing the lime and sewage, two screws for removing the precipitate from the bottom of the reservoirs, two Jacob's ladders for raising the sewage up into eight centrifugal drying machines, with space prepared for as many more, and that all these machines have been at work, with very slight exceptions; and that we expect the whole to be in full work before the end of this month, there being nothing more required than the many slight matters of adjusting, strengthening, &c., which are consequent upon the first starting of all new concerns. Whether you may think it worth while to read this letter or not, I do not know. I, however, beg leave to remind you that, as far as I am concerned, I am not desirous of having any discussion upon our works until they are complete; at the same time, I could not but respond to your second appeal, although in the foregoing imperfect manner."

Mr. Sidney, in the name of the agriculturist interest, warmly thanked the Council for the admirable paper on the very important subject which they had been the means of inducing Mr. Lawes to read. Mr. Lawes was not a mere chamber student—for a long course of years, on a very large scale, he had conducted experiments at his farm, which had already been of essential service to agriculture; indeed, a testimonial of no mean value had recently been presented to him by the united subscriptions of practical agriculturists, as a testimony of their sense of the value of his contributions to their special pursuits. It needed the investigations of such a man to draw the serious attention of those who lived by farming to the question of London sewage—a subject on which, within the last ten years, tons of volumes, and whole rivers of speeches had been circulated by sanatory reformers, most enthusiastic on town cleansing, but very insufficiently endowed with the scientific acquirements or habits of correct observation essential for affording intelligent advice to tenant farmers. In the sanatory Blue Books, he (Mr. Sidney) found the same examples of success on a small scale, under circumstances which had very little relation to farming, repeated again and again. He would therefore take the opportunity of giving some account of the irrigation by sewage water in the neighbourhood of Milan, conducted by Lombard farmers, of great skill, with the aid of the accumulated hydraulic science of two centuries. These operations and their results, satisfactory as they were in that climate, in an agricultural point of view, were very far from bearing out the views of the two gentlemen, Mr. Mechi and Mr. Edwin Chadwick, whose names were best known as advocates of the employment of steam-engines and pumps, and miles of pipe for the distribution of London sewage. These gentlemen attempted to justify the enormous expenses, incident to establishing and working machinery sufficient for pumping and delivering the sewage of London at long distances by exaggerating the fertilising qualities of sewage, by asserting that it would supersede all portable manures, and by maintaining that liquid manure was in every respect superior to solid manure; and they supported these theories by extremely under-estimating the operations needful for distributing the liquid where it was most valuable. On most of these points Lombardy afforded a complete contradiction. But in order that he might not be accused of misrepresenting Mr. Chadwick and Mr. Mechi, he would refer to speeches recently delivered by them on this question at the Farmers' Club. In the first place, as to the abstract value of the London sewage, Mr. Mechi intimated, although he did not positively assert, that its value far exceeded £250,000 a year. He compared the loss of sewage to the loss of so much Peruvian guano, and he concluded by asserting, on the strength of his Tiptree experience, that liquid manure was applicable and preferable in the cultivation of corn crops and root crops—that in fact, it was equally available "to all crops and to all soils." Mr. Chadwick had followed, at the Farmers' Club, in the same vein; he had quoted the old example of Edinburgh, which the shrewd Scotch farmers had not ventured to imitate; he had proposed to substitute steam-power with a jet and rain shower of sewage for water meadows, by which he promised to get rid of the poisonous nuisance of water meadows; and he illustrated the superiority of liquid manure over solid for cereal and all other crops, by telling an old story of an American who grew some large vegetables with liquid manure manufactured in a hogshead, and distributed in a watering-can. All this sounded very plausible in the ears of those who knew nothing of farming operations, but in sober truth, it was a mass of exaggeration on a small substratum of limited experience. Mr. Lawes had well shown that all comparisons between so unwieldly, bulky, and volatile a substance as sewage, with concentrated manures like guano, were absurd. Liquid sewage occupied at least thirty times as much bulk as guano; guano was easily stored and easily distributed. It was a mere rhetorical artifice to compare human beings as manure manufacturers to sheep who carried the manure on the land. The members of the Society of Arts were no doubt familiar with specimens of Canadian copper ore which contained thirty, forty, and fifty per cent. of metal, and excited ideas of unbounded mineral wealth in the minds of speculators, until it was discovered that the cost of carriage over some hundreds of miles of mountains would entirely consume the value of the ore. Of the same character were comparisons drawn between the results of sewage applied to farms thirty miles from town and experiments out of a hogshead on the lawn of a sewage commissioner. Italian experience was equally against the total substitution of liquid for solid manure, and the substitution of Mr. Mechi's artificial rain for the water-meadow system of Edinburgh. At Milan, for 30 years the sewerage had been under the care of a regularly-constituted commission, which levied a universal graduated tax on every house, shop, manufactory, and stable, for the privilege of access to the covered rivers, which, flowing beneath and around the city, formed main sewers, like our large intercepting sewers. For the use of this sewage water a limited number of persons paid a rate equal to 20s. an acre, and the results they obtained from its use under the Lombard climate were certainly extraordinary. The fields were laid out as water meadows, on the plan of irrigation which was so well understood in Italy. To adapt the land it was levelled and sloped, provided with main channels and drainage ditches. It was sown exclusively with one-fourth red clover and three-fourths Italian ryegrass, and during the months of June, July, and August a continuous unbroken film of sewage water was poured over it without cessation, except at the time of cutting, after the

rate of from two hundred to three hundred and ninety tons per acre, in the 24 hours. The result was the most valuable description of "marcite" or winter meadows for stall feeding cows in the great dairies near Milan. The meadows were mowed four times, that was to say, in November, in January, in March, and in April, for stable feeding. In June, July, and August, three crops of hay were secured; in September, the cattle obtained a month's abundant pasturage. Thus, the "marcite" meadows, irrigated with sewage, were made to yield from 45 to 50 tons of Italian rye grass, and, under extraordinary circumstances, half as much more. But these satisfactory results were confined to a limited space. It was the opinion of the Italian farmers that liquid manure was injurious to all cereal crops, except Indian corn. In a vast territory of irrigation, the whole extent of "marcite," or winter meadows, was under 15,000 acres, and of that extent only a few were under liquid sewage. To summer crops the Italians were careful only to apply liquid manure immediately after cutting grass; at any other time they considered that it burned up the crop. Although they had the means, in their perfect irrigating arrangements, of turning all their solid manure from their great dairy stalls into liquid manure, they adopted the reverse course. They collected from Milan, scraped from ditches, and gathered in stables, great heaps of solid manure, which they distributed over the land weeks and months before water irrigation commenced, after the rate of as much as twelve tons to the acre, thus proving that, with experience of both, they found both useful. These interesting details on Italian irrigation he (Mr. Sidney) had extracted from a laborious work by Lieut. Baird Smith (Madras Engineers), who had been sent to report on the subject by the East India Company. Allowing for the difference of climate, it was certainly more to be relied on than the small experiments to which attention was so often called by the enthusiasts in sanatory reform. On the subject of cereal cultivation, he (Mr. Sidney) certainly preferred the opinion of the farmers of Lombardy and Piedmont to that of his enthusiastic friend, Mr. Mechi. It must be remembered that Tiptree had been most lavishly cultivated and manured long before the pipe and jet system had been laid down on it. It had been deep drained—subsoiled, ploughed, cross ploughed, hand-forked at an enormous expense; for several years Mr. Mechi had been content to take for his share of profit a large stock of solid manure; if then, in 1853, when every good farmer had a bountiful corn crop, Tiptree was equally blessed, it would be rash, however pleasant, to assume that all this arose from the use of liquid manure. In any event, Mr. Mechi's liquid was very different stuff to sewage pumped and triturated through fifty miles of pipe. In conclusion, he had no doubt that, under favourable circumstances, sewage manure had a certain value for grass crops, if it could be applied on the water meadow system, by tons at a time, but he strongly recommended his agricultural friends to conduct their operations under the advice of men of science and practice, like Mr. Lawes, and to obtain their engineering estimates from engineers of acknowledged character and capacity, not to be led astray by the brilliant visions of sanatory reformers, who saw a very Pactolus in every street sewer.

Mr. Chadwick said the last speaker had couched his observations as if he (Mr. Chadwick) had made extravagant representations of the commercial value of sewer manure. Now, the following were the words of the Minutes of Information officially promulgated: "In respect to the money value of town manures, where payment is made for their removal (as in the majority of town districts) they cannot properly be said to have any money value whatsoever, their intrinsic value, 'that is to say, their power as fertilisers,' being counterbalanced by the labour and inconvenience of collection, removal, and application, and by their restriction—in consequence of that expense of removal—to a narrow field of application, and comparatively small market; but, in proportion as the labour and consequent expense of collection are reduced, and the conveniences and certainty of the application of these manures are increased—as they will be by systematised works, which may be substituted under the Public Health Act—their money value will be increased, as compared with other manures, which at present are more convenient for use." With such facts as he had displayed in 1842, of contract prices of one pound per house being paid, on the average, in the metropolis, for emptying cesspools, that is to say, for the collection and removal of the most powerful fertilisers, it was then demonstrated, as now enunciated in the paper which had just been read, that the cost of carriage regulated the price of manure. Abounding, as the metropolis was, in those fertilisers, it was then shown that their use was restricted to an area of a very few miles, seldom exceeding ten miles, by carts returning loaded with manure after the sale of produce in the markets. At Liverpool, and other towns, where the farmers had begun to pay for the collection of night-soil, that is to say, for emptying cesspools, this extent of demand for it was discontinued on the introduction of guano, and of such new manures as the one of which the gentleman who read the paper was so large and prosperous a manufacturer, namely, phosphate of lime. Why was this, but on account of their superior portability, and, also, on account of their comparative convenience of manipulation within the farm. The English farmer commonly had not attained skill in the manipulation of town manures, or in overcoming their offensiveness, or in dealing with their bulk. The Belgian farmer had got the idea of liquifying them, and some skill in applying them by the means of the water cart, comparatively expensive and cumbrous as it was; and in Belgium there was a demand and a price for the town manures in question. Mr. Lawes had stated that, his farm being situated at 25 miles from London, the cost of carriage from London upon one ton of manure was 15s., and reasoning only upon the conveyance of the solid manure, he said that from such data it was not difficult to decide the actual and relative values in a practical point of view of the chief elements of manures. No doubt from such data; but he had wholly ignored the engineering data, which fifteen years ago he, Mr. Chadwick, had submitted of the power gained by steam for the removal and application of town manures, in suspension, in water, and pipe distribution. In the sanatory report then published, he had called attention to the fact, that even London water companies conveyed and sold with a profit, 12 or 14 miles, and raised to heights of 150 feet, water at two pence half-penny per ton. Practically sewer water did not, as regarded this power of conveyance and distribution, differ from the river water. Indeed, at times of floods, the Thames water, unfortunately for the consumers, in the quantity of land surface washings and matter carried in suspension, did not differ from sewer water. Adopting the data, as to actual practice in pipe distribution, the late Mr. Smith, of Deanston, in conjunction with an engineer of one of the largest London water companies, had shewn that sewer manure might be raised over heights, and delivered with a profit to farms twenty miles distant, at two pence per ton. In various parts of the country, with small companies as well as large, three pence per thousand gallons was a common price for the conveyance of water considerable distances, and its delivery into manufactories. And the same might be done with farms, of course with the like extent and constancy of demand. The same principle which he had demonstrated, that for manures there was no mode of conveyance so cheap as pipe conveyance in suspension or solution in water, was applicable to the conveyance and manipulation of manures within the farm itself. Look, however, at its application to the case Mr. Lawes had presented of his own farm, twenty-five miles distant. Why, for the cost of carrying one ton of solid manure, no less than seventy-two tons of sewer manure, equivalent to three or four dressings for an acre, might be

carried thither. In the Minutes of Information on the application of the manures of towns, a demonstration of actua practice was displayed. In the instance of Mr. Kennedy's farm at Myer Mill, Ayrshire, where the principle of liquifying the solid manures had been adopted, some of the pipes radiated from the farm-steading more than a mile, and it was shewn that the expense of pipe distribution from such extremities, and giving a dressing of two hundred pails full, or between two and three hundred gallons, was under one penny. This engineering element of pipe distribution, now gave liquid or sewer manure the advantage not only over such cases as had been cited of solidified manure, but over the most portable manures, even guano itself, if it were applied in the solid form. Whilst Mr. Lawes failed in omitting to notice the evidence, of the practical operation of the economies and facilities for the distribution of the manures of towns, in his synthesis, he also failed in the omission of large constituent elements of sewer manures, properly so called. Let him go down to the laboratory attached to his own house—his kitchen, and observe the operations of his cook, her boilings of vegetables and meat, her solutions, her skimmings, her dish-washings; let him consider, too, the soap used in washing his person and the persons of his household, and in washing clothes and floors, and all other things carried away in the water used for domestic purposes, and he would find how large had been his omission from the constituent parts of sewerage from within the house. So large were often the quantities of fatty matters discharged from houses into the sewers, that a project had been set on foot for collecting the fat in sewerage, and making it into candles; and he (Mr. Chadwick) had been presented with candles made from the fat precipitated from sewerage. Whilst the constituent proportions of sewage from within the house were reduced by the omission of matters cognizable everywhere by domestic observation, the statements which had been referred to as authoritative, widely exaggerated the extent of necessary dilution, when it was stated at fifty gallons and even twenty gallons per head per diem. Now the actual discharge of sewage from houses of the first class in the metropolis, which had several water-closets, and in which the use of water was complete and liberal, had been attentively gauged, and it was found not to exceed twelve gallons, or twelve gallons and a half, per head—or seventy gallons per house. Thirty pails full a-day would be found a large domestic use. For the poorer classes it would be less. From those gaugings it had been demonstrated, from the run of water on the days when the water was on, that, under the intermittent system of supply for which Mr. Wicksteed contended, three-fifths of the water pumped into the metropolis was distributed in worse than waste. With mismanagement of the apparatus the like waste might occur under the constant system; but the exaggeration of the bulk of dilution actually required had been proved to be double or even threefold. Then the synthesis omitted the constituents of sewerage outside the house, the soot from the roofs, which was to be seen running down from the gutters like ink, the dung of horses and animals, and the surface washings of the streets. These had been collected on days of rainfall and storm, and had been found by Professor Way to contain silicates and other matters, in actual quantity of matter in solution or suspension, without comparison of the quality, to exceed the sewerage derived from within the house. Indeed, much of the matter treated as examples of sewerage, had been found to consist mainly of the surface washings of towns. The last speaker had referred to the case of the Italian irrigations. He (Mr. Chadwick) had directed the attention of Captain Baird Smith to the irrigations of Italy as a source of experience available for India, and could speak of them. The instances of irrigation carried on for centuries were not, as might be supposed, except in the case of Milan, instances of irrigation with town sewerage, but instances of agricultural irrigation with simple water; and, in the case of Milan it would be found that in the Palazza, or except, perhaps, some instance of an English hotel, water closets, or house drainage in our sense was unknown. Night soil might be collected and used in the solid form there, simply because there was no other mode of collecting and using it. The irrigation with the vetablia was mainly an irrigation with the surface washing of the city. The case of Mansfield was cited as an instance of irrigation with sewer manure. But Mansfield was a town of cesspools, with little or no proper house drainage, and the sewerage was chiefly the surface washing, which was most rich in days of heavy rainfall. Even the sewerage of the metropolis was far from being in a condition to reason from, and was not reasoned from by those who had considered the subject. Seventy and eighty per cent. of the houses in populous districts were proved to be without water closets, and in the higher class of houses, the water closets themselves discharged into cesspools. The brick drains were commonly drains of deposit, as were the greater proportion of the flat segmental sewers of recent construction. The whole system of house and street drainage and engineering construction, as had been demonstrated, formed one system of extended cesspools. That which they smelt at the gulley shoots, was the result of the decomposition of the matter retained in the sewer. Mr. Lawes, as a chemist, would admit that all that escaped by decomposition into the streets to the pollution of the common air was the loss of so much of the most valuable constituents of manure. The greater proportion of the metropolitan sewerage was the overflow from disintegrated and deteriorated deposit. Now, under the new system of pipe sewers, it was demonstrated that, where they were properly adjusted to the flow, by competent engineers, they were perfectly self-cleansing, there was no accumulation of deposit, no wasting of the manure by decomposition, no smell of decomposition in the streets or houses. They might now test the engineering or the administration by the smell. If there were any smell of decomposition from the new works, there was deposit, and if there was deposit or the need of flushing, even, there was default in the engineering. If they went to the outfall of the new pipe sewers laid down at Tottenham, which was now drained, as he contended every town ought to be drained, where even the poorest house had a water-closet, and where there were no cesspools, they would there, at the outfall, perceive that there was less smell from the sewerage discharged from sixteen hundred houses than there was from the uncovered cesspool of a single house, and that smell, not the smell of decomposition, as in the case of the cesspool. Under the new system, the excreta of towns was removed from beneath the site by a constant flow, at the rate of from a mile and a half to two or three miles per hour. Mr. Cuthbert Johnson, who had paid attention to the subject of the new conditions of sewerage, had shewn that ordinary house sewerage discharged by self-cleansing pipe drains did not enter into the stage of decomposition until about four days after its delivery. All the smells of decomposition from house drains or sewers were therefore generally smells from matter more than four days old. All the arguments from the experience of sewerage in old or the common conditions, even when derived from positive analyses were, therefore, fallacious when applied to the new systems of works, from which the applications of sewerage to agricultural production had been proposed. Instead of the constituent parts of sewerage (in addition to human excrements) being diminished with the progress of new habits and sanatory improvements, as Mr. Lawes had assumed, they would be increased in consequence of the superior economy as well as convenience, and comparative inoffensiveness of that method of removal. The data as to the extent of area requisite for the application of the sewerage of towns, appeared to have been as little attended to as were those in respect to its future composition. In his own report, in 1842, he (Mr. Chad-

wick) had stated: "If the increase of production obtained by the use of the refuse of Edinburgh (that is of 3900 oxen from one quarter of the refuse of Edinburgh), be taken as the scale of production by the use of appropriate measures, the refuse of the metropolis alone that is now thrown away would serve to feed 218,000 oxen annually, which would be double that number of acres of good pasture land." The case of Edinburgh was the best of which he was aware to serve as data, and that, it must be said, was the case of a wretchedly drained town. Now, the quantity of land on which a quarter of the sewerage, as near as could be ascertained, was applied, was not more than six hundred acres. At the same rate there would be required for the advantage of the metropolis about nine square miles, or a plot of about three miles square, or a belt of about a quarter of a mile broad round the metropolis beginning at its inner diameter five miles from St. Paul's. Compare this datum with the allegation of the requirement of 3,500 square miles for the reception of sewerage on the old principle? The only instance in which there had been any observations of which he was aware, of value in respect to sewerage in the new conditions as to drainage, were those of Mr. Cuthbert Johnson, who for several years had observed the application of the sewerage of his own house to a plot of land, and had analysed the soil water, and noted the products on grass carefully. On his scale 33 acres of land would be required to apply the sewerage of 1,000 persons to grass land. On the same scale, it would require 114 square miles, or a square of ten miles and a half, or a belt of little more than two miles for the metropolis, the inner margin beginning five miles from St. Paul's. But he obtained production only at the rate of twenty-two tons per acre,—which, however, was five-fold the production of his neighbours from the like land; whilst in Scotland, from more concentrated applications, they obtained sixty and seventy tons per acre. Mr. Johnson expressed his own belief, that one-third the area, or 38 square miles, might be made to suffice: and he, Mr. Chadwick, was led to believe that little more might be made to suffice with the addition of the surface washings of the town, which were not included in the observation. Mr. Lawes had spoken of sewerage as the best suited for grass lands. Now there was no warranty for this limitation. Sewer manure, and that of an inferior quality, had been applied to cereals and to every species of production in market gardens, and to and to all with complete success. Even in that of the highest agricultural production, gardens, where twenty pounds per acre in labour, and twenty pounds per acre in manure, had been accustomed to be bestowed, the range of the application of sewerage manure by the jet was displayed in the superiority of every species of vegetation. The sufficiency of Mr. Lawes' experiments in the growth of crops, or their applicability to the present subject, was to be denied. Those experiments, unless he (Mr. Chadwick) misunderstood, were made with solid manures? [Mr. Lawes expressed assent.] Just so. Mr. Pusey had, in a paper in the Royal Agricultural Society's Journal, stated some experiments as to the comparative effects of the application of guano by the old drill, or in the solid form, and the effects of the application of the same quantity of guano by the liquid drill, in the liquid form. He showed that the produce was double from the liquified manure. Mr. Pusey appeared to be amusingly unconscious that in that case he was giving the general case of liquified manures. In the Minutes of Information to which he referred, a case was stated of the application of liquified farm-yard manure for upwards of twenty years, during which a continuous fivefold production was obtained, whilst the highest dressings with the solid manures, only yielded an increase of one fold and a half on the same land. The proposed applications of liquified manures, were treated as novelties, whilst in a less convenient and economical form there was wide continental experience; and they had also the experience of the horticulturists, by whom the highest productions in weight and quality were obtained by that form of application. When it was proposed to restrict the application of liquid manure to one description of vegetation, it seemed to be forgotten that no one form of vegetation known did or could feed on manure in the solid form; whilst all vegetable physiologists agreed that moisture was necessary for the feeding of plants, it did not seem to be yet determined whether the matter of manures was not reduced to the gaseous form before it could be assimilated. The greatest vegetable physiologist of the last century, De Candolle, had pointed out that the course of agricultural improvement in Europe, would be giving to vegetation water and food at the same time. If the time permitted, much more might be observed upon the course indicated in Mr. Lawes's paper. He, Mr. Chadwick, had noticed, he thought, the chief points in which there had been serious misapprehension, or oversights of existing information.

Mr. Arthur Morse wished to make a few observations on the quantity of sewage manure that could be applied to land in a liquid form by the process of pumping. Mr. Wicksteed and others had assumed, that the sewage of a town would fertilize land at the rate of 2½ individuals to an acre. His (Mr. Morse's) experience, however, had led him to a conclusion of quite a different character. The value of sewage manure, he thought, was small, and that a very large quantity could be put on an acre. From his experience of the application of sewage water in the town of Swaffham, which had been tried since the introduction of the Health of Towns Act, he was of opinion that the sewage water from a population of 1,000 inhabitants could be safely put on an acre of land. The sewage of a part of the town of Swaffham had been applied to the land by the process of pumping, and the result was as follows:—The value of the land at the commencement of the operation, for gardening or building purposes, was £250 an acre. The reservoir and drains to connect the houses and streets with the land cost £200 more, and thus made £450 the cost of the acre. The annual rent of this acre at four per cent. would thus be £18 a year. Working expenses were found to be £10 a year more, and £10 a year was also charged for wear and tear and repaying outlay. The rent and expenses of the land were thus £38 an acre. Now for the profit. A careful weighing of each cutting of the Italian rye-grass in the year 1854, gave a quantity of 65 tons to the acre. This, at its market value of 15 shillings per ton, would be £48 15s. per acre, but the value of it to the owner was even greater than this, for the consumption of hay economised by it was to the owner 10 tons, at £6 per ton, or £60 per acre. If, as it was supposed in this case, that the sewage water of 1,000 inhabitants could be put upon an acre of land, the sewage of London, with its population of two millions and a half, might be got on to two thousand five hundred acres. Estimating it at £10 an acre, the annual value would thus be £25,000 a year. This was on the supposition that a great part of the solid manure of London was taken away, as at present, for garden and other purposes. On the whole, he thought the application of sewage manure by the pumping process was, on a small quantity of land, a very profitable undertaking, and on a large scale would be done at much less expense.

Mr. J. J. Mechi had only one word to say. He would express his deep gratitude to Mr. Lawes for the very valuable paper he had read, which added to the many claims that gentleman already had upon the agricultural community. Still he (Mr. Mechi) felt some regret that he had not put a sufficient value upon water alone supplied for irrigation. He would only call attention to the fact stated by Mr. Way, in the 14th volume of the Royal Agricultural Journal, in his paper "On the Constituent Properties of Grasses," namely, that the grass of meadows irrigated with water alone contained double the quantity of fattening, and double the quantity of albuminous

matter, compared with those which were not so irrigated. After that evidence he thought they were safe in considering that the application of water alone, of London, for grass crops, would be attended with very beneficial results. With regard to cereals from his own experience on the poor clay soil of his farm, he could say that the effect of applying solid manure in a liquid form had increased the crops to a very great extent, even as regarded cereals, and it also enabled them to do what most farmers were afraid to attempt, viz., to take off a crop of some 30 tons per acre of mangel-wurzel, and afterwards, as he had himself done last year, grew 13 quarters of oats per acre on the same land. He therefore thought they need not be afraid of cereals being too strong after having taken from the land a heavy and valuable root crop, such as he had mentioned.

Mr. F. O. Ward said that, at that late hour of the evening, and after the able and luminous remarks that had fallen from Mr. Chadwick, he should not detain the meeting with any lengthened comments on Mr. Lawes's paper, to the value and interest of which he was happy to bear his humble testimony. As, however, reference had been made by Mr. Lawes to the Metropolitan Commission of Sewers, of which he was a member, and as some proceedings of that body, and some papers laid before it, had been quoted as lending the weight and sanction of the Court of Sewers to a particular view of the question under discussion, he felt it his duty to say a few words on those points, to prevent misapprehension. Thus, Mr. Wicksteed's report, made at the request of the Commissioners, on the question, whether sewage should be applied in the liquid form, or whether its valuable ingredients should be solidified, was a document printed only for consideration, and must by no means be taken as commanding their general assent, still less as stamped with their collective authority. For his own part, speaking as an individual commissioner, he thought Mr. Wicksteed had exaggerated the difficulties of liquid manuring; and especially had laid undue stress on the supposed amount of pipeage that would be immediately necessary for carrying it into effect. He had described in his report successive circles of mains, amounting to 1200 miles in length, and costing, with engines and other adjuncts, between eleven and twelve millions sterling, to distribute the London sewage on above a million acres of land; and he argued, from this vast expenditure, and widely-extended range of distribution, that the plan was impracticable. But he (Mr. Ward) thought this resembled the arguments that were urged against gas lighting at the outset. "What!" it was said in the old days of oil lamps, to the daring innovaters who proposed gas-lighting, "do you seriously ask us to tear up all the streets of our towns, and lay down thousands of miles of subterranean arteries, to circulate a subtle vapour through every street, and into every house, to do at a cost of millions upon millions what our lamps and candles already do sufficiently well?" Such was the language used; and the proposal of gas-lighting was regarded, at the outset, by the majority of mankind, as the wildest and most visionary hallucination. But when Murdoch's factory had been illuminated with gas the whole problem was virtually solved; and when the first line of gas-lights burned along Pall Mall, the illumination of all the towns of Europe became a mere question of time. Just so, when the first farm had been successfully laid down with irrigating pipes for the distribution of liquid manure, there ceased to be any force in the argument about the quantity and cost of pipeage for this purpose; for what could be profitably done in 100 acres, could be done *a fortiori* on 1000 or on a 1,000,000. In this, as in other human affairs, progress would be gradual; there were not above one-fifth of the London houses in which cesspools were yet abolished, and as the water-closet system extended in the towns, so the means for utilising the refuse would, it might fairly be supposed, extend in the country. Nor should we be deterred from grappling with the problem by contemplating the vast magnitude of the results to which it would lead in the course of time—of generations, perhaps, when the whole subsoil of Europe would probably be piped for the distribution of liquid manure, just as all Flanders was already honeycombed with tanks for its storage. Again, the recent decision which had been come to by the Commissioners as to the course of the main intercepting sewer on the south side, must not be supposed to imply that the Commissioners had settled the question what was to be done with the southern sewage, or on what plan it was proposed to turn it to account. The decision which had been arrived at was an engineering, not a chemical, nor an agricultural decision; it denied the necessity of a high level intercepting sewer as proposed by Mr. Bazalgette, and affirmed the sufficiency of a low level intercepting line, but further than that it did not go. So little, indeed, could the question how the refuse was to be dealt with be considered as settled in the opinion of the Commissioners, that while one part of the scheme of their own engineer contemplated carrying the sewage of forty square miles to Barking, another part of the same scheme (Mr. Bazalgette's) proposed turning the sewage of nineteen square miles, on the west side, into Battersea Reach, after treatment by some deodorising or precipitating process not as yet defined. He mentioned this in proof that the subject could not be regarded as settled, though he must say that he himself was strongly opposed to such a plan as that he had just referred to. His (Mr. Ward's) view, after careful inquiry, was adverse to the plan of precipitation, except in so far as it might be made available as a transitional expedient, while the *vis inertiæ* of the farmers (always excepting such brilliant innovators as his friend, Mr. Mechi, opposite) was being gradually overcome; and, while the difficulties connected with the subdivision of property, and other obstacles of an administrative kind, were being dealt with. Adverting to Mr. Wicksteed's process itself, and generally to the processes in which lime was relied on as a precipitant, he said the defect of those processes could, he thought, be very shortly pointed out. Ammonia existed in sewage in two forms, one derived from the more solid *caput mortuum*, the other from the fluid residuum. The first form, or that in which the fæcal ammonia occurred, was principally as undecomposed organic matter, the undigested excess of the aliment consumed; the other form, or that of the urine ammonia, was chiefly as urea, which, in the sewage, was speedily transformed into ammonical salts. Now the behaviour of lime was quite different towards ammonia in these two forms. One form, the organic fibre of the fæcal residuum, lime sent *down*, the other, the ammonia of the salts derived from urine, it sent *up*; the first it precipitated mechanically, very much as white of egg clears coffee; the second it disengaged and set free as a volatile gas, substituting itself as a base in the salts decomposed. Now, if the organic fibre thrown down contained the larger part of the ammonia, Mr. Wicksteed's plan would be as useful in practice as it was ingenious and meritorious in conception. But, unfortunately, this was not the case. Four-fifths of the ammonia were derived from the urine, only one-fifth from the solid refuse. So that, to catch and retain, by means of lime, the fæcal fifth, we were obliged to sacrifice the renal four-fifths. Such, at least, was his present impression, looking to the chemical principles involved, and to such facts as were as yet before them. He should be happy if Mr. Wicksteed could show him he was mistaken, and that means had been really discovered to make lime, detain the ammonical salts of sewage, as well as the undecomposed organic fibre. Until this could be shown, the lime process must be regarded as uneconomical in two senses; first, as wasting the larger part of the ammonia; secondly, as fixing in a very bulky form the small portion which it did throw down. On this latter point he would observe that, from the analyses which he had seen, it appeared

that, while good guano contained 15 or 16 per cent. of nitrogen, the lime precipitate of sewage would barely contain 3 per cent.; so that such a precipitate, in respect of cartage and distribution costs, was what a ton of guano would be if mixed with five tons of sand or other inert ingredient. On the whole he did not at present see reason to hope that this process would be available for the utilization of sewage, except, as he had before said, transitionally, while ulterior measures were in progress. On another point he entirely concurred in what had fallen from Mr. Lawes, than whom there was no man in this country to whom agriculture was more indebted for the admirable experiments which he had conducted on a princely scale for a series of years, and from which he had himself derived much instruction. He agreed with Mr. Lawes that the grand difficulty of dealing with the sewage of London consisted in its vast, and, above all, in its *variable* bulk. The average rainfall in London was about 24 inches, equal to about 2400 tons per acre. The area draining into the London sewers was 26,613 acres, or nearly 41½ square miles on the north side, 21 being central, 20½ suburban. The southern area was 18 miles, half central and half suburban as nearly as possible. Together, therefore, the London drainage area was 59½ square miles, central and suburban, in nearly equal proportions. A considerable portion of the rainfall on the suburban area was absorbed by the ground, but the greater part of that which fell on the paved surfaces of the central district, found its way to the sewers. Calculating from these data, and taking the water supply in round numbers at 50,000,000 gallons a day, it might be said that the total quantities of the rainfall and the sewage proper were nearly equal—about eighty or ninety million tons annually. But the difference was this, that while the sewage was produced uniformly day by day throughout the year, (increasing somewhat in summer, but still pretty uniformly), the rain, on the contrary, was so variable, that 2 inches or $\frac{1}{12}$th of the whole amount of annual rainfall, would sometimes fall on London in one hour. The weight of 2 inches of rain-fall was 7,621,516 tons., equal to more than a month's sewage. Even, supposing the rain to fall uniformly on the 152 rain-days, its amount would be 601,700 tons per rain-day—or three-times as much as that of the sewage (223,200 tons per day.) But of the total annual rain about 16 inches fell in 44 days; or two-thirds of this rain in about one-eighth of the whole number of days. This had been observed in an ordinary year, a little perhaps above the average humidity. On 30 days, ¼ of an inch per diem fell; on 10 days, ½ an inch; on 2 days ¾ of an inch; and on 2 days 1 inch. On the quarter-inch days the rainfall was to the sewage as 4¾ to 1, on the half-inch days as 9½ to 1, on the inch days as 19 to 1. Now, making all reasonable deductions for evaporation and absorption, it was obvious that these vast and sudden variations of bulk tended to make the sewage unmanageable. He had, therefore, given close attention to the question, whether these variations of bulk, which so complicated the agricultural part of the problem, might not be avoided; and, point by point, he had been brought to the conviction that, for the profitable utilisation of the sewage, as well as for the thorough interception of human refuse from the Thames, it is indispensable to separate the sewage from the rainfall. He was led to propound this principle—"The whole of the rainfall due to the river, the whole of the sewage due to the soil." Looking at it in the urban point of view, he said, "To dispollute the Thames you must, first of all, dispollute he tributary brooks that feed the Thames:" and, as it had been said, "take care of the pence, and the pounds will take care of themselves;" so he would say, purify your brooks, and your rivers will run pure of themselves. Looking at it in this agricultural point of view, he considered the sewers under London as guano mines, rendered unworkable by flooding. The public, he considered, were the shareholders in these mines—the rates were calls that had been paid up, and the Commissioners were in the position of directors endeavouring to work the property up to a dividend-paying condition. The problem had hitherto baffled the ablest and most eminent engineers, including the engineer of the Commissioners, Mr. Bazalgette, whom he was glad to see present. They were attempting an impossibility in attempting to deal with streams liable to swell suddenly to several hundred times their ordinary bulk. The attempt to take such streams in enormous tunnels, like subterranean rivers, to Barking, was futile. The purification of the Thames could not be so accomplished. One day in twelve the rain-swollen brooks would still rush into the Thames, gorging and overflowing the biggest tunnels you could make, and carrying out tons of excrement into the tideway you were seeking to purify. And it was equally impossible, and equally uneconomical, to make culverts and reservoirs for the agricultural utilization of these swollen streams. He had been led, by these and similar considerations, to investigate the problem what it would cost to separate the sewage proper from the rainfall; to intercept the sewage water in twelve-inch pipes on its way from the houses to the sewers, instead of intercepting it with twelve-foot tunnels on its way from the sewers to the river. The inquiry was a laborious one, requiring an estimate of cost, street by street, and sewer by sewer, so variable were the conditions of the cases that presented themselves. But he had gone over a tract of the town, inhabited by upwards of 30,000 persons, more than one hundredth of the whole population, and he believed, from the results obtained so far, that the tubular would prove cheaper than the tunnel interception, independently of its superiority in facilitating the realisation of that which he regarded as an axiom in the modern sanatory art, namely, that "sewage, heretofore got rid of as refuse, must henceforth be administered as property." He said, in modern sanatory art, for the problem had originated in comparatively recent times. It had sprung out of Bramah's great invention of the water-closet, towards the close of the last century. Previously to the introduction of that admirable contrivance, which had secured us the inestimable benefit of cleanly defæcation, the refuse was retained in cesspools, and the sewers were protected by law from pollution. But the water-closet gave rise to a new requirement — that of an outfall for soil water—to which purpose the rain-sewers came gradually and illegally to be turned This abuse made such slow and silent progress, as water-closets one by one came into use, that for a long time its importance had escaped attention; and the surreptitious pollution of the rain channels, originally connived at as insignificant, had come at last to be recognised as a system. The recent introduction of a cheap form of water-closet for the use of the working-classes, had given to this system such a sudden and rapid extension, that attention had at length been called to the monstrous proportions of the evil; which, plainly stated, was the annual discharge of many thousands of tons of putrifying excrement into the rain sewers, the brooks, and the river. Every step that we had made in this false direction must, in his opinion, be retraced. The dispollution of the river, the brooks, the rain sewers, constituted a chain of operations, the links of which were bound together by the logic of an irresistible necessity. This necessity might seem hard, but it was absolute. You could not divert in tunnels, nor master with pumps, half-a-dozen rain-swollen brooks: their flood waters must rush into the Thames, and must carry thither whatever excrement you had turned into their channels. He was, perhaps, however, dwelling too much on the urban aspect of the problem, on an occasion when they were specially considering its agricultural bearings. The two branches of the question were, however, intimately connected, and the main difficulties in both grew out of

one and the same fundamental error, namely, the pollution of the water brooks. He would say, in conclusion, dispollute the Ranelagh, the Fleet, and the other brook-sewers of London, and your main difficulties at once disappear; the purification of the river, and the utilisation of the sewage become comparatively easy matters. But so long as you go on discharging human excrement into the brooks (arched over, and now called valley line sewers), you are driven to adopt the Great Tunnel Scheme as a palliative measure, to diminish evils which it cannot cure; to reduce to about one day in ten or twelve (instead of reducing to zero) the number of rain-days during which excrement will be ponded among houses, or poured out into the river at low-water to go upstream with the flood; to lessen (instead of preventing) the accumulation of deposit in sewers by diminishing the intermittency of their outflow, while retaining the insufficiency of their slope; and, in fine, to convey to the country, in a partially available condition, only so much of the sewage ammonia as may escape volatilisation by stagnancy, and dilution by rain. He thanked them for the indulgent hearing they had given him, and he trusted shortly to be in a position to submit the means of giving effect to his views in a practical shape for their consideration.

The CHAIRMAN said, when he looked at the time to which the clock before them pointed, he thought they would agree with him that it was pretty near the hour to wind up the business of the evening. They had had a most interesting, and he might say a most useful discussion; and he thought he should be wanting in his duty if he did not, in the name of the agricultural community, thank the Council of the Society of Arts for giving them the opportunity of hearing the admirable paper which had that night been read to them by Mr. Lawes; and also the very instructive discussion which they had heard from other gentlemen who seemed well up in the subject, and well acquainted with what they were speaking of. What was most satisfactory to his mind was, that no two opinions seemed entirely to agree, because, so long as the scientific men whom they had heard that night differed in opinion, it would be the interest of every man of common sense, and with brains in his head, to work out the subject for himself; at the same time, he hoped in the end they would come to something like a definite result. There was, however, one subject mentioned by Mr. Chadwick which, if allowed to pass unnoticed, might convey an erroneous impression to the minds of many present. Mr. Chadwick had stated that water companies made a considerable profit by sending a ton of water ten or twelve miles off at 2½d. per ton, but Mr. Chadwick forgot—or at least he did not put it in that form—that where the water was sent in that way there were a vast number of houses that contributed to the main channel which carried the water to a certain point. Mr. Chadwick could not have lost sight of this consideration in his calculation of the cost of supplying manure, but he did not bring it forward in his explanation; consequently it did not follow that, because a water company could deliver water at Brentford (for example) for 2½d. per ton, a gentleman having a farm the same distance off could get his sewage water at the same rate. If they could get a vast quantity of land lying together, and a certain number of persons subscribed to have the same conduit, then it would be an easy matter to have small conduits to their own farms. With these few remarks he would beg the meeting to join with him (and he was sure all he saw around him would readily do so) in returning the thanks of this Society to Mr. Lawes, for the very able and very instructive paper which he had read to them that night.

The vote of thanks having been unanimously passed,

The Secretary announced that the Paper to be read at the meeting of Wednesday next, the 14th inst., would be, "On a New Method of Teaching Drawing, involving the Principle of a New System of Architecture." By Herr Joseph Kumpa, of Dresden.

*** It having been represented, after the meeting, that there were still many gentlemen who were anxious to make some remarks on the important subject of the "Sewage of London," the Secretary is authorised to state that an Extraordinary Meeting has been fixed for Monday, the 19th inst., at eight p.m., for the purpose of renewing the Discussion.

## INSTITUTE BOOK ORDERS.

FEBRUARY ACCOUNT.

| | Full Price. £ s. d. | Red. Price. £. s. d. |
|---|---|---|
| Aylesbury, Mechanics' Institution | 6 15 9 | 5 8 4 |
| Blairgowrie and Rattray Mechanics' Institute | 5 0 0 | 3 11 5 |
| Brighton, Railway Literary and Scientific Institution | 0 5 0 | 0 3 7 |
| Bristol, Athenæum | 21 12 1 | 16 3 9 |
| Bury, Athenæum | 6 0 0 | 3 15 8 |
| Cambridge, Philo-Union Society | 5 3 0 | 3 18 7 |
| East Retford, Literary and Scientific Institution | 0 15 0 | 0 11 9 |
| Hampton (Middlesex), Literary Society | 3 17 6 | 2 15 9 |
| Horncastle, Mechanics' Institution | 11 15 6 | 8 15 0 |
| Leven (Vale of), Mechanics' Institution | 19 2 4 | 14 6 1 |
| London, Bank of England Library and Literary Association | 8 2 10 | 6 9 8 |
| Middlesbro', Mechanics' Institute | 3 19 6 | 3 2 9 |
| Northallerton, Institute | 1 19 6 | 1 9 5 |
| Northampton, Religious and Useful Knowledge Society | 10 12 0 | 8 2 6 |
| Sevenoaks, Literary & Scientific Institution | 7 8 0 | 5 14 11 |
| Sheerness, Isle of Sheppy Mechanics' Institution | 1 8 0 | 1 9 6 |
| Stamford, Institution | 1 1 5 | 0 17 0 |
| Tiverton, Literary and Scientfic Institution | 3 7 0 | 2 11 6 |
| Yarmouth (Great), Institute | 4 15 8 | 3 10 5 |
| | £123 0 1 | £92 17 7 |

Being a saving of £30 2s. 6d., or about 25 per cent.

## INTERNATIONAL COMMERCIAL LAW—BILLS OF EXCHANGE.

A letter, of which the following is a copy, has just been addressed to the Solicitor General by Mr. Leoni Levi.

"The Law of Bills of Exchange is about to be altered with regard to diligence or execution for the enforcement of payment, and the time seems propitious for endeavouring to introduce any other improvement which may render this instrument free from difficulty. The days of grace have always proved a source of much inconvenience, from the difference of the practice or custom in many places and states. France has abolished them by the Code Napoleon, and also all other nations which have adopted the same code. By the law of Bills of Exchange lately passed in Germany, days of grace were abolished throughout the German States, and it seems to me that it would be highly advisable to abolish the three

days of grace as they are allowed in this country, so as to put our law on the subject on an equal footing with that of other European nations. In the event of such a change being effected, it may be also considered whether, were bills become due on Sundays and holidays, and are now payable on the days previous, they ought not to become payable on the following day, an alteration which, where bills are becoming due on Sundays, and payable on Saturdays, would facilitate the desire generally felt of diminishing business on Saturdays."

## Home Correspondence.

### THE DISCUSSION AS TO WATER SUPPLY.

Sir,—I neither had, nor have I, any intention of engaging in a controversy with Mr. Homersham, but as he has thought fit to put forth in your pages a representation and account of the Dalton gauge in use at Apsley mill, which I had twice assured him to be false, I am reluctantly compelled again to address you.

The gauge in question was constructed some twenty years ago, not for the purpose of being employed in antagonism to such schemes as those of Mr. Homersham, but to enable Mr. Dickinson to form an approximate estimate, in the spring of the year, of the supply of water that would be available for his mills during the ensuing summer and autumn.

As the simplest and best means of ascertaining and placing beyond doubt the nature of the soil with which the receiving cylinder of the guage was filled, I have this day had it emptied, and find that, as I had already stated, there was no peat among its contents, and that the section at p. 245 of your Journal, is as entirely erroneous as many other of Mr. Homersham's so-called facts. The upper 10 inches consisted of mould and the ordinary surface soil of the neighbourhood, completely riddled with worm holes; beneath this was a layer of about 15 inches of sandy gravel, getting gradually coarser as it approached the bottom, which was filled with coarse gravel, entirely free from clay or sand. The water that percolated through this was collected in a leaden saucer-shaped vessel, that extended to the outside of the wooden tube, from which vessel it was conducted by a leaden pipe to the graduated gauge. As the percolating water would, by its own gravity, descend in a direction as nearly as possible perpendicular, I conceive that the guage would indicate nearly the same results, even if the wooden tube were entirely removed. When the gauge was first erected, the overflow-pipe was carefully watched, but it was found in practice that no overflow whatever took place, the soil being sufficiently porous to absorb the heaviest rains that fell.

Taking an impartial view of the contents of the receiving cylinder of this gauge, I am of opinion that if its results are in any way erroneous, it is in showing an amount of percolation larger than would actually take place over any extended area of this district, as it is very rarely that a section of three feet from the surface of the ground would present so permeable a series of beds.

I had the less reluctance to distrust this gauge, as we have had one of a similar character, but of cast iron, and on a larger scale, in operation during the last two years.

As regards our pumping, for the purposes of our manufacture, large quantities of water from wells and bore-holes sunk in the chalk, it is perfectly true that such is the case, though not to the extent asserted by Mr. Homersham. The quantity of water obtainable from wells and bore-holes sunk in the chalk and many other strata, depends, within certain limits, on the number and size of the fissures intersected, and as from common opinion, and our own experience at Manchester in 1834, we were led to believe that the cheapest and best manner of laying open the necessary extent of fissures was by boring, we employed Mr. Paten, a neighbouring well-sinker, for this purpose.

I am quite willing to admit that, whatever amount of water we may pump from these wells and bore-holes, is so much abstracted from the reservoir supplying the springs and rivers of this district, but as, after using it, we return the whole of what we pump to the river, we cannot see that we injure our neighbours in any way, or what particular private advantage we can be said to derive from having employed Mr. Paten in preference to any other well-sinker.

At all events we cannot be classed with those who would rob the inhabitants of these valleys of their water, and then claim to be considered public benefactors for selling the stolen property at a high price in London.

I am, sir,
Your obedient servant,
JOHN EVANS.

Nash Mill, Hemel Hempsted, Feb. 26, 1855.

## Proceedings of Institutions.

Bedford.—On Wednesday, the 28th ult., the Rev. Thomas W. Aveling, of London, gave a very interesting lecture on "Jerusalem and its Environs." Dr. T. H. Barker, V.P., occupied the chair, and, at the close of the lecture, tendered the warmest thanks of the committee and of the audience to the rev. gentleman, for his great kindness in coming down to give them such a graphic account of the scenes and places he had visited during his recent tour in the east.

Coupar Angus.—The twentieth anniversary of the Mutual Improvement Society was celebrated, in the Meeting Room, Campbell-street, on the evening of Tuesday, the 27th ult., Mr. D. Don in the chair. The balance-sheet showed that, although the Society is almost solely composed of, and supported by, a handful of poor working men, it has a mass of valuable property free from debt, and a small balance in the hands of its treasurer. There were no set speeches, but Messrs. Ferguson, Wilson, Forbes, Stewart, Robertson, and Mill, carried on an instructive conversational discussion on various important subjects, but more especially on mineralogy, and social economy. The table was well furnished with refreshments (no ardent spirits), which were freely partaken of during the evening. The proper work of the anniversary being ended, it was resolved to continue the important connection with the Society of Arts, and to petition the House of Commons to purchase the valuable collection of works of Art which belonged to the late Ralph Bernal, Esq., M.P.

### MEETINGS FOR THE ENSUING WEEK.

Mon. Geographical, 8½.

Tues. Royal Inst., 3. Prof. Tyndall, "On Electricity."
Syro-Egyptian, 7½. 1. "Dr. J. Lee, "On Some Maltese Coins." 2. Mr. Marsden, "On a Sarcophagus of the Reign of Hophra." 3. Mr. Bonomi, "On the Birs-i-Nimrud."
Civil Engineers, 8. Mr. R. A. Robinson, "On the Application of the Screw Propeller to the Larger Class of Sailing Vessels."
Med. and Chirurg., 8½.
Geological, 9.

Wed. Society of Arts, 8. Herr Joseph Kumpa, "On a New Method of Teaching Drawing, involving the Principle of a Natural System of Architecture."
Graphic, 8.
Ethnological, 8½.
Royal Soc. Literature, 8½.

Thurs. Royal Inst. 3. Mr. Donne, "On English Literature."
Statistical, 3. Anniversary.
Antiquaries, 8.
Royal, 8½.

Fri. Royal Inst. 8½. Dr. William Odling, "On the Chemistry of the Hydro-Carbons."

Sat. Royal Inst. 3. Dr. Gladstone. "On the Principles of Chemistry."
Medical, 8.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

Par. No.

*Delivered on 1st March, 1855.*

77. Assistant Surgeons (India)—Copy of Regulations.
81. Committee of Selection—2nd Report.
32. Bills—Court of Chancery (Ireland) (Jurisdiction).
34. Bills—Court of Chancery (Ireland) (Receivers).
37. Bills—Court of Chancery (Ireland) (Stamp Duties).
39. Bills—Tenants' Improvements Compensation (Ireland).
45. Bills—Ecclesiastical Courts.
Tuscany (Coasting Trade)—Convention.

*Delivered on 2nd March, 1855.*

73. Court of Chancery—Return.
79. Tallow, &c.—Return.
86. Army before Sebastopol—1st Report from Committee.
87. Committee of Selection—3rd Report.
46. Bill—Purchasers Protection against Judgments.
Railways—Reports upon certain Accidents (Nov. and Dec. 1854).

*Delivered on 3rd and 5th March, 1855.*

65 (1). Trade and Navigation Accounts.
80. Queen Anne's Bounty—Account.
84. Education (Ireland)—Return.
47. Bills—Union of Benefices.
49. Bills—Secretaries and Under Secretaries of State (House of Commons).
50. Bills—Tea Duties Decline Suspension.
France (Supplies to be furnished to the Turkish Army)—Convention.
France (Electric Telegraph between Bucharest and Varna)—Convention.

*Delivered on 6th March, 1855.*

50. Bill—Ecclesiastical Property (Ireland).

*Delivered on 7th March, 1855.*

67. Highways—Return.
83. Newspaper Stamps—Return.
90. Voters (Ireland)—Abstract of Return.
92. Commissariat—Estimate.

## PATENT LAW AMENDMENT ACT, 1852.

### APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, March 2nd*, 1855.]

*Dated 13th January, 1855.*

92. J. Britten, Birmingham—Filtering liquids.

*Dated 24th January, 1855.*

182. J. Livesey, New Linton—Lace machinery.

*Dated 3rd February, 1855.*

254. P. M. Crane, Attry, Kildare—Products from peat.

*Dated 12th February, 1855.*

322. J. Ramsbottom, Longsight, near Manchester—Metallic pistons.
324. G. Lucas, Hulme, Manchester—Spinning machinery.
326. R. Kerr, 41, Coleman-street—Loaf sugar.
328. J. Foster, Long Eaton—Lace machinery.

*Dated 13th February, 1855.*

330. J. L. Lambot, Carces, Var—Building material as a substitute for wood.
332. R. P. Courfield, Upper Holloway—Electro-coating of iron, &c. (Partly a communication.)

*Dated 14th February, 1855.*

334. T. Metcalfe, W. Slaiding, and J. Metcalfe, Clitheroe—Dyer's tube-frames.
336. I. R. Isaac, Liverpool—Portable buildings.
338. H. L. Pattinson, jun., Newcastle-upon-Tyne—Iron carriage-wheels.

*Dated 15th February, 1855.*

340. W. Blythe, Oswaldtwistle, and E. Kopp, Accrington—Soda-ash, and sulphuric acid.
342. J. Leadbetter, Halifax—Railway breaks.
344. J. Mason and S. Thornton, Rochdale, and T. S. Sawyer, Longsight—Finishing yarns.
346. C. F. Delabarre, Paris—Apparatus for propelling gases and forcing liquids.

*Dated 16th February, 1855.*

348. E. Carless, Stepney—Paper cloth, or artificial leather.
350. W. C. S. Percy and W. Craven, Manchester—Bricks, tiles, pipes, &c.
352. H. L. Pattinson, jun., Newcastle-upon-Tyne—Wrought-iron tubes.
354. R. Blackburn and W. L. Duncan, Wandsworth—Bleaching.
356. A. H. Ward, jun., Massachusetts—Loom temple. (A communication.)

*Dated 17th February, 1855.*

360. J. Hackett, Derby—Leather cloth.
362. J. Robb and L. Hill, Greenock—Masts and spars.

*Dated 19th February, 1855.*

364. G. R. Chittenden, London—Measuring fluids. (A communication.)

### WEEKLY LIST OF PATENTS SEALED.

*Sealed March 2nd, 1855.*

1942. John Henry Pape, Paris—Improvements in wind musical instruments.
1951. Paul Adolphe Garnaud, Paris—Improvements in certain gazogene apparatus used for the production of aerated liquids.
1957. John Youll, Burton-upon Trent—Improvements in the mode or method of fermenting liquors, and in the machinery or apparatus employed therein.
1960. Tony Petitjean, 45, Upper John-street, Fitzroy-square—An improved process for re-cutting or re-forming the faces of files.
1963. William Prior Sharp and William Weild, Manchester—Improvements in the production of raw and thrown silk, and in machinery and apparatus to be used for the purpose.
1985. Charles Wentworth Forbes, Bartley, Hants—An improved rest for fire-arms.
1996. Charles Frederick Stansbury, 17, Cornhill—Improved machinery for making screws.
1998. Charles Frederick Stansbury, 17, Cornhill—Improvements in punches and dies.
2022. Joseph Porter, Salford Screw Bolt Works, near Manchester—Improvements in machinery for cutting, punching, forging, and forming nuts, bolts, screws, and various other articles in metal.
2026. Martin Billing, and Walter George Whitehead, Birmingham—A new or improved waterproof paper.
2046. Thomas Lawrence, Birmingham—Improvements in machinery or apparatus to be employed for the purpose of shaping and finishing certain parts of bayonets.
2050. Thomas Garnett, Liverpool—Improvements in steam-engine and other governors.
2052. Thomas Banks, Derby, and Henry Banks, Wednesbury—Improvements in apparatus for retarding and stopping railway trains.
2092. Thomas Foxall Griffiths, Birmingham—An improvement or improvements in lamps.
2093. Thomas Mohan, Aclint, Louth—An improved churn.
2498. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in the manufacture of wrought-iron wheels for locomotives or railway or other carriages. (A communication.)
2666. Louis Henri Frederic Melsens, Brussels—Improved process of saponification.
2687. George Tomlinson Bousfield, Sussex-place, Loughborough-road, Brixton—Improvements in machinery for splitting leather.
2694. Henry Render, Liverpool—Improvements in the manufacture of night lights.

*Sealed March 6th, 1855.*

1970. Achille Guyardin, Paris—The use of a certain fibrous matter for the manufacture of paper and pasteboard.
1976. John Rigby, Dublin—Improvements in fire-arms and guns, and in waddings to be used therewith.
1977. Edward Palmer, Southampton—Improvements in propelling vessels.
1981. John Chillcott Purnelle, Tachbrook-street, Pimlico—Improvements in obtaining and applying motive power.
1983. Edward Gillman, Twickenham—Obtaining filaments from certain vegetable substances, and applying the same to various manufacturing purposes.
1997. Charles Frederick Stansbury, 17, Cornhill—Machinery for making lock springs.
2003. Thomas Purdon, Hull—Improvements in safety lamps.
2004. Robert Rawlinson, Westminster—Improvements in valves or adjustable thoroughfares.
2033. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improvements in machinery for washing paper stock.
2038. William Prior Sharp and William Weild, Manchester—Improvements in machinery for winding, cleaning, doubling, spinning, and throwing of silk.
2057. Georges Danré, Marseilles—Improvements in gas-burners.
2079. Robert Renfrew, Glasgow—Improvements in bobbins.
2429. Frederick Joseph Bramwell, 29, New Bridge-street, Blackfriars—Improvements in steam engines and steam hammers.
9. Joseph Arnold, Tamworth—A new mode of ornamenting bricks and other moulded articles for building purposes.
112. George Jackson, Manchester—Improvements in the construction of tents.

### WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3690 | March 2. | Radiating Gas Stove | J. Rhodes and Co. | Holborn Brass Foundry, Nottingham |
| 3691 | ,, 3. | Stays or Corsets | William Plyer Elby | Portsea. |

Journal of the Society of Arts.

*FRIDAY, MARCH* 16, 1855.

## FOURTEENTH ORDINARY MEETING.

Wednesday, March 14, 1855.

The Fourteenth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 14th inst., Professor T. L. Donaldson, in the Chair.

The following Candidates were balloted for and duly elected Ordinary Members :—

| | |
|---|---|
| Brooks, Wm. Penny | St. André, Jules Le Chevalier |
| Carruthers, C. B. | Starling, Joseph |
| Dempsey, Henry William | Steibel, Isaac M. |
| Greenaway, Edward | Williamson, Alexander W., Ph. D. |
| Lewis, Waller, M.D. | |
| Macgregor, Alexander | |

The following Institutions have been taken into Union since the last announcement.

386, Radway, (near Banbury) Institution.
387, Carlisle, Church of England Religious and General Literary Association.
388, London, Camden Town Literary Institution.

The Paper read was

## ON A NEW METHOD OF TEACHING DRAWING, INVOLVING THE PRINCIPLE OF A NEW SYSTEM OF ARCHITECTURE.

By Herr Joseph Kumpa, of Dresden.

Drawing, as an art, beyond its merely mechanical quality of representing external objects as they appear to the eye, is truly the language of the imagination by which the artist, the mechanic, and the designer, are able to communicate to others their ideas and conceptions. These ideas, to a great extent, until they are realised, are more or less indistinct even to the originator, and though, as they appear before the eye of the imagination, they are filled with beauty, still the contest which may be said to arise between the subtle thought and the difficulty of practically expressing it, tends so to confuse the first conception, that the finished design often wanders somewhat from the true idea, and the harmony which the fancy saw is much impaired. This it is, perhaps, which often distresses the greatest geniuses when they look upon the efforts of their skill. An innate and highly refined sense of truth and beauty will go far to correct the effect of this tendency to error, but where nature has bestowed this unfrequent gift in an inferior degree, science and education must endeavour, by their researches and rules, to supply the necessary antidote. If these researches have led to truth, and upon this truth the rules have been founded, the knowledge of them must be beneficial to all, even the most endowed, but to the majority they must be absolutely necessary. All instruction in drawing, therefore, which has for its object something more than the attainment of mere mechanical skill, should be based upon principles simple in their nature and solid in their foundation, and should tend to arouse within the pupil, and teach him to appreciate, that sense of real beauty which is necessary to the attainment of the freedom and boldness of self-reliance, without which the representation of natural or artistic objects falls to the level of mere imitation, divested alike of vigour, poetry, imagination, and originality.

We, in our present purpose, find no place for any desire to destroy any system of teaching already in existence, in order to substitute as our own a new theory, and a new development.

We have no new principles of truth to establish on the ruin of existing belief. We wish to add only to practical science any mite we may have to offer, and to assist, if it is in our power, the present endeavour to bring within the reach of the masses the means of instruction in at least the rudiments of art.

With these feelings it appears to us, that pupils, whose tuition consists for the most part in toilsomely kneading together drawings after models which are placed before them, are scarcely put in the way to attain to the essence of the art which they practice. A method by which it would be possible to conduct them by regular and natural sequence from the very simplest commencement, to more advanced drawing, assisting in the mean time the application of their thoughts to the elements of the science of what they are taught, would seem to afford the most obvious means of successfully cultivating, and possibly of creating, an artistic feeling and capability in those upon whom nature has not bestowed those powers which require for their development, opportunity only rather than encouragement. We think also that such a method would be found of great advantage when applied to the talented, in correcting many whims and unfortunate biases into which the best are apt to be betrayed when first beginning to learn, and whose effects are afterwards apparent even in their finest works.

As the result of reasoning similar to the foregoing, we wish to be permitted to present, with some confidence in its success, the following system of tuition, for the proper understanding of which we apologise for drawing attention to some preliminary remarks of a sufficiently elementary and obvious character.

The first thing, of course, in teaching drawing is to teach the pupil to draw a straight line, and with this first step the first difficulty presents itself. We are speaking at present rather of those who have no particular facility for the art. The importance to the pupil of learning to accomplish this first necessary with a firm delicate and sure touch, and in any direction, need only be alluded to. Every one also engaged in teaching knows that in practice it can scarcely be obtained with the majority. The student is set to the drawing of many strokes, first in one direction, then in others; but the lesson is so tedious, (and precisely so in the inverse ratio of the child's talent) that it has to be immediately abandoned, at the risk, at the outset, of arousing in place of taste, a most unconquerable dislike for the new occupation. The beginner is at once carried on to subjects more interesting, but on that account less likely to be accomplished, and the disappointment of early failure is only less dangerous than the disgust of dreary drudgery. Moreover, as most school drawings shew, this first deficiency still clings to the pupil even after much progress, and while it spoils the effect of his own drawings it engenders a lax and inattentive taste with regard to art in general. Our first attention has, therefore, been directed to this point, and by combining the lines which the tyro has to draw, without destroying the simplicity of the lesson, we believe (and some experience has confirmed our belief) that we have succeeded in lending to the study sufficient interest to enable it to be insisted upon.

By our arrangement the student, as soon as he can accomplish a line only decently straight, without much regard, at first, as to the way in which he makes it, is told to copy a square, which, when done, he divides by lines into quarters, diagonals, and various mathematical figures, rapidly advancing into figures of some complication, curiosity, and beauty; proceeding from straight lines to arcs and curves, and eventually into some practice in the use and combination of the elementary colours. During all this time he is carefully practising the drawing of the lines in every position, which the mathematical nature of his copies is continually urging him to delineate correctly; his appreciation of angles, power of measurement, and sense of form and

beauty, being also fostered and developed. This may be said to be the principle in outline to which we invite a closer attention in the following details :—

The art of drawing, and particularly that branch which is termed free-hand drawing, requires that, from the commencement of its study, three truths should be kept in view. That proficiency mainly depends,

First—On the power of accurately appreciating the form, colour, and character of the subject represented.

Second—On the acquisition of ready dexterity in manipulation.

Third—On the extent to which the imagination has been improved and educated, and a taste for the beautiful developed.

These three truths, it seems to us, should be attended to from first to last, through all the steps of progress; and, we think, that that system must be the best which most constantly maintains them in sight. At first, as we have implied before, the education of the hand presents the earliest, and a great difficulty; but, bearing in mind that all forms in nature and art must be composed entirely of lines straight and curved, we have insisted that these lines should form the substance of a student's first lessons. We have said, too, that if progress is to be obtained these lessons must be made interesting. For this purpose, instead of a book, or a box, or any other usual object which possesses neither interest nor any further utility for study than the immediate difficulty of drawing it (which is sometimes almost a disadvantage), we take a square, Fig. 1, for the beginner to copy, as one of the simplest of all possible figures. When the pupil can draw this tolerably, he adds to it diagonals, as at Fig. 2; he then

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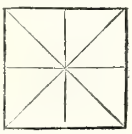

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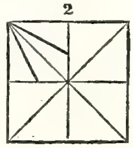

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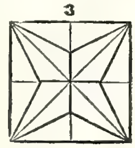

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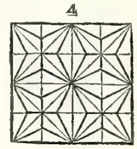

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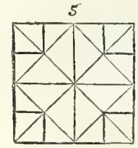

draws Fig. 3, upon which he further constructs Fig. 4, Fig. 5, and so on, as an examination of the diagrams on the walls will render evident. It is apparent that these studies are extremely simple, and, therefore, suitable to the beginner—to whom they not only present an appearance of purpose, but fulfil the purpose by offering variety and continual progress, which is gratifying to the mind, and stimulates the curiosity of the student. The natural sequence, moreover, by which each figure follows upon its predecessor, prevents those abrupt occurrences of difficulty which distress the beginner with failure. This advantage also accrues, that, every figure being mathematical, the proportions are apparent, and the laws which govern them gradually show themselves, and become fixed in the memory. A taste for proportion and harmony is awakened, and the angles and lines which best assist in producing them are ascertained, together with the means of constructing them. The early habit, too, of dealing with angles and mathematical proportions, of estimating them with the eye, and having false estimates detected by the working of the figure, and by the same means the rectification shown, will, we think, be found of very great advantage when the pupil has advanced to sketching from nature and art. Nor is the imagination left without its stimulant. As the proficiency of the student progresses, the learner will find his power of combination roused into activity, as he discovers how easy it is to invent fresh forms, and is tempted to exercise his ingenuity in arranging them for himself. Provided that the master is careful to insist on the lines, angles, and distances being accurately drawn, no danger to the taste or progress of the pupil is to be apprehended from such attempts at originality, for the mathematical nature of the drawing prevents the possibility of false proportions or bad harmony—the worst error to which he is liable being poverty of invention. On the other hand, this poverty will be best consulted by this very practice, and confidence and self-reliance especially fostered by it; so that we would certainly recommend the teacher to applaud and encourage such attempts to a reasonable extent.

From straight lines, and their combinations, the pupil proceeds to curves, as will be seen by reference to Figs. 8, 9, and 10. The points fixed by the intersections of

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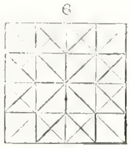

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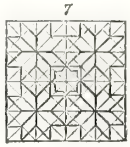

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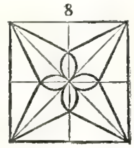

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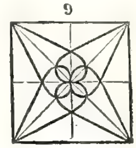

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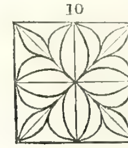


lines, and otherwise naturally indicated, will suggest the proper dimensions and character of the curves, and, assisted by them as guides, the pupils will readily learn to delineate circles, spirals, and curvilinear ornaments, with a ready, free, and bold hand; while his sense of beauty and proportion will continue to receive the same species of encouragement as we have explained with reference to straight lines. The figures drawn by these means, especially the more complicated, may be made very useful for the purpose of explaining to, and practising the pupil in the use and combination of colours; but, as this has more particular reference to another branch of the sub ject, we will return to it at greater length further on.

It appears, we would submit, from what we have now shown, that, by the method of teaching here explained, important advantages are gained. Not only is it rendered possible to educate the hand at the outset in a way hitherto unattainable, but, in the meanwhile, the pupil receives a mental training exceedingly well calculated to set his after acquirements on a good and solid basis. His eye is trained, his hand practised, and his imagination roused, by a process at once simple, interesting, and effective. It is not, however, to be supposed that this system renders it by any means necessary to abandon the means at present used. We offer our suggestions, as we commenced by saying, as additions to existing methods, and as calculated, also, to be beneficial when no other means would avail. Our proceedings are evidently intended to conduct the learner to that proficiency of hand and eye which will fit him for studying nature. But the master is, of course, at liberty in the exercise of his discretion, and without injuring in any way the effect of our plan, to vary the routine by introducing natural objects, as at present customary, as early as he may think proper, as well as occasionally to cause his most advanced scholars to revert from their studies from nature to a little of our practice. It will, indeed, we think, be advantageous to cause the pupil to pay more or less attention to these elements, according as the ultimate direction of his studies should become mechani-

cal, architectural, or artistic. It may be observed, also, that it is not essential that the form of the square should be rigidly adhered to, as any symmetrical figure of mathematical construction will be found to possess similar qualities; a square, however, will, we think, prove for general purposes the simplest and most convenient. Having conducted the reader thus far in the elucidation of our proposal, we would wish to offer some observations as the result of our experience, as to the best method of proceeding upon our theory in the instruction of a class.

MODE OF INSTRUCTION.

The class being formed, the teacher should be supplied with a black board, and the students with paper of a coarse description, sufficiently large to admit of a square of six to twelve inches diameter being drawn upon it. A slate, however, might be used in the first instance in poor schools, where paper is too costly. The pencils should be charcoal, which has the double advantage of marking with a small pressure and of being easily obliterated; by which the pupil is compelled to a light and free touch, and much paper will be saved. If the paper, also, is hard and well glazed, it may be washed and re-used more than once; and if of a blue or grey tint, will not so strongly show the traces of former obliterations, and will, therefore, last longer without washing. If possible it should be stretched on a frame, and the method we shall propose will be found to admit of this without much delay or inconvenience. All being thus prepared the master proceeds to draw successively on the board the figures 1, 2, 3; the Fig. 4 may be said to be a result of the preceding. Figs. 5 to 10 are developed in a similar manner. Pupils copy after him. After a time it will be sufficient to hang on the board the originals, and after further progress the class may be required to finish for themselves designs which in the original are left incomplete.

The pupils should be obliged, in the first instance, to make a rough sketch as freely, lightly, and accurately as possible; the charcoal should then be whisked off with a handkerchief, leaving the lines faintly perceptible, and upon these traces the drawing should be finished.

The master should, of course, be very constant in his attention to each student, and insist upon the proportions being accurately preserved, and the lines firmly, equally, and boldly drawn. When the teacher is satisfied with the drawing the charcoal may be removed, and the paper will serve without washing for several drawings. In all classes some pupils will always progress rapidly, and others be laggards; and in teaching a number this always constitutes a difficulty. The mathematical basis of this system, however, gets over this obstacle effectually, for when the best pupils have satisfactorily accomplished one example, the addition of a few lines furnishes them with fresh occupation, without destroying the use of the figure for the rest. At such times also they may very properly be encouraged to exercise their invention, as has been before explained. The spirit of emulation will, moreover, be augmented by this means. At the end of each quarter, or year, proof specimens of the pupils' progress should be prepared, and these will be found usually to give the following results: If there be several classes formed, to keep together those who have started together, then the lowest class will show the greatest difference between the good and the indifferent, the former, however, preponderating. As the classes rise, the backward will approach nearer to the more quick and clever, until in the highest class, the distinction will consist only in the air of decision and ease which the best drawings will exhibit.

In concluding this part of the subject, we would observe, that it is intended to publish, in separate numbers, a series of drawings with appropriate directions, in accordance with this system. These drawings will constitute a complete course of instruction in the combination of straight and curved lines, with ornamental designs, passing into studies from models and nature. To this course will be annexed a certain number of drawings from mediæval art, which cannot fail, by their beautiful proportions, pure feeling, and elegance of design, to be of great utility in illustrating and assisting the principles upon which this system proceeds, and in fostering that correct and fervent taste of which the originals are the glorious result. When to these are added copious instructions on the laws and practice of aerial and linear perspective, we hope to have presented to the public a work capable of adding somewhat to the means already in existence for promoting the diffusion of that refined and artistic feeling which those who appreciate the softening and elevating influence of truth and beauty desire so earnestly to establish.

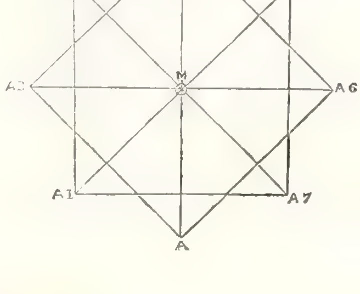
We beg, however, particularly to draw attention to the circumstance that this system is principally intended for the education of those engaged in manufactures and the arts of design connected with them. The progress of the natural sciences of late years, the enormous extension of industry, and the necessary consequences upon the social condition of man deeply affecting his mental and bodily welfare, have opened up a rich and unbounded field for investigation. Industry has been directed to the investigation of nature, and has sought to solve the problem of how to turn the laws and forms of natural phenomena into channels which will render them subservient and useful to man. To attain this high object it was necessary that natural sciences should be cultivated with particular attention. Everywhere colleges and schools have been erected for the principal purpose of giving instruction in these branches of human science, and are contributing to its further development. Out of this has arisen the art of drawing, which has been found to be an indispensable sister science of natural philosophy, and it soon became evident that the methods hitherto adopted for the purpose of instruction did not satisfy the claims made upon them, and that a thoroughly systematic reform and reconstruction of the method of drawing and teaching drawing was called for.

ARCHITECTURAL SCHOOL.

As we think that those whose instruction in drawing is directed to the object of preparing them for architectural studies should be more rigidly trained than others in the principles of proportion, and should have their appreciation of precision and symmetry more perfectly disciplined, we have considered it advisable to prepare for their use a more extensive and methodical system of linear tuition, in which free use can be made of rule and compass. For this purpose, we divide this portion of the subject into several parts, to the first of which, as relating to the diagrams which we shall have occasion to use, we beg now to draw attention.

These differ little from those which have already been explained, being a variety of progressive figures developed with right lines and arcs on the basis of the square; but to understand them properly, with the key to the construction of each, we must explain that we have adopted in teaching a convenient method of lettering the diagrams, giving all the points which are used in their formation letters of the alphabet, according to their distance from the centre, all those equally distant being marked with the addition from left to right of small numerals, as *a*, $a^1$, $a^2$, &c., Fig 11; and *b*, $b^1$, $bb^2$,&c., Fig 12.

Nº 11



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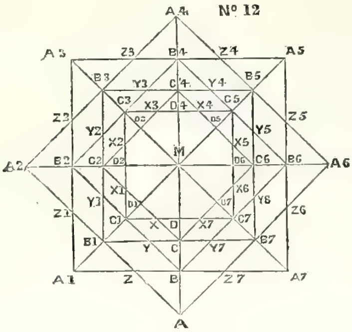
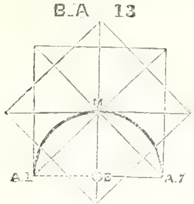



By this simple means, if a figure (as Fig. 16) be constructed by taking successively as centres $b$, $b^1$, $b^2$, &c., and $b\ a^1$, $b\ a^2$, $b^2\ a^3$, &c., as radii, as represented in figs. 13, 14, 15, 16, then $b\ a$, may be said to be the formula,

B_A 13



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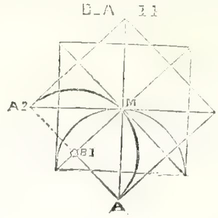
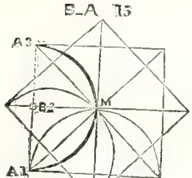
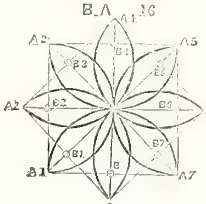


B_A 15



B_A 16



or key of that figure, the first letter signifying always the centre, the second in combination with the first determining the radius of the circles which compose it, which radius is also further distinguished in the plates by a line $a\ b$. In this way, given such a figure as Fig. 11 as a base, and being told to complete a diagram with either $b\ a$, or $a\ b$, or $a\ m$, or $m\ a$, as formulæ, the student can construct the drawing without further assistance.

Part II. treats of rectilinear and curvilinear figures on a plane, tinted in such a manner as not to give the effect of raised surfaces. These figures are combinations of the elementary figures of the diagrams as shown in Fig. 17.

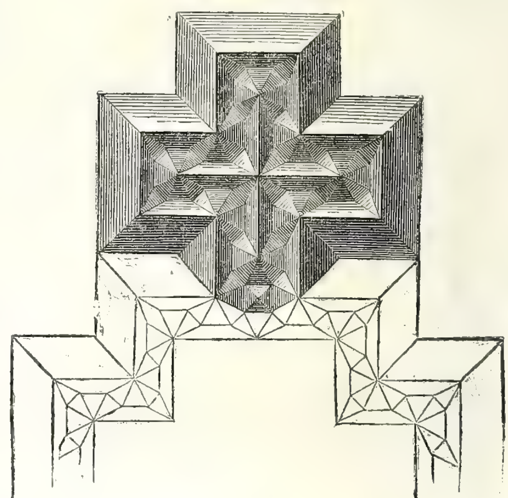
K_Z.B & K Nº 17.

Each individual field, as it may be termed (vide Fig. 17) of a drawing in outline, is treated with a uniform tint of colour, or at first merely with an equal shade of Indian ink. In this manner the deep tints are produced by laying one coat of the original tint over the others, and may be deepened by successive coatings, as the pupil progresses in the management of tints. This has the advantage of practising the pupil in the use of the brush or camel-hair pencil, and in the management of colours. These figures can be beautifully executed in colours, the attraction of the colours at the same time increasing the interest of the pupil.

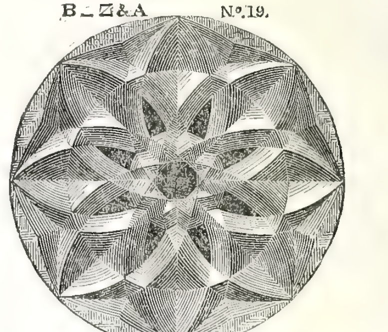
By these drawings the pupil is practised in the harmonic combination of tints on a plane, which is of importance in architecture, mosaics, the printing of cotton, silk, velvet, paper, woven fabrics, &c.

Parts III. and IV. give the application of the elementary figures of Part I. Both represent bodies described by planes, and bodies described by planes and curved plans as shown in Figs. 18 and 19.

T Nº 18



B_Z&A Nº 19.



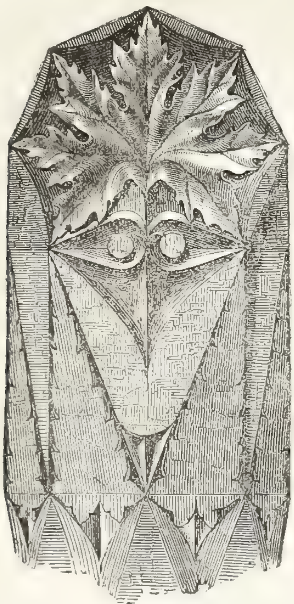
These figures, the elements of which are contained in the diagrams on the wall, seem at first sight to be difficult of construction, but a little attention will show them to be simple and easy. The formula, with which each figure is headed, gives at once the key to its design or construction. Fig. 19, for instance, is constructed similar to Fig. 16. This portion of the system is specially applicable to architecture, the different branches of industry, and the mechanical arts.

Part V. consists of drawings representing an entire edifice, with some of its important details, which we desire to offer as a result of the development of the system; being, we believe, new as to style, construction, feeling, and principle.

We by no means put forth this design as the final result of what we hope to accomplish, but as a proof rather that the proposal which we make offers a means of directing thought into a new and original form of expression, which may happily lead to the production of that desideratum of modern art, a fresh scientific and inexhaustible style of architecture, which may prove to be as well adapted to the varied requirements of modern society as were the arts of Greece, Grenada, and Gothic Europe, to the times in which they flourished.

The diagram on the wall exemplifies the method of construction for an architectural design; a similar example

Fig. 20.



is shown in Fig 20. In this section also we endeavour to show how the forms of nature, without being conventionalised, may combine harmoniously with geometrical forms, and without sacrificing their utmost purity: the geometric shape constituting, as it were, the frame which serves more perfectly to set off the exquisite perfection of nature's moulding. In this portion of study, the pupil's attention is of necessity carefully directed to natural objects, as leaves, of which in our system he will have constant and important use.

A little consideration of the Parts II. to V. will serve to demonstrate the mode by which designs are developed, and, at the same time, will convince, we think, every one, that the variety of form, expression, and direction which such designs may take is perfectly inexhaustible, and requires only the genius of invention to produce rich and beautiful effects.

Instructions in embossing, moulding, and intaglio, forms an integral portion of our system. The method pursued for this purpose is similar to the preceding, working from the simple elementary forms upwards through the various gradations, till thorough efficiency is reached. The rigid mathematical education of the hand and eye will here be found to be of the most essential advantage, as the principles inculcated will be of constant application.

These observations close the explanations which we have thought it necessary to give in order to convey a sufficient idea, in as condensed a form as possible, of the method of teaching which we propose for consideration. It is directed, as will have been seen, upon the principles with which we started, of keeping constantly in view, in all manner of instruction, the groundwork and secret basis upon which all symmetry, and truth, and beauty of form and combination depend.

We hope to have convinced all whose candid feeling of genuine interest in the successful attainment of those objects, to which we among many others have endeavoured to direct our exertions, that by the alliance of interest with method, we have succeeded in suggesting a means by which many, at least, of the difficulties heretofore experienced in the way of popular tuition, may be smoothed away, and a truly artistic feeling fostered and developed, where at present alone exist unreasoning apathy and ignorance. If we have done this, we are rewarded by the conviction that to us will belong the happiness of having materially assisted in bringing into healthy action those feelings and sentiments, whose influence upon individuals and nations are among the best calculated to secure the peace, content, happiness, and civilization of mankind. Surely the day will be a fortunate one for England, when the masses can wander among the beauties of Sydenham, and applying to the objects around them the simple rules which all have been taught to appreciate, can estimate each perfection with a certain measure of the delight which at present attends the steps only of the few. It is for this end that our system has been originated, and with this desire that these remarks have been penned.

## DISCUSSION.

After the reading of the paper, Mr. P. Le Neve Foster, the Secretary, stated that he had received three communications, one from Mr. R. Redgrave, R.A., one from Mr. G. Wallis, and the third from Mr. D. R. Hay, of Edinburgh.

Mr. R. Redgrave, R.A., after regretting that he was unable to attend at the reading of Herr Kumpa's paper, proceeded to say that he did not doubt it would be "the means of diffusing much useful information on the cultivation of invention, and a power of drawing and designing. The method, however, is not new in this country; it has largely been practised by many teachers, although, perhaps, not so systematically as is advocated in the paper. It is practised in some of our local schools exactly as described, and I have seen it in use in the Home and Colonial Training Schools. It has many advantages when not carried out to the exclusion of other practice. Geometrical forms, as the structure and the production by means of such forms, of the symmetrical ornament, has ever been the basis of the teaching in the Government Schools of Art; and all the early lessons in the excellent drawing-book produced by Mr. Dyce, in 1842, for these schools, are based on geometry and symmetrical forms, and the pupils' interest in the lessons, stimulated by the practice of invention in some cases—as in the lessons of Herr Kumpa. The black-board instruction recommended by the professor is now practised largely by our masters in training or teaching pupils in parochial schools, and in many instances the production of symmetrical patterns by repeats, forms the subject of the lesson, although much varied with drawing objects and utensils with which the children are familiar; since it is found that they are apt to tire and weary of abstract forms, which, even if they could render them beautiful, appeal but little to their minds. Moreover, the advanced students in our schools have their inventive faculties stimulated by an exercise almost precisely similar to that recommended by Herr Kumpa, and it forms a particular stage in the course of instruction. A geometrical form is given, and a natural object (flower or foliage) as the unit for repetition, and the students in all schools are required to arrange it symmetrically in the given space, both as to form and as to colour. I enclose you the prize-list for 1854. At page 2 of this list you will find the

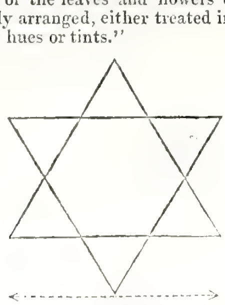
given form—the floral motive for that year;* and, in the report on the awards in that year (which I also enclose) you will, at page 9, see the examiners' report on the results, and their opinion on its utility.† From these remarks you will be aware that I have a favourable opinion of Herr Kumpa's method—if it is not used to the exclusion of other means—and shall hail with much pleasure a careful manual on the subject."

Mr. George Wallis, (Government School of Art, Birmingham,) says, "I send you a few proofs of the truth of Herr Kumpa's plan of elementary instruction, as it has been pursued in the branch elementary school attached to the Birmingham School of Art during the last twelve months. The drawings I send have been all executed in the regular course of study, chiefly by students who have not been in the class more than three months. Had it been worth while I could have sent diagrams, identical line for line with Herr Kumpa's, which have been used there during the period above named. In fact, the method propounded is the same as that now followed in all the Elementary Drawing Schools in connection with the Department of Science and Art, and my practice as a teacher has been based upon an analogous principle for 14 years past. Of its value as a preliminary course of training there can be no doubt. The student can always prove for himself whether he is right or wrong, without the opinion of his teacher. The students commence with drawing upon black boards, with white chalk. This is for economy's sake. The 1st class draws figures altogether rectilinear. The 2nd class, still drawing on the black boards, draws figures in which curves and right lines are combined, or curvilinear figures, based upon their angular construction, as shown by right lines. The 3rd class studies on paper. I approve of the charcoal upon paper, but it is too costly for the poorer students. The examples sent, with three exceptions, which are dated some days back, are a selection from the result of a two-hours lesson this evening (March 13) in our Elementary School; the original diagram being by one of the elementary masters. The process of construction is shown by the state of one drawing as compared with another, and fully illustrate the *truth* of Herr Kumpa's proposition; as regards its *novelty*, that is another question."

Mr. D. R. Hay, (of Edinburgh) writes, "I have no further remark to make, than that I believe Herr Kumpa's method of teaching drawing a very good one for very young people; but I do not see any principle of a new style of Architecture evolved in it."

Mr. Digby Wyatt said, he thought all who had listened to the paper, must agree that it certainly possessed at least three good qualities, viz., that it was lucid, earnest, and short, and he would endeavour as far as possible, to emulate these merits in the observations he had to offer upon it. So far as the pith and moral of the paper were concerned, the whole might have been summed up into the smallest possible compass, if the author had simply stated that the study of geometry was essential to a successful prosecution of the fine arts; those few words comprehensively expressed all that was really important in Herr Kumpa's system. Of course the steps by which the results shown upon the walls had been obtained, were to a certain extent original, since it was open to any professor, in working to its ultimate consequences any theoretic system, however popular or well-known, to modify the progressive steps according to his own views. He thought a more scientific and equally simple mode of teaching geometry would be, to develope various elementary geometrical figures, so that the student might recognise the properties of each first of all, and then their mutual relation when brought together; rather than to work out single figures to their ultimate complications. By this latter mode the pupil lost time, and after all failed to gain an accurate knowledge of geometrical configuration until a late stage in his career; whereas, if in the beginning of his course he had taken the circle, the square, and the triangle, and mastered their peculiarities and properties, he would have learned to apply them when necessary to verify the leading lines of whatever natural object he might be called upon to imitate. So far as the application of the system of geometry to the teaching of elementary drawing in connection with industrial training was concerned, it was scarcely necessary for Mr. Redgrave or Mr. Wallis to vindicate the universality of its adoption in this country, since almost every drawing-book which had been prepared for the use of pupils, had for many years been based upon a more or less complete symmetrical development. Those who were acquainted with the work of the Baron Dupin, "La Geometrie appliquée aux Arts," published some twenty years ago, and translated by Dr. Birkbeck, would know, that throughout France, and more particularly in the great Conservatoire des Arts et Metiers, the same system had long obtained. Disposing, therefore, in a few words, of the novelty of Herr Kumpa's proposition, he now came to two particular points of analysis, which did not appear to have been sufficiently attended to in the paper. Drawing, it was always to be remembered, was of two natures, one of which only the author had fully taken into account. It was, primarily imitative, and, secondarily, abstract, involving all projection of forms upon planes. He thought the best geometrical system as a beginning was rarely of advantage in leading to ultimately good imitative drawing, because scarcely any curves admitting of easy projection, and much less the forms and lines in the figures now exhibited, were those which ordinarily met the eye in any material objects, modified by perspective, which the pupil might be called upon to imitate. The curves of the human figure, for instance, were compound and ever changing curves of the higher order, and, therefore, the pupil who, in the beginning of his career, had become too much accustomed to straight lines, arcs, and segments of circles, took some time to get rid of a hard and regular mode of drawing, and was unable to define with delicacy and facility the curves either of flowers or of the contours of the human figure. He thought, with regard to *projection*, as contra-distinguished from simple imitation, that the best way to prepare a pupil to derive most ultimate benefit was first to let him try and imitate the form of any object, and find out for himself the diffi-

* "Stage 22a.—Elementary Design. A set of 4 studies (mounted on one sheet) of modes of filling the accompanying spaces with forms of the leaves and flowers of the wood anemone ornamentally arranged, either treated in a self colour, or in complementary hues or tints."



6½ inches.

† "The methods by which they are led to exercise the inventive faculty, both in form and colour, according to definite laws of arrangement, quantity, space, &c. The results of this system of instruction seem to warrant the conclusion that laws of arrangement judiciously defined for the student rather increase than limit the sources of variety. The fact that in more than two hundred studies in this class the same geometrical figure has been filled, more or less agreeably, by a varied arrangement of the same simple flower, shows the infinite variety that may be obtained while conforming to certain rules and principles of composition, and that the inventive faculty is stimulated rather than checked by means of such rules." The examiners were Sir C. L. Eastlake, President of the Royal Academy, Mr. D. Maclise, R.A., and Mr. R. Redgrave, R.A.

culty of mastering general proportion, unassisted by a knowledge of certain abstract forms, to serve as gauges and scales to test the truth and aberrations of vision. If geometrical figures, made in wires, were placed immediately in front of the object the pupil might be attempting to project, he would recognise the fact, that unless he had some such lines, either tangible or abstract, in his memory to guide him, he would be liable to remain astray indefinitely. He would thus constantly be made to feel the necessity of geometry, and to appreciate its value; while the acquisition of such experience would probably induce him to make himself master of its principles. He (Mr. Wyatt) would not detain them longer on the subject of drawing, as he saw that there were other gentlemen present who had distinguished themselves as artists and teachers, and who were far better qualified to deal with the subject than he was. With regard to the architectural part of the subject, he would remind the meeting to be upon their guard, since there was great danger in hastily adopting any system of form as new, and recognising it as likely to engender any new and "natural" system of architecture, for in the first place any such adoption or recognition would involve the ignoring of the labours of generations of wise and able men; even supposing, in the second place, that this responsibility could be assumed, and that all that had gone before was ignored, grave difficulties would yet present themselves; since it was to be remembered that the danger of a rigid geometrical basis in art was, that its presence and imperative laws, prevented the student from exercising himself in those minute refinements of form which lend their winning charms to the highest order of grace. In Greek architecture and other styles of eminently subtle beauty, the geometrical figures in use could only have been exercised by artists who united the highest powers of imitative drawing with a refined knowledge of the mathematical principles of pure geometry, not to be attained by any prosecution of the system of straight lines and portions of circles they saw before them. The Romans converted the beautiful ovoid, hyperbola, and parabolic curves of the Greeks, into those most easily struck by an ignorant workman with a compass. As in that case so also in the Gothic, and even in Moorish art, the triumph of elementary geometry showed the already commencing mortification of the vital part of the art. While geometrical tracery, degenerating into lininess, superseded those curves and flowing forms that were found in early English ornamentation, a system of manufacture came in, which gave a death-blow to poetry and inspiration. So it had been in Greek art, and in the best Byzantine styles; so the Alhambra, although possessing great beauties, sank as compared with the earlier works of the Moors at Cairo and Corduba, into an almost monotonous repetition of forms, which, however complicated or harmonious, failed to affect the imagination with aught of human or dramatic interest; and so in all these diagrams of Herr Kumpa's, they set out with a sense of an almost crystalline rigidity, and felt oppressed with the feeling that as they tried one form and it succeeded, a thousand others were inevitable, generated by no more intellectual effect than by turning the compasses over and over again, with varying radii from varying points. Such mechanical operations, which were beaten out of the field by a good eccentric chuck, could scarcely be dignified with the title of a *new* system of architecture, and most certainly not of a *good* one.

Mr. J. D. Harding said he was somewhat taken by surprise in being called upon to express an opinion on a subject to which he had paid so little attention. He fancied that all this system—however good it might be for the purposes for which it was intended—had no proper relation to art. It might be a very good system for mechanically working out patterns, but he was afraid it could never come under the designation of a system of art, for he confessed there did not appear to him anything in it which could lead to an appreciation of nature. They saw very few objects in nature of an angular form, and if there were any, they seldom saw them composed of right angles; and, again, as to those curves, in all the examples exhibited they were segments of circles. Now, he believed there was no form in nature that had, as a curve, the segment of a circle; they were all ovoid. When they considered the beautiful and exquisite form of flowers, which were curvilinear, in order to show how different those curves were, if they took a single leaf, and twined it the least in the hand, it assumed curves of so subtle and beautiful a character as to require the most delicate and educated eye to detect the minute differences, that it did not appear to him that a pupil carried through this or any equally mechanical system, could possibly be in a condition—in the first place, to appreciate, and secondly in a condition to draw any of those curves. Therefore, unless we found that this or any other system led in the first place to an appreciation of nature, and in the second place, to the power of delineating her, he did not think it could be appropriately termed a system of art, but rather one of mechanism. Inasmuch as he ventured to submit that it was not a system of art, he did not think it would be proper in him to take up the time of the meeting in making any observations upon the subject. It might, nevertheless, be a very good system for the purposes for which it was intended, but as those purposes were wide away from everything to which he had given his attention, and as it could not in any way be called art, but rather a mechanical operation, he thought the less he took up the time of the meeting in discussing its proper merits the better.

Mr. John W. Papworth was not prepared impromptu to address the meeting, and therefore would not touch the topics already handled by such masters as Mr. Wyatt and Mr. Harding; he would rather call attention to one of the preliminary passages of the paper of the evening, in which there occurred, what he considered at first an incautiously expressed idea, but afterwards found repeatedly as a fundamental error in the paper. He alluded to the words "DRAWING, *as an art, beyond its merely mechanical quality, of representing external objects as they appear to the eye, is truly the language of the imagination,*" which, if transferred to another graphic process, would be at once seen to enunciate the absurdity that "WRITING *is the language of the imagination, &c.*" This error was to be combatted, as in the numerous translations from the French and Italian languages now pressed upon the public attention as guides to the knowledge of art, he found the words *drawing* and *design* used with indifference as to their real purport. He would render his meaning clearer by looking at *copying from an example* as mere *drawing*, but at the *invention of a new example* as real *design*. That the manner now explained of teaching drawing as mere *drawing*, if, as appeared, it was to be confined to the use of divided squares and circles, was imperfect—admitted of no discussion. He repudiated the notion that straight lines were the first and chief objects to be gained by the student, for in the educations which he had superintended, a commencement with curved lines had been adopted with greater success than that with straight lines; when the pupil could draw a curved line properly, he could give up the use of a ruler, and a very little practice would give a free-hand line as straight as might be necessary for sketching. Neither would Mr. Papworth do otherwise than equally repudiate the idea that drawing as *design* could be taught by the mode displayed in the diagrams; the variations, though numerous, must be limited in their novelty, still more limited in their applicability, and although useful as only part of a course of education, were desirable when the student had ideas of his own, but pernicious to the pupil who had none. There could be no objection to the use of such diagrams by a draughtsman, either as guides in the construction of presupposed combinations, or as limits provoking the efforts of invention in composition; but the result of drilling in the manner proposed would leave the

hand and eye disinclined to the curves which they would subsequently have occasion to form. He therefore held that the three points which the system was supposed to gain, viz., appreciation of angles, power of measurement, and sense of form and beauty, were not attainable in that way, any more than correct views upon polychromatic decoration, a question into which he need not then enter. Mr. Papworth apologised for expressing himself strongly upon these passages, but felt it a duty, as he could speak with some authority, being, perhaps, the only person in England that could say he had taught the deaf and dumb to *design*, *i.e.*, to invent and draw the invention. With regard to the concluding portions of the subject, he could not agree with the view expressed in the paper, that architecture should be more correct in proportions than ornament; he considered all ornament to be a portion of the decorative part of civil architecture. Construction alone was the basis to which he looked for a new system of an architecture that was to be natural, *i.e.*, resultant from its materials, otherwise all symbolized or applied natural and artificial objects, if they were implied by natural architecture, would necessarily be used in a known style or in a mixture of known styles. In conclusion, he would say that he was surprised and alarmed to hear a repetition of the dogma that conventional and natural objects could exist together in a good design for any purpose. It was sufficiently clearly understood and taught, as he hoped, at the present time, that in spite of examples of bad taste from great hands, the artist in decoration must give conventionality in some degree to natural objects, and most of all when he applied them in conjunction with geometric or any other artificial forms.

Mr. Waterhouse Hawkins said it would be with great reluctance he should offer any critical observations upon the paper which had just been read, as being evidently the production of a gentleman who was a total stranger to all that had been done in this country during the last fifteen years, and our better use of better means, as had been so well described by Mr. Redgrave and Mr. George Wallis, as well as by the excellent observations of Mr. Digby Wyatt, rendered any remarks from him superfluous. He would merely say, that with his experience in geometrical teaching, the present proposed use of geometrical diagrams as a means of teaching drawing, did not suggest any facilities which could not be obtained by the use of a rule and pair of compasses, and so far from the possibility of a new system of architecture being generated by such mechanical means, its adoption would, according to his belief, be the death-blow to all art in connection with architecture.

Mr. F. S. Cary felt that the subject before the meeting was not one which came under that branch of the art to which he had more especially directed his attention. If it were merely a mode to teach people to draw lines, no doubt this was an excellent plan of doing it; and, looking at it as early practice—say for children of ten to twelve years of age, or, as Mr. Wallis had stated, for three months' practice for older pupils, he (Mr. Cary) conceived it might be an excellent plan to draw lines, squares, and the curious combinations shown in the diagrams, but it did not apply to his branch of study, which had been imitations of the human form and forms of nature. The plan which had been represented to him as the right one, and which he had endeavoured to act upon during all his practice, was to show how those things could be represented which really existed, and how to convey, by drawing, to the minds of others an impression of whatever occurred to one's own imagi. ation. He did not think the system now under consideration would apply to the representation of natural objects, and certainly the figures exhibited did not resemble anything he had seen in nature. After the observations which had fallen from Mr. Digby Wyatt and Mr. Harding, he felt that the question had been perfectly "used up."

Mr. Henry Twining thought that the disparaging remarks which had been made on Herr Kumpa's system, partly arose from its having been considered with reference to Art in general, whereas he thought that, by confining this discovery within its due limits, and considering its applicability chiefly to patterns in tapestry, paper-hangings, marqueterie, &c., it would be found to possess a considerable degree of utility and interest. He thought, also, that although the use of geometrical figures for teaching the art of drawing was not a new discovery, there was something original in the manner in which Herr Kumpa facilitated the construction of his various figures by means of cyphers, which, when once understood with reference to the simpler designs or patterns, served as a key to the formation of those which followed in succession. It was desirable that this system should not be confounded with those which tended to make geometry subservient to the highest realisations of art. Systems had been formed which sought to attain perfection and beauty of form by the rules of geometry; as these tended to check the development of taste, and to mislead the judgment, they might be considered dangerous. No such objection, he considered, attached to Herr Kumpa's system, which, keeping aloof from æsthetical theories, appeared to aim at teaching, by a quick and secure means, those forms of objects which had already been recognised as most suitable for ornamental art, and which might, therefore, be introduced with advantage into those schools or classes which were especially appropriated to this branch of the art.

Mr. Henry Mogford must prefix his remarks by saying, that there was not the slightest pretension to call the system now propounded by Herr Kumpa, a novelty. The diagrams before the meeting had been published in a great number of elementary works on Linear Drawing, in France and Belgium, and, he believed, also some in Germany. Having himself had an extensive practice in teaching drawing among the youth of both sexes, from those very works, he was free to assert that, in endeavouring to make use of similar mathematical diagrams for his pupils to copy, either on black boards or on slates, they failed of their purpose to create any interest in the pursuit of drawing. When he looked at the diagrams the Professor had exhibited, they appeared to be entirely the production of the rule and compass, and not to have been drawn by free hand without these mechanical aids. It seemed to him an erroneous proceeding to expect youths to draw by free-hand pure mathematical curves when the commonest experience was patent to all, that the simple curves which formed the letters of handwriting were rarely attainable by them as they should be formed. How could we, then, expect that the variety of combinations in the diagrams before the meeting were to be drawn with any regard to exactness. In the instruction proposed to be given by this system, he had merely to observe that, the occupations and isolation of the agricultural population placed them out of consideration, and it was to the manufacturing classes—to our artizans—that the elements of drawing must prove of the highest advantage. A more just and beautiful apothegm was never enunciated, than the one for which we were indebted to Lord Ashburton, "that common people should be taught common things." Now, instead of instructing mechanics, or endeavouring to do so, to draw the complications before the meeting, which could give them no interest, he believed the best instruction that could be given would be to draw accurately their own working tools—their chisels, planes, and the hundred appliances by which they earned their daily bread. This study of the forms of things in their constant use would have the additional utility of improving their judgment in the selection of working tools, and they would insensibly acquire a mathematical knowledge, as it was upon true mathematical principles that good and efficient tools could only be constructed. In addition to this acquirement to artizans, it might, perhaps, be permitted to

suggest that the best instruction to make excellent working mechanics, was to enable them to draw, by free-hand also, the identical objects they were engaged in manufacturing. But to place before them combinations of pure curves having no representation to their minds of any actual object they were accustomed to see, would, he was sure, prove a failure, independently of the hopelessness that men who were incompetent to write their names in the true forms of letters, should be ever able to conquer by free-hand pure mathematical curves running in all directions over a surface. On the subject of architecture, he ought to feel hesitation in the presence of the learned Professor who occupied the chair on the present occasion, still he hoped he might be excused a few words on the advent of a new style in this beautiful art. He could not believe that human genius, in its production, was exhausted, but he thought he might venture to say, the foundation of architecture being utility, a new style could only be conceived by uniting utility with the requirements of climate, and with the aid of those new elements for construction which might hereafter arise; perhaps glass might play an important part in such a style. With our advancing learning and civilization it must infallibly be imbued with beauty of form and ornament to be accepted. It had been better expressed than he could hope to do, by Plato, in "De Republica," book 3. He says, "painting, architecture, and the other arts, as well as all public games and spectacles, in short every external object, as far as possible, should appear constantly before us in their full beauty and perfection. Thus living in the perpetual contemplation of the most perfect works of the arts, as in an atmosphere of the highest purity and serenity, we should feel their influence penetrate the inmost recesses of the soul, and by a correlative instinct display in our actions and our manners the same degree of refinement, harmony, and the highest virtues of humanity."

Mr. Burchett said he should confine his remarks wholly to the system proposed, as a *new method of teaching drawing*, leaving any consideration of its application to the evolvement of a new style of architecture to others more competent to discuss its merits in that direction. It must be evident that the method proposed by Herr Kumpa referred only to the representations of the outlines of forms, and not to what was usually implied in the term drawing any complete representation of objects by the imitation of their form, and light, and shadow. In fact, that *drawing in outline* was the utmost extent to which the system, as a method of drawing, could be applied. The drawings exhibited must also of course be regarded as *examples* to be *copied* by the student as a preliminary study to his drawing from natural or other real forms. The subject under discussion, therefore, would appear to be, not *whether the method proposed by Herr Kumpa was either a new or a good method of teaching drawing*, but *whether it was a new or a good method of teaching the first step in learning to draw.* The *outlines* or *figures* of objects were expressed by lines, either straight or curved, such lines having given relations to one another. The art of representing, in outline, the appearances of objects would, therefore, consist in the ability to draw lines of every degree of varying character and extent, and placing lines in any required relation to other lines. The placing, therefore, lines of the simplest character before a student for his imitation, and, as a second step, directing him to place such lines in some given relation to other similar lines, as proposed in Fig. 1, appeared to be a first step in a method of procedure likely to achieve the desired result—the repetition of lines of the same character, giving the student an increase of practice, and therefore a greater power of drawing that particular line. The commencement of the practice of proportional subdivision of lines, as shown in Figs. 2, 3, 4, 5, 6, and 7 followed in natural sequence the first steps; the drawing of straight lines, the subdivision of straight lines, and the placing of straight linee in given relation to each other, having been the extent of the practice of this section of the instruction, the second section presenting a similar treatment of simple curved lines. This, therefore, was the essential principle of the system, as applied to teaching drawing, the drawing of lines of a geometric character, the practice of subdividing them, and the placing such lines in given relations to one another; producing, by such combination, figures more or less varied, according to the complexity of the arrangement. This principle—this method of procedure—had been fully recognised, and long acted upon in the teaching of Elementary Drawing. In the Government Drawing Book, produced by Mr. Dyce, thirteen years ago, the whole of the two first numbers was devoted to precisely the same class of examples, and a large collection of similar ones might be found in the Drawing Book published in Germany, by Veitbrecht, which had for the same period been in use in the Schools of Design in this country. The right-line patterns of Moresque ornamentation would supply an almost unlimited number of similar examples. The examples exhibited by Herr Kumpa, as well as those by Mr. Dyce and by Herr Veitbrecht, might be regarded in two views; first, as examples from which to learn to draw, and second, as examples of, and incentives to, geometric design. His (Mr. Burchett's) remarks applied wholly to their use as examples from which to learn to draw. It was evident that any value they might possess in this character must depend upon their being copied by the hand, unaided by any instrument, by their being used as what was technically termed, examples for *free-hand* drawing. The advantages which this class of examples would offer would be, 1st, the simplicity of the individual lines—presenting to the student a subject easily criticised, and, therefore, one which his own powers of perception might insure a fair imitation of; 2nd, simple subdivisions of the line when produced, thus exercising him in proportioning quantities or spaces; and 3rd, the placing lines in given relations to each other, such relations being readily criticisable from the regular character of the figure produced. These were, it was believed, the only particular merits to which this class of figures could lay claim as examples from which to learn to draw. Let us now examine whether there were any probable particular disadvantages likely to attach to the use of examples such as those exhibited. In seeking to make tuition in drawing a part of general education, it would be evident that this object must be, to a great extent, limited, to giving to all a power of more or less accurately expressing their ideas in a language more ready and intelligible than writing, and we might fairly suppose that the subjects and objects on which such language of form would be employed, would consist generally of such things as were related to our every-day wants and associations. In fact, that such drawing would be of an *imitative* rather than an *inventive* character— but further than this, *imitation* must claim the first effort of the student who proposed even higher aims to himself; whether he be the designer of ornament or the producer of pictures, in both cases must the imitation of nature and the knowledge and power acquired thereby precede the practice of design. Again, it would generally be found that the nascent art element was indicated by the love of imitation; and upon what subject was this power of imitation, either possessed or to be acquired, likely to be exercised? It would be upon the objects which surrounded or were familar to the student, the workmen, or the amateur—things which had known existence, uses, and associations, the successful imitation of which would be both an end and a stimulant to further practice. But the figures exhibited by Herr Kumpa were abstract figures, combinations of geometric forms, possessing but a remote connection with natural form or with the products of formative art, and for this reason, and in this respect, were they undesirable examples from which to learn to draw. The objection, then, was made not to the principle enunciated, but to the examples employed. During the past three years, considerable efforts had been made by the Department of Science and Art, to introduce

drawing into general education; in furtherance of this object, tuition in drawing had been given in a large number of parochial schools in London and in the provinces. In many of these schools large classes, varying from eighty to one hundred and twenty, had been taught drawing at one time—the method adopted being that the master drew on the black board a figure, *geometric in its character*—explaining as he proceeded the character of the line employed, the relation of the second line to the first, and so on, and the nature of any subdivisions he might employ—the children copying, step by step, the work of the master, drawing generally on their slates, sometimes on small black canvasses, with white chalk, and the more advanced on paper, in pencil. This system, which had been in full operation in London for the last three years, had offered many opportunities for testing the advantage derivable from the use of examples suggested by objects with which the students were familiar, and a representation of which by themselves, however imperfect, gave great additional pleasure to any derivable from an imitation of abstract geometric forms;—thus, instead of the square, as in Fig. 1, an oblong, the pairs of sides having a given proportion to each other, has been proposed: parallels at a given distance within the first lines had been drawn, a second series of parallels within the first, with the mitre lines at the angles, the pins at the corners, the strap for the pencil, the pencil itself, more parallels having a given proportion to the length of the side, the holes for the string, and, lastly, the string itself; the result being an exercise quite as full of practice as Fig. 1, and having, besides, the feature of individuality, the charm of imitation—to the student no small one; and tending, also, to stimulate the faculties of *observation* and *perception*, faculties, of all others, first requiring development in art education, of however humble a character. Many other instances had fallen under his notice, of which one might be mentioned. On visiting a parochial school, the master was found with a square drawn on the black board, its two diagonals and a semicircle described on the upper side. The students were evidently copying this languidly, and one, on being spoken to, said, "They did not know what it meant." A fresh lesson was commenced—an upright oblong was drawn, an equilateral arch constructed on the top, lines drawn parallel to the sides, some horizontal lines, and some diagonals, all having given positions and proportions obtained by proposed subdivisions. Great interest was soon manifested by the students, and on being asked, if they knew what "that meant?" one simultaneous shout proclaimed it was the "school-door"—as a mark of honour the best draughtsmen were allowed to add the fittings of the door. All education in drawing must have for its object the enabling the student to represent the *appearances of things*. The extent to which this power might be sought to be imparted must undoubtedly be a question of degree, but the character of the instruction would differ but in degree, not in kind. He did not think a method of teaching drawing in a parish school could be a good method, if it was not also a good method, so far as it went, for teaching drawing to a nascent academician; and in all schools an all-important consideration must ever be borne in mind, that all copying from the flat (or from examples) was but the preparatory step to drawing from nature, and any system which did not constantly bear this in mind was a bad system, and one that mistook the means for the end. All drawing from the flat should only be employed as a means of educating the eye to perceive, and the hand to imitate forms, which being *represented by lines*, presented at first fewer difficulties to the student in *copying* them than the *imitation* of the forms themselves would do. And here it might be questioned whether any long continuance at the practice of straight lines and the common curves would not be apt to *blunt*, at least to some extent, rather than to educate the eye to perceive the delicate inflections of line that was found throughout the works of nature and of beautiful art. Some years ago a set of models of the head and extremities were introduced to public notice, invented by Mr. Dupuis. The human form was in this case sought to be reduced to forms which might be represented by a series of shorter or longer straight lines; a very competent tribunal in this country condemned them, and that condemnation had been repeated in the past year by a tribunal, no doubt equally competent, in Paris. It was felt in both cases that a hard unfeeling and mechanical manner of drawing would result from such a course of study. It was not necessary that he should pursue the subject further, having regarded it only as a method of teaching drawing; that its principle was better than the examples which illustrated it would, he believed, be found in practice; that it was anything but *new* was only another proof, among a multitude, that different minds, widely separated, arrived at similar results, and adopted similar practices at the same time, unconscious of the existence of each other until accident brought their expressed opinions into contact.

Mr. Digby Wyatt begged to say one word as to the general result of what had been observed by the late speakers. He thought it was but just to Herr Kumpa to remark that, although the meeting appeared to invalidate his claim to novelty, they did not wish to do so with regard to originality in the working out of his system; for this reason—that any person who attempted to go through a series of elementary forms was very likely to—indeed he must—hit upon a certain number of the same forms that others occupied in analogous studies must have already done. Therefore, although it appeared to be the case, that in most of the various drawing-books which took notice of geometry, many of Herr Kumpa's diagrams occurred; it must be felt, from the elaborate designs, to which the progressive elaboration of the figures shown in his diagrams had given rise, that Herr Kumpa and his assistants had worked out a system, which they would appear to have conscientiously believed to be both novel and original. How impossible it was to express the deep inspiration upon which they had been told the design for the Palace of Justice had been based by such self-generated forms alone, would, he thought, be apparent upon the most cursory inspection of the beautifully-executed drawings upon the walls. He (Mr. Wyatt) thought speakers had not sufficiently regarded the complete difference between drawing as an imitation, and drawing as a projection. The one was mainly perfected by the visual and manual faculties—the other specially affected the reason and imagination, and a thing was pourtrayed the tangible existence of which was not involved. Such was the great difference between the two systems. Architecture, and indeed all high art, was always a compound of the two; invoking the aid of both geometry and imitation if they would "please the eye, or win the heart." He considered that the fault of those designs lay in the fact, that compounds of elementary geometrical forms, of a low order of structure, occupied the most prominent parts, whereas they should only have diapered the more retiring surfaces. Those, he thought, were the main points which appeared to call for a word or two from him. One remark he would offer as to Mr. Papworth's comments on conventionalising form. He (Mr. Wyatt) observed a tendency on the part of all self-convicted of error, to jump very quickly, and often too violently, to contrary conclusions. A few years ago producers arrived at too great a tendency to direct imitation. Few objects of manufacture were supposed to be good unless they had some story to tell; unless they represented men, birds, beasts, or fishes, or flowers and plants thriving as in wild Nature. But that was afterwards felt to be wrong; they then ran away with the idea that nothing was right unless it was conventionalised with a pretty complete abjuration of natural forms. Either excess, he felt, involved error, since those designs had always retained most permanent popularity in which

simplicity, and conventional or geometrical combinations were made the back-ground, from which were relieved the more interesting features, those involving an approach to direct imitation; by contrast with convention, that which was human, and spoke directly to the understanding and imagination, had invariably additional brilliancy imparted to it.

Captain L. L. Boscawen Ibbetson thought the discussion had taken more the turn of high art and architecture than he supposed Herr Kumpa intended. During the progress of his (Capt. Ibbetson's) mission last year, at the request of the Society of Arts, through the principal towns of Germany, his attention was drawn by Herr Bouffier to Herr Kumpa's work, and he particularly requested that it should be sent to the Society of Arts for the Educational Exhibition, as any novelty in the teaching of so important a branch of study as drawing, must lead to some good result. His attention at that time was especially called to elementary schools, and in all the towns he visited where (Gewerbe) or Industrial Schools were most flourishing, he found the drawing schools the most frequented, and even in some of the towns. The first principles of drawing were taught in the Kripe, or Infant Schools, not merely for taste and art, but to accustom the infant mind to certain geometric forms, so essential to mechanics, as the mind's eye of a mechanic for drawing, and the mind's eye of an artist, were essentially different. There were certain applications of Herr Kumpa's method which were new, but as to the first general principle, he was taught that himself at the Military College, many years ago. He was sorry to see that the diagrams had the appearance of being drawn by the rule and compass, when he was certain, from a conversation he had had with Herr Kumpa, that the *elementary* part of his method was intended to be entirely free-hand drawing, and for the purpose of giving geometric ideas to the youthful mind, as he had before mentioned. Although Herr Kumpa might have made a mistake as to the novelty of the entire invention, still the Society must feel obliged to him for the labour he had bestowed upon his work, and the ingenuity he had displayed. He must also add that Herr Scholz deserved great credit for his universal zeal in publishing everything he thought might be advantageous to the advancement of knowledge.

Mr. Harding remarked, that whilst they were always glad to receive new ideas from any quarter, yet they ought not to overlook what had been done in this matter by one of their own countrymen, Mr. D. R. Hay, of Edinburgh, who had produced some very beautiful and elaborate patterns by a system of geometrical figures, somewhat similar in character to those now exhibited; and in one of that gentleman's works he had entered into a system of curved lines—*not segments of circles*—but treated of the æsthetic beauty of ovoid curves. Mr. Hay had put forth his works in a very elaborate form, and having looked into them, he thought they evinced as great, if not greater talent, of the same kind, as was laid claim to in the system of patterns now exhibited. It appeared to him that the application of Mr. Hay's system was capable of producing endless varieties of forms for paper-hangings, floor-cloths, carpets, and tapestry of any kind.

Mr. Warren wished to put in a word for a class of learners in drawing to whom this system of teaching was not applicable, but of whom no notice had been taken in the discussion. The observations of the different speakers referred to the instruction of children whose future pursuits were yet to be decided on, and whose minds had yet to be formed, or to those who studied as artists or for the purpose of design. He wished to say a word for the working men, having been connected with the introduction in this country of drawing schools intended specially for that class. Some instruction in geometrical drawing was necessary for carpenters and masons, to enable them to set out the work they had to execute; but he had found geometrical classes never well attended—there was too much necessary formality in the instruction to interest the minds of the men. In what were called the art classes of these schools, however, he found great interest taken by the men; the object of these studies was to teach them the true natural forms of the objects of ornamentation which they had to execute in wood, stone, ivory, plaster, silver, gold, or iron—and for this object free-hand drawing alone was suitable. On the proper instruction of these artisans much depended for the diffusion of a real appreciation of art in every-day life, and he could have wished that in the discussion more consideration had been paid to the teaching of these, the hard-handed men.

The Chairman said that he felt he should only express the general feeling of the meeting in proposing a vote of thanks to Herr Kumpa, for the important paper which had been read, and which had given rise to so many useful and instructive remarks from various gentlemen of high attainments and of great experience in the subject; and who had so fully treated the matters relating to it, that he should not detain the meeting long by the few observations which he had to offer. He thought that Herr Kumpa's aim had hardly been distinctly appreciated, and that he had been supposed to give greater extension to his system than he himself intended; a natural mistake, however, arising from the title of the paper. Herr Kumpa stated that "he intended to guide the mind to the appreciation of form in nature by geometric figures." No one could doubt the utility of this; for, in looking at Barry's fine pictures on the walls around, it must be obvious that the natural uninstructed mind would be bewildered in the variety of graceful forms, unless it brought to its aid some artificial means of reducing the general masses into something like geometric figures in the first instance; and thus the mind and hand also would get into the habit of a certain training, which should control their operations. Allusion had been made to the first element of a straight line, which it was necessary to have the power to express. But the truth was, that, as Nature abhorred a vacuum, so she likewise abhorred a straight line, for it was never found in Nature.

Mr. Tennant apologised for interrupting the chairman, but crystals afforded an exception to the remark he had just made. It was probably in the recollection of some architects present, that the late Mr. Inwood commenced a work, about twenty years since, in which he endeavoured to show that architectural illustrations might be taken from crystallized minerals.

The Chairman remarked, that this was an exceptional case, and, as it were, produced by an artificial means, if it might so be said, of Nature herself. But no artist would recognise that crystals could come, as to artistic treatment, under the class of natural objects. In the architecture of the Greeks there was no straight line; their cornices were all curved, as had been proved by Mr. Penrose. The earlier specimens of Greek sculpture, as in the Temple of Ægina, were highly geometric, the limbs strictly angular; but Phidias, and the subsequent sculptors of the Greek school, threw aside those restraints, and followed the graceful flowing lines of Nature. Herr Kumpa only offered his system to produce a mental training—but what class of training? His own words were, "for those engaged in manufactures and the arts." Thus he judiciously limited its application. And, be it observed, as to manufactures, a subordinate department of architecture owed all its excellence to mere geometric forms. As Mosaics, and all classes of inlaying—viz., parqueterie, marqueterie, the ingenious inlaid works of India, China, and the American Indians, showing that this system was the first natural step of the lowest class of minds to produce effect by simple elements of form. Thus geometry, applied in this manner, produced precision and symmetry, but not proportion; for the pupil was restricted to the elementary diagrams, and thus the system

could not properly pretend to reach the higher intellectual powers of invention and creation. We might assume, then, that it was a mistake to suppose that this system could produce a new style of architecture. That depended upon a more important primary element. One speaker had alluded to glass as calculated to suggest a new style. Iron, also, was likely to effect taste and proportion in a great degree; and it might be observed, that all the styles of antiquity, and even of recent times, depended either upon the materials used or a new system of construction introduced, as with the mediæval architects, Indians, and Chinese. We must agree, then, with Herr Kumpa, that geometric forms were desirable, as an elementary principle, to enable the beginner to appreciate form, and to give a species not only of mental training, but also of mechanical handling—a system known, however, long ago, and extensively used already in foreign countries, and in this one, with much success. But it seemed difficult to agree with the author of the paper, that it could mount any higher, or furnish those exquisite results or nobler productions of the imagination, so as to create a new style of architecture, or a new school of high art. In conclusion, the chairman proposed a vote of thanks to Herr Kumpa, which was unanimously responded to.

Dr. Thudicum would not address the meeting at any length, seeing that the time allotted for discussion had passed. He merely wished to be permitted to offer a few remarks in reply, on behalf of Herr Kumpa; and first he begged to make, what he might be allowed to call, a statement in behalf of Herr Kumpa. This gentleman was publishing his work when Captain Ibbetson, an emissary of this Society, invited Herr Scholz, of Mayence, the well-known publisher, to send Herr Kumpa's work, though not finished, to the then Educational Exhibition of this Society. Captain Ibbetson's invitation eventually amounted to an encouragement for Herr Kumpa to be himself the bearer of his work That gentleman arrived in England a few days before the close of the exhibition. Notwithstanding, Herr Kumpa resolved upon submitting his system to the consideration of the Society. In spite of many extraneous difficulties, he ultimately was enabled to lay his views before this meeting, in the paper which had been read. After having stated this, he could not do more than convey to this meeting the most sincere thanks of Herr Kumpa for the kind attention given to his paper, and particularly to express Herr Kumpa's gratitude for the many valuable remarks and suggestions offered by the different gentlemen during the discussion. Herr Kumpa would certainly give his deepest consideration to all the opinions that had been expressed, which on the whole, he might say, seemed to admit the system as such, the method as a whole, to be new; the novelty of the single steps Herr Kumpa would never venture to claim, as the combination of lines to a system, to a figure had been known to all ages since *Pythagoras*. But the gradual development of one from the other, by an addition of lines or curves, and the thorough systematic arrangement, would, perhaps, on closer examination, be found novel. If it would not be presumptuous on his part, he might be allowed to say, that it was his impression that the architectural part had attracted more attention than the system of teaching drawing. Now Herr Kumpa wished it to be particularly understood, that he intended to teach able mechanics, masons, carpenters, designers, and so on; in short, practical men rather than artists. A technical school could never be expected to form artists. Therefore his system was particularly directed to assist the many unaided by genius, because genius wanted little assistance. But in practical life, which was not generally the arena of genius, we wanted the concise aid of mathematical figures to teach the many how to convey and express their ideas and conceptions. For this purpose Herr Kumpa's system would be found particularly applicable. Some speakers had remarked, that in their practical experience, gained in teaching after some parts of Herr Kumpa's plan, the pupils got tired. In reply to that he begged to state, that Herr Kumpa, in an experience of eight years, gained in his quality as teacher at the Polytechnic School at Darmstadt, in private schools at Darmstadt and at Dresden, the reverse of what the speakers stated as their experience had been the fact. The pupils of both sexes, and all ages, a great many in number, had invariably been interested, so much so as to induce them to proceed to construct on their own account the complicated figures according to Herr Kumpa's plan before they had ever seen the originals. The pupils progressed rapidly, and became good designers. He regretted that he was unable to reply to all the varied remarks which the different speakers had favoured the meeting with, as his pursuits were quite apart from art. And, still more, he regretted that Herr Kumpa himself was unable to reply at full length, as he had no doubt but that that gentleman would have been able to settle many doubtful points at once, and to explain fully what could be explained only partially and imperfectly. Perhaps the future might enable him to do so.

Dr. Hoffman said it would be altogether presumptuous on his part, in the presence of so many masters in the art of drawing, to offer any remarks on the relation in which Herr Kumpa's method of teaching stood to the higher walks of art, nor could he pretend to have an opinion how far this method would be successful in assisting the student in its humbler branches; but he begged leave to say a few words regarding a special application of Herr Kumpa's plan, which appeared to him to deserve the notice of the Society. He was speaking of the representation of *crystals*. It had been repeatedly stated during the discussion, that straight lines did not occur in nature. But he thought it would be admitted that an exception must be made in favour of the straight line if you contemplated the beautiful form which chemical compounds assumed in their passing from the liquid to the solid state, not by any artificial interference on the part of the chemist, but in virtue of the peculiar powers which belonged to the smallest particles of matter. He could not, perhaps, offer a better illustration of these forms, than by calling attention to a kind of crystals, which of late had been brought rather extensively under notice. By examining a diagram representing snow flakes, upon a colossal scale, which he had brought for the occasion, it would be found that here we constantly met not only with straight lines, but also with forms very similar, and in many cases identical, with those figures into which Herr Kumpa had combined the straight lines in the development of his system. He might mention that he had carefully examined Herr Kumpa's plan, and that he believed it admirably adapted for assisting the students in drawings of the kind to which he had alluded, and he had no doubt that all engaged in similar pursuits would find that gentleman's elaboration of the subject would render them very considerable assistance.

The Secretary announced that there would be a *Special* Meeting on the Evening of Monday next, the 19th inst., for the purpose of resuming the discussion on "The Sewage of London." Also, that there would be No Meeting on the Evening of Wednesday, the 21st inst.

## PROPOSED EXCURSION OF THE MEMBERS OF THE SOCIETY OF ARTS TO PARIS DURING THE EXHIBITION.

It is proposed that the members of the Society should join in an excursion to Paris during the summer, to visit the Exhibition. It has been suggested that, probably on such an occasion,

special facilities for visiting various interesting objects might be obtained for the members of the Society, and that convenient hotel and lodging arrangements may be secured if sufficient time beforehand be given. Members desirous of joining in the excursion are requested to send in their names to the Secretary as early as possible. As soon as a sufficient number of names are received a meeting will be called to fix the time of the visit and determine the general arrangements for it.

## Home Correspondence.

### ON THE CONSTRUCTION OF SHIPS OF WAR.

Sir,—The national importance of the subject prompted the drawing up of the following paper of suggestions for improving the efficiency of our ships of war, in January last, not indeed with any assurance that the Admiralty could be moved by an individual effort to so progressive a step, but under the impression that it behoves every subject of the state to do what in him lies to strengthen her efforts at the present crisis, whatever may be his opinion as to the original expediency of the struggle she is engaged in.

Though more than one engineer of the first ability has expressed a very favourable opinion of certain of these suggestions, your correspondent is quite prepared for various grave objections being raised against them. To such all efforts after important ends must be obnoxious in this our sublunary state, where every action of our lives is but a choice of evils. Any plan promising great advantage, free of all disadvantages, can find no practical realisation in this our lower world.

Thus the stem of a floating battery formed as in Fig. 3 would doubtless diminish its speed; but then, speed is of small moment for it in comparison with security against the possibility of the vessel's grounding. Again, it may be questioned if the stem could be given sufficient strength to act as a kind of plough-share over so large an area of sand, even though the vessel should be proceeding cautiously; but your correspondent has, in long voyages up and down the river Ganges, so repeatedly watched the different effects of shoaling against sands on large boats of various forms of stem, that he is persuaded a heavy flat-bottom vessel could, by a proper construction and strutting of the stem, be better prepared to receive the shock of a cautious speed end on, than the strain of rubbing over gravel and riding up an incline till she was half out of water. But, whatever the strain it involved, the object sought by the former construction—a security against the possibility of lying helplessly grounded in shoal water under the fire of a battery—is one of too great importance to be relinquished until the difficulties, which an unaccustomed form may suggest, have been demonstrated insuperable, either upon constructive principle or by actual trial.

Nor is a security against getting aground the only advantage of such a construction. A vessel so formed could work its way, by repeated impulses, from one deep channel to another, through bars at the mouths of rivers and through shoals between channels, even where there was not over the bar or shoal a depth of water equal to, perhaps, half the vessel's draught. In Asiatic rivers, a fleet of boats, some of them carrying from fifty to one hundred tons of produce, and drawing four feet of water, will be worked through a long and firm sand, over which there are not two feet of water, by mere manual labour; each vessel in turn receiving the aid of two or three crews besides its own, who stand around it in the water, and simultaneously jerk the vessel forwards, so as to agitate the sand into a semi-fluid state.

The question, however, of paramount importance is the protection of ships-of-war from conflagration; and it is the chief object of this paper.

The structure (Fig. I.) proposed as the fabric for future vessels would obviously possess this advantage of incombustibility in an especial degree, together with that of great mechanical strength, and of rendering the timber of old ships, if sound, and also merely cubical blocks of wood, almost equally servicable for new vessels with the primest timber.

It is in no warlike spirit that these proposals have been tendered, but, under the conviction that, so long as a spirit of ambition, vain glory, and aggression, shall continue implanted in man's nature, it is necessary that this country (while more earnest than hitherto in suppressing these evil emotions in herself) should possess a defensive navy of commanding strength; and it is not in a dogmatic spirit, but a suggestive and deferential one, that this paper is submitted to the attention of the Members of the Society of Arts, through its ably-conducted Journal, with the view of inviting to the questions proposed the inventive and constructive talent which abounds amongst them, and which, if duly encouraged by those who have assumed charge of the public interests, would, doubtless, be successfully exerted for the nation's good.

I am, sir,
Your obedient servant,
JULIUS JEFFREYS.

Kingston-hill, Surrey, Feb. 28, 1855.

### REMARKS ON SHIPS OF WAR AND FLOATING BATTERIES.

By Julius Jeffreys, F.R.S., F.G.S.

In these days of incandescent projectiles, combustible ships of war promise to become about as serviceable as would be combustible fire-places.

Not only do red-hot shot imperil the wooden walls of England, but it would be easy to suggest a more dangerous missile of conflagration still, the action from which, probably, nothing could save ships, as at present built, from suffering destruction.

Were all the air spaces in ships' walls as necessary as is commonly imagined for retarding decay, they are, in these days of projectile heat, so imminently dangerous as feeders of combustion, that it is a question whether every ship in the navy ought not to be immediately uncased sufficiently for all these interstices to be filled up thoroughly with cement. But this cementing would also put an end to that infiltration of air and moisture which is the real cause of rotting, and which is now rudely remedied by a rush of air. If air were really needful to prevent rotting, the heart of every thick timber to which air has no access would be the first part, instead of the last, to rot. On every account, then, air should be shut out from every part of the *fabric* of a ship.

Having filled up all interstices, the next point is to allow no wooden surfaces to be exposed, but to coat them everywhere with sheet-metal, say copper on the outside and iron* on the inside of the walls, and decks,† and iron around beams, &c. Quite thin metal would answer, if studded over with nails.

A shot, however intensely heated, penetrating and even lodging itself in wood properly coated from the access of

* Or iron on the outside of the ship above water would answer if well painted over, though no galvanic action between the two metals is to be feared through the massive and dry walls.

† Over the metal casing of decks thin planks of hard wood might be nailed down, to keep the feet of the crew from the slippery and conducting metal. This planking, on taking fire, could burn but feebly over metal, and could communicate no combustion through it.

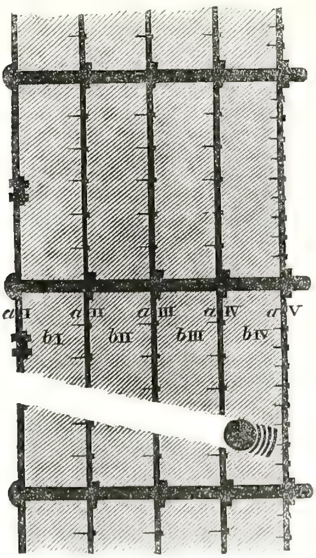
air, could only reduce two or three inches of wood around it into charcoal, which, without air, would form a bed indestructible by any heat known, in which the shot might be permitted to lie for any length of time. As to the hole made by the shot, combustion could no more thrive at the bottom of it than in the socket of a deep candlestick in which a light had burnt down; and the hole could always be stopped for the time with clay or cement. The oxygen in the woody fibre itself only suffices to blow off in union with its hydrogen as steam, or with a little carbon also, as some binary, or ternary, pyroligneous compounds. The carbonaceous mass of the wood would assuredly remain unconsumed, so long as air had no free access to it. There is, perhaps, nothing to prevent ships on service from being subjected to this cementing and sheathing process by the carpenters and engineers on board, whenever the weather is fine; planks at different levels being removed, and liquid concreting cement being poured into all crevices to fill them up; the surfaces might then be well cased with metal from the water's edge, as well as all interior surfaces.

The writer is next led to repeat a proposal for the construction of ships' walls in future, which he made last year to an able officer connected with the Admiralty.

For the main substance of ships' walls woody fibre is, perhaps, the best material. But mechanical and economical principles indicate that it should be employed in the walls, not actively as their framework, but what may be termed passively, rather; as a massive support to the material of active strength, and as a tough bed for cushioning shot—destroying gradually that momentum which cannot be instantaneously annihilated.

The great cohesive power of iron points it out as the material for the active strength of the walls. But in *ships*, at least, to give it a shot-proof thickness, cannot be thought of. Let an outer table, or wall of iron, *a* 1., Fig. I., say half an inch thick, of sheets rivetted together as in

Fig. 1.




iron ships, form the exterior surface. Let a foot of wood filling-in *b* 1 (formed of any tough old timber or cubical blocks of wood, with cement to fill up all spaces) come next; then a table, *a* II., of sheets of ¼ or ⅓ inch iron be nailed, with long spiked nails, against this wood filling-in; the edges of the sheets being nailed over each other. Let a second foot, *b* II., of such woodwork follow, and a third table of iron, *a* III., be nailed on to it, and so on, until the wall had the determined thickness, from one foot upwards to any extent required.

Then let bolts of 1½ to 2 inch round iron, pass through the whole, keying up each table of iron, and binding the whole together by screw nuts; there might be one such bolt to every square yard of surface.

Not only would such a fabric for ships' walls possess prodigious strength, probably surpassing, *for them*, the tubular principle of bridges, inasmuch as it would be solidly firm in *every* direction against the countless strains in floating vessels; so that, with proper decking of a like kind, and truss-framing, vessels of gigantic dimensions might be made, if desired; but it would remove all danger of conflagration. It would, likewise, receive solid shot in the very best way. The sheet-iron tables, if duly proportioned in thickness to the wood supporting them, would be punched into the wood behind them, as into a die, as at *g g*, the shot driving on the cup-like pieces before it, until its momentum was exhausted, which cups would, indeed, guard the wood before the shot from singeing, though this is of minor importance.

Such a fabric might be riddled by shot, like a cullender. before its strength was materially impaired, and it could be readily repaired by driving plugs into the shot-holes, and plating over the outermost table of iron and the innermost also, where the shot went clear through the wall.

It is, perhaps, not too much to say that a large ship thus constructed would not be more costly per ton measurement than ordinary ships of war While armed with suitable missiles of conflagration it might set a whole navy of ordinary ships at defiance, and any that approached it destructively on fire in a few minutes.

A floating battery fabricated in the same way, but more massively still, and of the form described below, might, if armed with a missile of another character, be enabled to hew down stone fortresses impregnable by round shot.

The writer has regretted that the experimental iron ships were so hastily denounced. They only required to be banked up with wood against the metal, and this again lined with thinner iron, studded to it with nails, to make them, perhaps, the most serviceable vessels at present afloat. The wood would have served as a die, causing the outer plating of iron to be punched into it by round shot, instead of being extensively crushed in and torn.

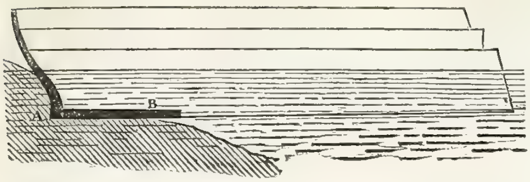
The time has surely come when future ships of war must be constructed in a totally different manner from the present, and when existing ships must have every air passage in their walls—every feeder of conflagration—stuffed with cement, and every wooden surface cut off from the play of oxygen by plating with metal.

### A Word on Floating Batteries.

Four or five inch plates of solid iron overlying wood are reported to stop dead the largest round shot. which, after causing considerable indentation, *fly to pieces* against them. Would it not be prudent to try the effect of *wrought* iron shot (easily made by compression), the momentum of which cannot be thus instantaneously destroyed by diffraction, before trusting implicitly to even five such plates? If the plates are still sufficiently resistant, their object will be secured for floating batteries; but for ships of war generally they would, of course, be inapplicable, and, as said to be employed, they do not form the strength of the fabric of batteries, nor guard them from instant conflagration by missiles projected through their port-holes, and conveying fire to exposed surfaces.

As to the form of a floating battery.—It is desirable that it should be so constructed as not only to draw as little water as practicable, but also, if possible, to suffer no injury on running aground upon any surface but solid rock, and to have a tendency to float off by itself, or easily by the aid of its engines. A stem formed like Fig. 3, with a stout recurved foot at A, of massive iron, and with a perfectly flat bottom, would not, on striking, ride up on to a sand or shingle bank, but would plough for the vessel a level bed,

Fig. 3.




over which she would float if trimmed slightly down by the head, while the earth heaped up ahead would help to push her off as soon as her momentum ceased, or, if desired, she might, by returning with repeated moderate impulses, cut her way through a bank of sand to a deeper channel.

By such a construction the whole force of the blow would be thrown lengthways against the bottom, which, if massive and properly framed to the stem, and embraced by iron arms, projecting laterally from the iron foot ahead, should not suffer from the shock of any cautious motion against it, end on; whereas a strain to a vessel riding up on a bank might be much greater, while it would be scarcely possible to get a vessel of immense weight off again when under fire.

In operations against land batteries, the effectiveness of a floating battery would be greatly increased by a freedom from all danger in shoal water, enabling it to operate fearlessly in any position.

The writer ventures to suggest the outline Fig. 2, as the transverse section for a floating battery, and Fig. 4

Fig. 2.

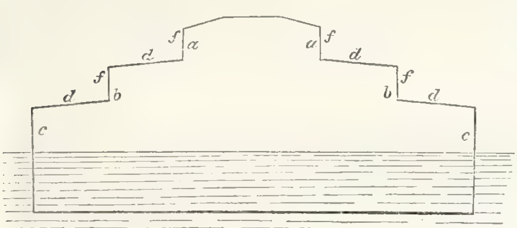
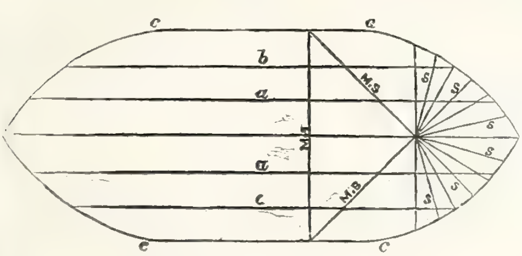



Fig. 4.




as the horizontal plan of different levels. The two upper tiers of guns ranged at *a, a, b, b,* would serve to give the vessel stability without ballast. While the lower tier, *c, c,* must, from the great breadth of the vessel, run in an arch round the sides, the two upper might form long straight batteries of guns having the same direction. Also, on the deck spaces *d, d, d, d,* and against the walls, *f, f,* might be laid bags of wet sand if desired, which would materially retard the progress of shot. The lines *s, s, s, s,* &c., Fig. 4 suggest converging struts supporting the head of the vessel at the foot and at other levels, and conveying the strain to main struts in the direction of the lines M.S. The whole longitudinal frame work of the bottom and of the decks ought to support the head pressure at their levels.

Kingston Hill, January, 1855.

## STATISTICS OF THE IRON MANUFACTURE.

SIR,—The paper read by Mr. Scrivenor before your Society, on the 13th of December last, gives a very clear and elaborate view of iron manufacture, its progress, its improvement, and its general features to the present time.

The tables annexed also exhibit most clearly the fiscal arrangements of other nations, with the direction they are taking, so that the ironmaster, iron merchant, and consumer can readily see and appreciate the whole information brought before them, even in so brief a space, and benefit thereby, although they may be apt to forget the zeal and industry which has drawn together so much worthy their notice.

In two subsequent letters Mr. Scrivenor has announced that he had offered his services as a *general secretary* to the trade, for extending and keeping up all the statistics attendant upon this most important branch of industry and wealth.

If I might be permitted to express an opinion, I would say that such is most worthy of consideration. So important is the trade, sprung up, as it were, into real vitality and importance in the present century, that it appears to me a duty of the Government to assist and to promote it; not in the way of an obnoxious inspection, or as an excise, but with, and having the assistance of, committees of the masters in the several districts for ironmaking in England, Wales, and Scotland, so that a true and accurate return might be made of the whole home supplies, their distribution, and their application, with all matters affecting foreign agencies connected with this valuable mineral, whether fiscal or commercial, when every man directly interested could be able to see the elements at work to promote or retard his operations, while the Government would be provided with such matter as could be safely relied upon, so as to know exactly the riches accruing from this source of national industry.

Surely it is not needful to prove that these objects are worthy of the small expense which would attach for obtaining them? An intelligent, energetic and exact person engaged in such a work, knowing what is required, and acting under those in the trade, could well supply, arrange, and complete such statements as would be needed, and the whole cost, compared with much that is called for by the House of Commons, would really be trifling, yet a great desideratum would be attained, not upon an uncertain or unreliable basis, but upon facts and authority, which is the only way to make returns valuable at any time. Strictly confined to the one object, it should be no part of the duty of such inspector or secretary to introduce matter which would interfere with individual interests, nor yet to attempt to teach the trade any lessons, but giving only statistical facts of all relating to the manufacture at home, and those bearing directly upon it abroad. I know no information which could be made more valuable than this, whether to the government, the ironmaster, or the consumer; indeed, to the people at large, as it refers to an article which affects every comfort and convenience in daily life. My impression is, that it is of such importance as not to be taken up as a mere present inquiry, but to be made a positive and permanent duty, year by year, to be made up to the latest period, and yearly a report to issue, setting forth the position of the interests concerned.

If it should be carried out in the way I have ventured to suggest, and the appointment made and controlled by the committee I have proposed, I do not think it would be difficult to get a large contribution for the purpose from the trade, while Government might be induced to contribute the printing of the reports, and the proceedings of the committee might be well and properly placed under the sanction and confirmation of the President of the Board of Trade.

I have no personal acquaintance with Mr. Scrivenor, only knowing him from his work and the paper he read before your Society; judging from these, I believe him to

be a man of sound discretion, and such a person as would be the proper party to enter upon such duties; but as the appointment should rest with the trade, they would decide, and, I doubt not, give him every opportunity for preferring his claims, and his suggestions and labours would have full weight in their minds if the plan be matured and the task fully decided upon.

Since no parties are better acquainted with the necessity of *good and well-proportioned* machinery than those employing it in making iron in all its forms, so no class of men is more likely to appreciate any moral or social machinery, which shall add to their exact knowledge of all that relates to the substance of those products; and from this I would make the deduction, that the ironmasters will see at once how far and how surely that which is proposed will really contribute to their benefit.

The Government cannot but be sensible of the advantages proposed, rather than be groping in the dark, as they must to a great extent do at present, while the consumer will be benefited, even against his will, to an extent he may not examine and therefore cannot estimate.

Sincerely trusting that these remarks may produce good fruit,

I remain, yours, &c.,
THOMAS M. GLADSTONE.

Adelphi Chambers, March 6, 1855.

## THE DECIMALISATION OF OUR CURRENCY AND ACCOUNTS.

Sir,—A lady once asked a clergyman, who had laborious duties to perform, "why he did not compose shorter sermons?" The reply was, "That he had not time."

The same excuse may be pleaded by a few writers for not having applied the pruning knife to their prolix and desultory arguments on the decimalisation of our currency. That which is practicable, brief, and simple, and realises our object with the least interference with existing coins and customs, rely upon it, is the system which the public will prefer.

The £ sterling is the unit adopted in all existing marriage settlements, wills, deeds, &c. It expresses sums of magnitude with greater brevity and simplicity than any other unit. It expresses a value peculiarly familiar to our minds. It can be subdivided decimally into tens, hundreds, and thousands, without any violent interference with the coins now current. Why, then, change this unit? *Cui bono?*

What we require is not a change of the unit, but for economising calculations and accounts, that it should be subdivided into decimal instead of fractional parts. In lieu of shillings, pence, and farthings, representing $\frac{1}{20}$, $\frac{1}{240}$ and $\frac{1}{960}$ parts, it is proposed to substitute florins, cents, and mils, representing respectively one-tenth, one-hundredth, and one-thousandth parts of the £.

Our money table would then stand thus:—

| Mils. | | Cents. | | Florins. | | |
|---|---|---|---|---|---|---|
| 10 | = | 1 | | | | |
| 100 | = | 10 | = | 1 | | |
| 1000 | = | 100 | = | 10 | = | £1 |

The coins at present in use would represent values in the following proportions:—

| | | Florins. | | Cents. | | Mils. |
|---|---|---|---|---|---|---|
| The Sovereign | = | 10 | or | 100 | or | 1000 |
| ½ Sovereign | = | 5 | ,, | 50 | ,, | 500 |
| Crown Piece | = | | | 25 | ,, | 250 |
| Half Crown | = | | | | | 125 |
| Florin | = | 1 | ,, | 10 | ,, | 100 |
| Shilling | = | | | 5 | ,, | 50 |
| Sixpence | = | | | | | 25 |
| *New Silver* coin to represent | | | | . | . | 15 |
| Ditto | | Ditto | | . | . | 10 |
| The penny present coin would represent | | | | | | 4 |
| Halfpenny | | | | ditto | | 2 |
| Farthing | | | | ditto | | 1 |

The silver coins now representing fourpence and threepence, would be replaced by two new silver coins, to represent respectively 15 mils and 10 mils. But as our silver and copper coins are merely tokens, representing a nominal and not an actual value, the former being a legal tender to 40 shillings, and the latter a legal tender to twelve pence only, the present penny, halfpenny, and farthing copper pieces may be denominated, and made to represent 4 mils, 2 mils, and 1 mil respectively.

According to this arrangement, poor men, to whom the farthing is of importance, will get 25 mils or farthings for their sixpence, in place of 24; and as Mr. Wm. Brown, M.P., very properly remarked at the Society ot Arts, "they will see it places them in a better condition, inasmuch as a mil would go as far as a farthing in many cases." The currency is decimalised—the unit to which we are accustomed is preserved—and coins now current not interfered with, beyond the substitution of two new silver for two other coins to be withdrawn.

Decimal currency may therefore be at once adopted without confusion, sacrifice, or expense. It is capable of being understood by the meanest comprehension, and considering the facility of calculation that a decimal system of accounts would confer, it is marvellous that so much discussion and time should be considered necessary to reduce it to practice.

The importance of this subject to the public at large is my apology for troubling you with these remarks.

Yours, &c.,
JAMES S. TRIPP.

Kew Green, March 7, 1855.

## THE DISCUSSION ON DECIMAL COINAGE.

Sir,—You are aware of the grounds on which I did not at once comply with the wish expressed in your note, that I should furnish a statement for insertion in the *Journal of the Society of Arts*, recording my views on the Decimal Coinage question, with reference to your recent discussion. This discussion seems to have, unfortunately, wandered off into points not properly before the meeting, particularly into that *modification*, suggested by Mr. Minasi and Dr. Gray, of the simple scheme of substituting the tenpence for the twelvepence as the legal form of account, which I proposed about eighteen months ago, on the first appearance of the Parliamentary Committee's Report, viz., the entire abandonment of the pound as a money of account for what it was proposed to call an imperial, ten tenpences, or a hundred pence, in amount. *Mr. Minasi's short unanswerable paper, however, avoided all allusion to this modification which* THEY *had suggested*, and simply brought under discussion, as he had been requested, a comparison between the results of a millesimal division of the pound into the proposed three new moneys of account, mils, cents, and florins, or, on the other hand, of adhering to all our present moneys of account *and* circulation, (*but one of the former*) so long as found expedient, *by simply abandoning the duodecimal shilling for the tenpence, and keeping all our ordinary accounts in pence and tenpences*, whilst retaining the pound as the legal tender and standard of value, and money of account in unusually large amounts, to whatever extent may be hereafter found convenient. Although Mr. Minasi's comparatively short paper was still further cut down by the chairman,—the advocates of the tenpence had not even the opportunity of a short reply,—fully five-sixths of all that was brought forward being on the part of opponents—the useful figures brought before the meeting by some of these, and particularly by Mr. Franklin, the clear sound positions relative to what is essentially necessary in decimal accounts, laid down by Mr. Hugo Reid, and, above all, the way in which, throughout the discussion, judgment was allowed to go by default, with reference to the unanswerable grounds on which it has been again and again shewn that the proposed *millesimal* division of the pound *is impracticable*, render the discussion highly useful and effective in the promotion of a sound, simple, and comprehensive decimal system.

In the first place it was not even attempted, by either the writers or speakers in defence of the pound and mil scheme, to deny or to meet the weightiest of those decisive, and, it will be found, wholly insuperable objections, rendering impracticable that mode of proceeding, in the opinion of parties of the highest authority, including members of the Decimal Association itself, and of the Committee of the House of Commons, as well as such organs of public opinion as the *Times* and the *Liverpool Mercury*. To several of these objections attention was called by Mr. Headlam, the member for Newcastle, in his evidence before the Committee, and they were fully stated in my first pamphlet, and are shortly given, pages 8 to 20, of the second "Comparative Statement of Different Plans of Decimal Accounts and Coinage."* In the second place, positions laid down as obviously *essential* in the introduction of a decimal system of money and accounts by Mr. Reid and others, are not only wholly and inevitably contradicted by the pound-and-mil scheme, and every modification founded upon a millesimal division of the pound, but *can only be met, as they are, by the penny and tenpenny form of account.* A "*sine qua non*," Mr. Reid says, is that there shall in any decimal system be ONLY TWO moneys of account, the lower of the two sufficiently low to express with convenience all ordinary money transactions; and another *advocate of the millesimal division of the pound* justly observes that, "there seems little likelihood that while the Americans and the French have *unsuccessfully* attempted to introduce *three* coins of account, we in England should be satisfied with the comparatively complicated system of *four*." But in order to escape this unhappy peculiarity of the pound-and-mil scheme, Mr. Reid proposes to *banish its pound*, not merely in *ordinary* money transactions and accounts, as on the penny and tenpenny plan, but *altogether*, and, also, its hundredth, the cent, which, being nearly 2½d. in amount, is certainly *not* a coin "sufficiently low to express all ordinary money transactions." Accounts would thus be kept in amounts of 2s., and the one hundreth of 2s. (that is the $\frac{24}{25}$ of the penny); two moneys of account *not even decimally united;* for, although 100 is a very useful "power of 10," *it certainly is not* 10, whilst the 100th of 2s.; so far from being a convenient money of account to express all ordinary money transactions, it is *less than the farthing*—the introduction of which into ordinary accounts *is protested against by men of business as an intolerable inconvenience;* and all that the *humblest* classes require is evidently only those more exact (less than farthing) *measures of value* so simply and admirably provided by the decimal *coins* of the penny and tenpenny form of account. Subdivisions these, too, equally perfect, and superior to the proposed millesimal (as demonstrated by Mr. Laurie and Mr. Minasi) in furnishing commercial equivalents and expressions, and for the most practically convenient arithmetical forms. Against this beautifully simple and efficient mode of proceeding, what, then, have the partisans of the complicated, clumsy, even if practicable, proposition of a millesimal division of the pound, to object? That to keep accounts in the proposed *perfectly decimal form* of pence and tenpence, would not be found convenient; for that, if it had been convenient, accounts would have been so kept, there being nothing to hinder their being so kept, as the advocates of this form have already had all they ask—a tenpenny silver coin in Ireland, and its equivalent in the silver 4d. and 6d. in this country. To these *assertions*, alike unsupported and entirely unfounded, it is sufficient to oppose the long European *experience*, as well as that of every traveller in Europe, of *this identical proposed form of account*—a tenpenny money of account, decimally divided,—as found and unanimously agreed to be *the most convenient and useful of all possible forms of account.* Whilst so far from its advocates in this country having ever had what they ask, —and have asked from their first proposal of *this* mode of proceeding eighteen months ago, the sanction of the law of the land to their proposed form of account—that, "*at option*, pounds, tenpences, and pence, or simply tenpences and pence, should be the legal forms of account" —*this* enactment would *at once* have substituted the decimal for the duodecimal addition in *all* accounts, thrown *all* accounts *up to the pound* into the above *perfect* decimal form, and given *in all* the simple means of adopting individually this same perfect form to whatever extent, and as found convenient—*not an existing coin having to be withdrawn until worn out, and gradually replaced by a more convenient and uniform coinage.* All that the French, Belgians, &c., want, we have—not merely gold coins, like their Napoleon and 25 franc Leopold, (corresponding so closely in value with our sovereign and old guinea,) but a large *money of account*, such as our pound, for the convenient expression of cumbersome very large amounts; and when this is introduced, as it probably will be very shortly, instead of the great commercial country of the world having to give away, (as assumed without the slightest foundation,) in *all* the changes required to secure international uniformity of accounts and coinage, if England is only prepared by the above simple decimalisation of her own, the far greater probability would be that

* Mr. Franklin in his paper speaks of my "manifold writings on this subject," and he and others appear to take their ideas of my proposition from some wholly unknown to myself. All I have ever published are these two pamphlets—"Examination of the Report and Evidence of the Committee of the House of Commons, with Reference to a Simpler, Sounder, and more Comprehensive Mode of Proceeding. Ridgway, 1853." "Comparative Statement of the Different Plans of Decimal Accounts and Coinage. Ridgway, 1854." Price tenpence. With a short preface to the second, and postcript to the third edition of the first of them, and one or two letters and statements like the present, *all strictly and uniformly in support of the same view.* Private correspondence with individuals has certainly been much more extensive, for I found there was scarcely an instance of any one of ordinary candour and intelligence not becoming satisfied of the advantages of this simple mode of proceeding, after a little of this sort of discussion and explanation. My first and most valuable convert was poor Mr. Laurie, who wrote to me the day my first pamphlet was published, and of course after very hasty perusal, to submit what he then considered the objections to my scheme. His views were at first strongly in favour of the pound-and-mil scheme, and his evidence to this effect before the Committee of the House of Commons was highly valued, and full of important information; but he soon became convinced that this scheme was impracticable, and only contended, (as Mr. Reid at present does,) for *that fragment of it* which, dropping the pound, renders the 2s. coin the highest money of account. Then, finding *this* plan still less tenable than the other, he, not only in his letters to me, but on the first public opportunity, gave his unreserved adhesion to my scheme, as he plainly saw, he stated, *that the division of the pound into* 24 *tenpences, decimally subdivided, was the best selection that could be made, and all that was wanting to render the currency scientific, and to bring it into harmony with foreign decimal systems.* The extremely important commercial and arithmetical results worked out in his last publication, "Practical Analysis of the Comparative Merits of the Pound and Tenpence," and the unanswerable illustrations of the difficulties connected with *the practical arithmetic of the pound-and-mil scheme* in Mr. Minasi's paper, might far more advantageously, and *fairly*, have occupied the meeting than the diversion accomplished by the introduction of that gentleman's suggestion of imperials and argents, to which his paper made no allusion whatever. The suggestion of a coin and money of account of 100d., a ducat or imperial, in place of the pound, was first made by Dr. J. E. Gray, in the preface to the second edition of my first pamphlet, in the most modest and sensible manner, his words to me simply being, "I have read your pamphlet with great care, and agree with you in every part of it, &c.; but would not object (*if it was proposed*) to the ducat of 100 pence, leaving every coin now in use in circulation." Neither of these gentlemen *urge this suggestion* as an essentially important modification, or seek immediate consideration of what is so easily adopted if hereafter found expedient. The *sole* advantage of duodecimal accounts is the number of useful factors, 2, 3, 4, 6, 8, 12, and it would largely compensate for any inconvenience from still retaining the *occasional* use of the 24, as proposed, that this advantage would still be secured.

other countries, in which the standard is already practically gold, though professedly silver, would, like this country, also adopt gold as their standard. At all events, the alleged "danger to *our* standard of value from the pretensions of the tenpenny unit," is preposterous, and utterly without foundation. Mr. Yates, indeed, seeking similar objects and results, *by an entirely different mode of proceeding*, the adoption of the "système métrique," and consequent abandonment of all our moneys, weights, and measures, for the French, does, as stated, suggest that "*perhaps* it would be indispensable to adopt silver as the standard of value," as in France. But *my* proposition never involved, or can involve, the slightest alteration of the present standard of value, the 10d. being, as at present, in value, a 24th, and the penny a 240th of the *legal tender*, and, of course, *measure of value*. Whilst *in accounts* our penny *has been found by long experience, so much the most convenient, and the sufficiently low coin of account to express our ordinary money transactions*, that it has wholly banished from them *even halfpence*, and still more, of course, any so intolerably inconvenient as farthings, or the still smaller proposed mils; and, on the other hand, its *only possibly really decimal ally*, the tenpence, has been *experimentally* shewn to be *a sufficiently high money of account* for all ordinary use and convenience in current accounts. A *real* alteration of the present standard of value in this country, and very considerable deterioration of the standard fineness of our gold, without after all rendering it uniform in fineness with that of our neighbours, is, indeed, proposed in page 59 of the pamphlet which the *pound and mil Association* are urging the friends of decimal coinage to subscribe to circulate, and this deterioration has been most anxiously urged by the most active members of that association, without having been disclaimed by their associates. It surely, then, requires no little hardihood for *these very persons* to be the parties to bring such a charge as this in defence and support of their scheme, and to term those "the obstructives" who, after millesimal division of the pound as a means of obtaining a decimal system has been again and again fruitlessly proposed during the last half century, at length *propose* in so short and simple a way, to attain more than, and far more perfectly, all that it has been so long vainly attempted to secure by their opponents' mode of proceeding.

The pound and mil scheme of a millesimal division of the pound being evidently defeated on *English* ground, an endeavour is perseveringly made to transfer the battle to *foreign*,—although the proposal, whatever its ultimate advantages and results, is, in the first instance, simply the decimalization of our English accounts. The reiterated attacks on my scheme on *this* ground only amount to a reiteration of the well-known fact, that the English tenpence and French franc, (which there has never been any motive or reason for making exactly alike in intrinsic value,) do not, in fact, at present consist of *exactly equal* amounts of silver, and require to be by some arrangement rendered such, in order to become international, and mutually current and exchangeable coins. Whilst, in order to prove that no "slight adjustment" would bring dollars into interchangeable correspondence with five-franc or tenpenny silver coins, the industrious Mr. Franklin travels off *to Hayti* to find a coin which, *bearing the name of dollar*, so little corresponds with the well-known dollar (with which, alike in Europe and America, General Pasley gives evidence that our troops are always paid at exactly five English tenpences, and which at all times so nearly corresponds with this amount and the five-franc piece in intrinsic value) *that this nominal Hayti dollar is actually a coin not containing one third of the silver constituting the ordinary wide spread well known dollar of America and Europe, the five-franc coin of France, or the five tenpennies of England.* *I* never suggested that *all* the out-of-the way coinages in the world would, *all at once*, become uniform and corresponding, but simply and solely that with the proposed slight decimal modification of English accounts, the silver coins of the great commercial and influential nations of the world, those using English tenpennies and their multiples in accounts and circulation, and ordinary francs, florins, and dollars, *with slight adjustment* might, and almost certainly would, be rendered strictly corresponding and international, and that with such authority and influence this circulation must in the end become universal in some one or other corresponding form. Mr. Franklin's own figures sufficiently show with *how very slight adjustment* this may be accomplished to the extent suggested as the first great step. Between the 69·43 grains of silver constituting the franc and the 67·27 grains the English tenpence, there is, of course *literally only about two grains of difference*, with a corresponding degree of difference in the dollar, &c., and so far from there being any approach to accuracy in Mr. Miller's extravagantly wild assertions that by the proposed adjustment, I mean "that England should abandon every one of her present measures of value, &c., &c.," it is *not even proposed that she should abandon any one of them whatever.* America has quite recently had to make a very large reduction in the amount of silver in her new issue of dollars, and in the words quoted by Mr. Franklin from the notes on the Annual Report of the Bank of France, if the weight of *their* silver coin is not reduced—that is, brought nearer and more exactly to the weight of our own—"it must inevitably be exported to the last franc." But even if, in return for these large approximations to exact correspondence with our own silver coin, and perhaps also the adoption of our gold standard, we have to consent to some little increase of the present weight of our silver coins, what *imaginable* effect could this have on our "measures of value"? The *silver* and *copper* coins are but the representatives of certain portions of the gold standard of value, and although it is highly inconvenient and objectionable to alter their *actual current value*, by substituting that of mils, or altering the value of the gold sovereign, (as proposed by Mr. Franklin and Mr. Miller, and in the Decimal Association Manifesto,) there is no possible object in having them of any one weight of metal rather than another, but that of avoiding such weights as to induce fraud on the one hand, or melting on the other. Once properly settled by common general consent, there would be no fear of anything so intolerably inconvenient as partial abandonment, or change on any other basis; and even if a general gold standard formed no part of the arrangement, how vast would be the gain to mankind of a strictly uniform and interchangeable silver coinage.

My good friend, Mr. Brown, our worthy and most zealous South Lancashire member, as already more than once pointed out,* is under a strange misapprehension as to his 250 members of Parliament, of the Commissions and Chambers of Commerce, of the Government, and others, who, deceived by the title, have subscribed to his "Decimal Association," being, therefore, by any means, all in favour of his *pound* and *mil* scheme. Few of these have at all considered or made up their minds to *any particular plan of proceeding*; and, of the few who have, there are those who entirely repudiate, and, as repeatedly shown, *who condemn as utterly impracticable this particular scheme.* Mr. Brown states that "the mercantile community of Liverpool have had my views placed more prominently, perhaps, before them than any other town," and appeals to *their* petition in favour of the decimal system, and the pound as the unit; but he has forgotten that *my decimal system strictly preserves the pound as a unit*; and that, not only did he *vainly* endeavour to have a prayer for the *pound and mil* plan of his Committee introduced into the Liverpool petition—this course being successfully opposed *by the member for Liverpool*—but that, quite recently, at the general meeting of the proprietors of the Bank of Liverpool, where he has great and deserved influence, and I am not even a shareholder, on his urging a contribution

* Comparative Statement, pages iii, 90, 106.

to what is called "the Decimal Association," the chairman inquired if it really was an association, as it professes, to promote and fairly inquire into decimal coinage, &c., impartially adopting the simplest and most effectual of these two schemes?—and, on its being admitted that the contribution would, in truth be given to support *a mere pound and mil scheme, it was refused without even a division.* If we are ever to have a Decimal System, it requires little sagacity to see that it must begin in the simple way proposed, and that it is of incalculable importance to the world that it should not be delayed.

THEODORE W. RATHBONE.

Allerton-priory, March 1st, 1855.

## PROFESSOR WILSON'S PAPER, AND THE DISCUSSION ON THE IRON INDUSTRY OF THE UNITED STATES.

SIR,—In perusing the paper and discussion on the subject of the manufacture of iron in the United States, given in your last week's number, we are struck with the almost total absence of the details essential to form an opinion as to the respective advantages claimed for England and the Union. The discussion did not turn on practical facts, but on a mass of assertion that political economy must be in favour of America supplying us with cotton and edibles to be paid for in English iron. That coal and iron ore exist in large masses in the Union there seems no doubt, but of the respective qualities of this coal and iron, and their proximity together, of the supply of labour, rates of wages, cost and quality of human food, temperature, and other atmospheric conditions, in short, the mass of conditions of all kinds essential to cheap production, we have little save the general statement, that, west of the Alleghanies, the proximity of the coal and ore is more favourable than in Pennsylvania. Mr. Wilson gives the following statement of the produce in seven districts, and the estimate of cost—I presume on the spot:—

"1. The Houseatonic district—Production, 10,000 tons; cost per ton, 20 dols. to 25 dols.

"2. The Hudson River district—Production, 80,000 tons; cost per ton, 18 dols. to 20 dols.

"3. The Delaware and Lehigh Rivers district—Production, 120,000 tons; cost per ton, 16 dols. to 18 dols.

"4. The Schuylkill River district—Production, 100,000 tons; cost per ton, 20 dols.

"5. The Susquehanna River district—Production, 100,000 tons; cost per ton, 15 dols. to 18 dols.

"6. The Potomac River district—Production, 125,000 tons; cost per ton, 20 dols.

"7. The Ohio, Cumberland, and Tennessee Rivers district—Production, 150,000 tons; cost per ton, 20 dols.

"Besides these well-defined districts, we must allow about 100,000 tons as the production of the numerous isolated works scattered throughout the upper portions, especially of the Atlantic States, where charcoal as fuel is universally used. In these iron of the best quality is made, but at a cost of nearly double that of the coal furnaces."

I presume this is in pigs. The Houseatonic is the smallest production and the highest cost, averaging 22½ dols., or £4 13s. 9d. per ton. The Susquehanna averages 16½ dols., or £3 18s. 9d. per ton. Now, it would have been of importance to have stated the quality of the iron, and the cause of difference in cost—whether the circumstances were similar to Scotch and Staffordshire, and so on. Mr. Wilson goes on to state:—

"As long as the price of English iron prevents its importation into the Union under 20 dollars for pigs, and English bar-iron under 50 dols. per ton, the home manufacture can compete profitably with it in their markets, and the iron industry of the States will flourish and increase. Any fall in the English iron that would bring down its price in the American markets lower than the sum quoted would immediately check their home production, and again throw them on our markets for their supplies. The difference in price between the two markets may be taken at 80 per cent. This includes all charges for freight, commission, insurance, &c., about 50 per cent., and the *ad valorem* import duty of 30 per cent. In round numbers, pig iron selling at Liverpool at 45s. to 50s. will cost 20s. at New York Thus the ironmasters of the States possess a *natural protection* of 50 per cent., which will always remain, and an *artificial* one of 30 per cent., which, like all fiscal charges, is liable to be changed."

This statement is not very clear, but I presume it means, that pig iron selling at Liverpool at 45s. and 50s., will cost 20s. more in charges to get to New York, making it 65s. and 70s.

Even on this showing there would be a profit left on the cost at the Susquehanna district, from which there is freight to pay to New York; and if it be practicable to pay freight for American ores from New York, as Mr. Wilson intimates, as ballast, English pigs can also go as ballast *to* New York. Mr. Wilson's statement of the cheap rate of transit inland, from New York to Chicago, 1500 miles, for a ton for 3½ dols., is certainly remarkable—a ton carried 4½ miles for one halfpenny—but it is quite clear that this is as much in favour of English imports as American exports.

So long as the American legislature levy 30 per cent. on foreign iron, we must suppose they fancy there is a good reason for it. Either it is for revenue or for protection. If for revenue, they would get more by lowering the duty. If for protection, it is clear that their consumers are a minority in power, or they would not tax themselves for the benefit of American ironmasters.

Mr. Wilson's arguments went to shew that, in his opinion, the American ironmasters were shrewder than the English, and managed their business better; and that their wages were not higher than in this country. Had Mr. Wilson stated the wages specifically, and what amount of food and raiment could be bought with them, and had the English masters done the same, we might have been enabled to judge, and then have gone to the further inquiry how many days work a man could achieve without sickness in the respective countries.

Mr. Wilson gave a favourable description of Renton's patent process of making "blooms" direct from the ore, instead of by the ordinary process of smelting and puddling, and gave some good chemical reasons why it ought to be better, though the English ironmasters dissent from it, on the score of cost.

Mr. Campbell, of New York, gives us a statement on the subject:—

"In the United States the difference averaged about 25 per cent. in favour of the Renton process. At Newark, New Jersey, a ton of bloom was made at a cost of 29 dollars, a large portion of which was paid for the raw materials, the ore and coal being remote from the works, and subject to expensive transportation. The quantity necessary to make a ton of blooms cost about 10 dollars each, making 20 dollars, which left 9 dollars for labour and all other expenses. Of course, in localities where those materials were cheaper, iron, by this process, would be made at a corresponding reduction in cost. In reference to the manufacture of iron generally in the United States, he would remark that the prominent difficulty in the minds of several gentlemen appeared to be the transportation of the article from its insulated position to a market at the seaboard. At present, and probably for years to come, the Western States would require the largest proportion of iron consumed in that country, and the fact was overlooked that iron manufactured in the interior was, in most cases adjacent to the channels of navigation, and already half the distance from the seaboard to its destination and place of consumption in the west, while English rails landed at New York had to pass through the same channels, double the distance, and at a corresponding increase in cost of transportation. American rails were generally very much superior in quality to English, and were invariably preferred for curves, and all places requiring the best iron; and such was the desire for these rails that the manufacturer found a ready market at his own furnace for all he could produce. In reference to the inability of Americans to compete with the English in this department of industry, Professor Wilson had very properly remarked, 'that they had not the necessary capital,' and he would add, that America was comparatively a young country, with a rapidly increasing population, and a large portion of her capital was

employed in opening up channels of navigation and communication for developing the vast resources of the great west."

So on the seaboard of New York the material for a ton of bloom costs 20 dollars, or £4 3s. 4d., and on the bloom, £6 0s. 10d.; and be it remembered that a bloom is neither a rail nor a merchant bar, but needs still further cost of conversion. It is puzzling to understand why this process of Renton's is not performed direct in the Susquehanna district, to transport the blooms as rails or bars only, and save the cost of transporting the coals and the ore, with the materials of slag.

We can understand that iron produced on the spot where it is consumed, many hundred miles inland, may be cheaper than importing it from England, but there is a discrepancy between the statements of Mr. Wilson and Mr. Campbell as to transit—the former stating its cost at $4\frac{1}{2}$ miles for $\frac{1}{2}$d., and the latter complaining of "expensive transportation."

The cost of producing iron—other things being equal—is really a question of labour. If the quality of ores and coal are the same, the next consideration is the question of climate. That climate will be best which is neither too hot nor too cold, too moist nor too dry, but with sufficient variety to stimulate the body to work, and, in short, keep the human body in the most perfect state of health. It is possible, that as time runs on, an artificial climate may be produced to temper the cold of winter and the heat of summer, but as to obtaining the greatest amount of labour from men in an intensely cold winter, and with a summer of 130 to 140 Fahrenheit, it is out of the question. It is quite true that people can be found to work, for good wages, in a bad atmosphere, rather than starve in a healthy atmosphere; but, on the whole, people will congregate most where, though wages be moderate, their health is good. With a good climate, abundant food, and favourable circumstances, the numbers multiply rapidly, and, probably, were the artificial circumstances equal to the natural, there is no place in the world more favourable to population than England and Wales. The population that feeds the labour market of the States is Irish and German, rushing out of misery to comparative comfort; but the time may come when the tide of industry may roll eastward instead of westward, and it is doubtful whether the United States will then "fill up their numbers" so rapidly. The pallid cheeks of the States are more akin to the indigenous non-working red man than to the hardy, fresh-coloured industry of England, and there seems no present reason why these circumstances should change. The probability is, that the industry of the States will find employment in other things than iron, and that the industry of England in iron will go on increasing. Even supposing the climate of America favourable, it is clear that, with coal and iron almost on our sea's margin, our transit must always give us the advantage in the world's market.

In the course of the discussion it was stated that the iron and coal of America were above the water-level. If so, it is a question of machinery and cost in pumping, which may be of far less importance than an unfavourable climate and long transit.

A charge was brought against the English ironmasters of inertness in the progress of improvement as compared with American ironmasters. We think this arises chiefly from circumstances. Labour is comparatively plentiful in England, and labour-saving processes are not rapidly resorted to. But this will be less and less in future, as knowledge grows and education goes on. And if the quality of the American ores be so far superior as to pay for freight, they may ultimately be brought to the English coal and climate.

Chemically considered iron is a simple substance. In the state of ore it is in some conditions mixed with oxygen, sometimes with other matters. Fortunately for us it is not found pure metal, like gold, or it would be difficult to get it. The more numerous the ingredients in the iron ore the greater probably will be the cost of separation. If the smelting process tends to incorporate them we shall have iron from some ores inferior to that from others. It is, therefore, very important to ascertain whether Renton's process of burning away the oxygen does not enhance the cost, and also whether it be not practicable to mix other ingredients to neutralise such chemical agents as damage the quality of the iron. There is also to consider whether the process of Mr. Nasmyth, rendering the iron porous, with bubbles of steam in the puddling furnaces, is not cheaper than Renton's, and more convenient; and also whether a further process of chemical injection, by means of the steam, may not be applied. In the course of the discussion Mr. May adverted to the inferior quality of English rail iron in the present day, as compared with rails made at the commencement of the railway system, and deprecated the competition called for by railway directors. There are two circumstances to consider in this. Without competition improvement could not exist; there would be utter stagnation. With competition there needs some specific mode of ascertaining quality. Rails, as originally made, cost more than merchant bars; they were much of the same quality of iron, and required heavier blooms. The inconvenience of making a heavy bloom has to be set against the labour of reducing into thin bars of greater number. The original rails, being of light section, yielded under the pressure of the wheels, and where thus saved from abrasion. But this was at the cost of increased haulage prices. To prove effectually the quality of iron, it should be fixed on rigid supports. This test it undergoes in the tyres of locomotive wheels, for which the iron of Yorkshire is better adapted than the iron of Staffordshire, and even the best Yorkshire tyres tread out or squeeze under the loads of modern locomotives. Were the iron of rails laid as solid on the bearings as the tyres are laid on the wheels, it would be found that the rails also would tread out faster than they do at present. What is required to effect the purpose which should be held in view is, rails vertically and laterally rigid—as rigid as the tyres—and laid on such a structure as will absorb vibration. To accomplish this much heavier rails are needed than have been as yet applied, and the wearing surfaces of such rails will probably come in time to be hardened steel, representing as nearly as possible a continuous bar. But there is a limit to the capacity of even hard steel to bear weight without crushing, and sooner or later the limit of weight on wheels must be determined considerably within the ultimate power of resistance. If great weights are needed on wheels, the width of rails must be proportionately increased up to the point where inconvenience outweighs advantage. Chilled cast iron surfaces would be the best were there any mode of preventing brittleness and crumbling at the joints.

With regard to the quality of the metal in rails now manufactured, it is obvious that the sectional form must have something to do with it. If the test of skill in an ironmaster's foreman be, what proportion of cinder he can cover up with a cortex or crackling outside, it is clear that he will succeed better with a double I than with a bridge rail, as being thicker metal. The plan of putting hard granular metal on the surfaces is of very dubious utility, for it breaks away in fragments, and soft fibrous metal does not answer, for it laminates. In examining rails long in use they will be found of a curved form in their length, rising in the middle, the rolling action of the wheels elongating the upper surface. If the surface were hard enough this would not take place. If the upper surface were converted into hard steel, while the lower portion were tough fibrous iron, and the rails of sufficient width and depth, the result would probably be the best quality of rail, while the centre might be left nearly like the structure of a bamboo cane. But even then the modes of securing the rails and connecting them together would be an important consideration. If the joints be so hard as to produce a knock with the wheels,

destruction must rapidly ensue, however good might be the material. I am, Sir,

Yours faithfully,

W. BRIDGES ADAMS.

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SIR,—The discussion which ensued upon the paper read by Prof. Wilson at the last meeting of the Society, shows that there is a large degree of interest felt in ascertaining the progress of the United States in their iron manufactures. The rapid increase of population in the States—at the rate of more than three per cent. every year—the extension of railroads to distant quarters of the country, and the enormous demands for iron for general purposes, are more than can be supplied for many years to come by the home production; and we may, therefore, confidently reckon upon a profitable market in America until her manufacturing interests have made greater headway than they have yet done. A few added facts to those given by Prof. Wilson will, perhaps, be acceptable in certain quarters, respecting the growth of the iron trade and manufactures of the United States.

In 1816 there were 153 furnaces, producing 54,000 tons of pig iron. In 1845 there were 540 blast furnaces—averaging 900 tons each annually—yielding 486,000 tons; and 950 bloomeries, forges, rolling and splitting mills, yielding, of bars, hoops, &c., 291,000 tons, and of blooms, castings, machinery and stove plates, 151,500 tons, making that year an aggregate of 929,100 tons, of the value of 33,940,500 dols. (about £6,800,000). About 30,000 men are stated to be employed in iron casting—25,000 in the manufacture of pig iron, and 14,000 on wrought iron.

According to the American Census returns of 1850 there were 377 establishments engaged in the production of pig iron. Of these, 180 were in Pennsylvania, 35 in Ohio, 29 in Virginia, 23 in Tennessee, and 21 in Kentucky. The remaining States have a smaller number.

Pennsylvania, the principal iron state, has the following works in ten counties:—

| | | |
|---|---|---|
| Berks County has | 44 | Ironworks. |
| Lancaster | 30 | ,, |
| Clarion | 30 | ,, |
| Huntingdon | 28 | ,, |
| Blair | 27 | ,, |
| Chester | 25 | ,, |
| Venango | 21 | ,, |
| Columbia and Montour | 20 | ,, |
| Centre | 20 | ,, |
| Armstrong | 18 | ,, |

The capital invested in the manufacture of pig iron in that year in the States was stated at 17,348,000 dols., (nearly £3,500,000); the value of the raw material consumed, 7,000,000 dols.; cost of labour, 5,066,000 dols.; value of the entire products, 12,749,000 dols.; 645,242 tons of mineral coal, and 54,000,000 bushels of coke and charcoal were used.

In Tennessee the iron interest principally centres about the Cumberland river, and the following is a statement of the capital employed, and the produce:—21 furnaces, yielding 29,200 tons metal; 9 forges, 10,600 tons blooms; 2 rolling-mills, 4,700 tons of iron—total, 44,500 tons. Capital, 1,250,000 dols.; value of the products, 1,678,000 dols. Hands employed, 1,395 white men, and 1,810 negroes.

In the manufacture of iron castings, 1,391 establishments were engaged in 1850, employing a capital of about £4,500,000 sterling. The value of the products was about £5,000,000, 322,725 tons of castings being made. 323 works were in New York, 320 in Pennsylvania, and 153 in Ohio; the remainder being scattered in twenties and thirties in other States—Massachusetts having the next largest number, 68. The value of the raw material, fuel, &c., used was estimated at £2,100,000, including 2½ million bushels of coke and charcoal, 191,000 tons of mineral coal, 345,553 tons of pig iron, 11,500 of old metal, and about 10,000 tons of ore. The cost of labour engaged was estimated at 7,000,000 dols.

There were 422 works employed on wrought iron. The principal of these were situated in the following States:—131 in Pennsylvania, 60 in New York, 53 in New Jersey, 42 in Tennessee, and 39 in Virginia. These 422 works gave employment to a capital of £2,800,000. They made 272,044 tons of wrought iron, and used 254,500 tons of pig metal, 33,344 tons of blooms, 78,767 tons of ore, 527,000 tons of mineral coals, and 14,500,000 bushels of coke and charcoal.

The comparative imports and production of iron in the United States may be given as follows:—

| | Imports. | Production. |
|---|---|---|
| 1830 | — | 165,000 tons. |
| 1840 | 80,866 tons. | 286,903 ,, |
| 1842 | 100,055 ,, | 230,000 ,, |
| 1846 | 69,625 ,, | 765,000 ,, |
| 1850 | 441,514 ,, | 564,755 ,, |
| 1851 | 341,750 ,, | 413,000 ,, |
| 1852 | 501,158 ,, | 500,000 ,, |

In 1821, the value of iron imported into the United States was 1,213,000 dollars, and for the next ten years the imports scarcely ever reached 2,000,000 dollars in value. In the next ten years, the imports ranged from 4,000,000 to 5,000,000 dollars in amount. The imports fell off until 1848 and 1849, since which they have been largely on the increase. The values of the bar and pig iron imported in 1850 was 9,254,512 dollars; in 1851, 9,113,862 dollars, besides manufactured iron to the value of 8,183,143 dollars.

The subjoined statement, from the *United States Mining Journal*, shows the value of iron, and articles which are wholly or in part composed of iron, which were imported into the United States in 1852:—

| | Dollars. |
|---|---|
| Pig iron | 1,142,717 |
| Railroad do. | 10,650,191 |
| Manufactures of cast | 1,219,202 |
| ,, wrought | 3,460,112 |
| ,, not specified | 2,319,280 |
| Cutlery | 1,607,158 |
| Other manufactures composed of steel in part | 916,889 |
| Old and scrap iron | 311,444 |
| | 21,626,993 |

= about £4,325,400.

In the past two years the American imports of iron and iron manufactures have been even larger, and, according to Professor Wilson, the consumption of iron in the States is now fully 1,200,000 tons; of which they are dependent for one-half on the iron-furnaces of this country. Moreover, it appears clear from the general remarks of the speakers that the irregularities of climate, want of ample capital, and the great distances from market, must long prove serious drawbacks to cheap and extensive production of iron in the United States commensurate with the increasing local demand.

Yours, &c.,

P. L. SIMMONDS.

5, Barge-yard, City, March 5th, 1855.

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SIR,—As the limits of the meeting last night precluded any further observation being made on the highly interesting paper read by Professor Wilson, and as you afterwards requested me to commit to writing what I know of one of the processes mentioned in the paper, but which was not at all discussed, I venture to send you a few general remarks, such as I should have stated verbally had an opportunity presented itself. In the first place, I quite sympathise in the remarks which fell from Mr. May as to the slowness with which some iron makers avail themselves of manifest improvements, even when they have unquestionable data to go upon, in the vicinity of

their own works, as instanced in the use of the gases from the blast furnaces, whereby some firms would effect a saving of more than a thousand tons of coal per week! but, the fact is found in this, that, while prices are high, it is "make! make! get through as much work as possible"—and, when prices are down, then the plea is, that the diminished profits will not afford any increased outlay; so that any discovery, no matter how fair its prospects, is laid aside, until some one, more far-seeing and spirited than the rest, takes up the matter in earnest, and shows, by his contracts, that he is enabled by such improvements to undersell his less spirited opponents.

With regard to the new method of making wrought iron direct from the ore, it appears to possess many very important advantages—such as saving nearly all the cost of casting the ore into pig metal, that is, avoiding a large amount of engine power, the cost and carriage of limestone, and the whole paraphernalia of the blast and refinery furnaces; thereby reducing the make of iron to the simple operation of pulverising the ore and coal, and placing it in an inexpensive chamber, at the end of each puddling furnace; and there the *waste* heat is said to be sufficient to bring down the ore in a state fit for immediate balling or puddling. Surely, a system so beautifully simple in itself, combined with the no small probability of obtaining chemical changes in the iron so made of a highly beneficial character, deserves a speedy and fair trial.

Mention (only) was made of the conversion of slag into useful purposes, as carried out by Dr. Smith, of Philadelphia. Being an eye-witness to a series of interesting experiments which were made by that gentleman at the Dowlais Ironworks, a few months since, I may remark that, like the other American invention just alluded to, this is also simple in the extreme, and consists in nothing more than running the molten slag, as it comes from the mouth of the blast furnace, into rings or moulds (the same being somewhat heated), and when the slag so run is "set" sufficient to be removed from the mould, it is immediately transferred to an annealing furnace, which is kept at a bright red heat until the furnace, or oven, is fully charged. After this it is brought up to a higher degree of heat for a few hours, and then all apertures are hermetically closed, and remain in this state until the oven and its contents are lowered to the temperature of the surrounding atmosphere, or nearly so, thus occupying some four or five days in the cooling. The articles inside are then removed, and that which is, under ordinary circumstances, a weak, brittle, substance, is then found to be a strong, compact, devitrified mass, peculiarly beautiful and varied in colour, and bears a polish much superior to the best descriptions of marble. Such is, in a few words, the process referred to; to what extent it will be made useful remains yet to be seen. That *this* is important to the ironmaster, no one can doubt, when it is borne in mind that for every ton of iron as now made, there is little less than three tons of this material (some eight or nine millions of tons annually throughout the kingdom), which is not only *useless*, but is attended with enormous cost for removal and "tipping." When these things are taken into account, besides the no less important consideration that the material is to be had in the very state it is wanted (the molten state), without any cost whatever for the operation, I say it does seem a matter of immense moment whether this long-lost-sight-of material should not at once be converted to some of the useful purposes in this country to which the talented gentleman referred to has successfully applied it on the other side of the Atlantic, that is, for paving, &c.—rough cast for common purposes, and polished for halls and the like.

Should the subject be renewed at any time I shall be happy to go more into detail than the hurry of this moment admits of.

Your's faithfully,

R. DAVISON.

33, Mark-lane, March 1, 1855.

## THE SEWAGE OF LONDON.

Sir,—As the "Value and Use of the Sewage of London" is again to be discussed on the 19th inst., it may help to confine that discussion within more reasonable limits, if the actual points of difference between the two parties are briefly defined.

Mr. Chadwick and his followers attach a very high value to London sewage. Mr. Ward calls it "a mine of Peruvian guano." Mr. Mechi intimates that it is worth "half of thirty-seven millions sterling" (viz., the cost of feeding London), and compares the value of the excrement of one thousand human beings to that of one thousand sheep.

Satisfied of the fertilising elements of London sewage, Mr. Chadwick goes further, and maintains that liquid sewage is the most economical fertiliser that can be applied to any crop on any soil; that the results would produce a profit which would repay the cost of large special expenditure in machinery for distributing the fertilising liquor at the distance of 12 miles round London. Mr. Mechi hopes to supersede the use of Peruvian guano with the contents of London water-closets and the drainage of London kitchens. The holders of these opinions refer in support of them, to China, where pure night-soil is the chief manure; to the little peasant farms of Belgium, where night-soil and liquid manure are both employed with considerable skill; to the Edinburgh water meadows; to the now "piped" farms of Messrs. Telfer, Kennedy, &c.; and lastly, to the experiments recently made by Mr. Cuthbert Johnson with the soil of his house applied in a liquid form to the sixth of an acre of grass land. Finally, perfectly satisfied with these results, and with calculations that liquid sewage can be delivered at 2d. per ton 12 miles from London, the Board of Health school propose to sink a million or so in plant, and undertake the expense of pumping the whole sewage of London to the rural districts, feeling confident that it can be profitably retailed at prices which will more than repay the whole cost of plant and pumping.

Mr. F. O. Ward goes a step further, and is so satisfied of the value of the London guano that he proposes to execute a set of drains for its preservation in a pure state, undiluted by rain-fall and street washings. Every house is to have one set of pipes for its roof gutters, and another for its sinks and water-closets, while in every street the main sewers are to be given up to water only, and a new set of tubular drains are to be provided for night-soil, to be diluted with enough of water to wash it down to the reservoirs, where pumping engines are to raise it, and drive it all over the country.

Dissenting from the views of Mr. Chadwick and his pupils, are a number of agriculturists, chemists, and engineers of the first class, who agree in the desirability of thoroughly freeing London and the Thames from the pollution of sewage, but who doubt whether the value of the article will repay any extraordinary expenses incurred in pumping, &c., and who consider the advantages of concentrated portable manures like guano and superphosphate quite beyond the reach of competition.

First, as to abstract value. Mr. Lawes, after a series of most elaborate analyses, estimated the value of the excrement of London ("supposing it were possible, which it certainly is not, to separate the constituents of fertilisation from sewage"), at upwards of £700,000. But this manure, even in the freshest state, "contains 94 per cent. of water," and is forthwith diluted with water supplied by the water companies at the rate of at least 20 gallons per head, and rain-fall of 24 to 25 gallons more. So that Mr. Lawes estimates that a ton of sewage would contain nine ounces of excrementitious matter. Mr. Chadwick disputes this estimate, in which he says, no allowance has been made for soapsuds and dishwashings. If doubled, to 18 ounces, it will still be a very thin liquor,

requiring for its accommodation and conveyance vast space as compared with guano, or artificial mineral manures.

The agriculturists follow the chemist, and maintain that sewage water, strong or weak, can only be advantageously applied to grass crops; that if it can be conveniently carried to fields near London, where green crops are wanted, it may be usefully applied at the rate of not much less than 10,000 tons to the acre. The evidence against the employment of liquid manure of any kind to cereal crops, is found in the fact that Mr. Littledale, of Liscard, near Liverpool, Mr. Telfer, Mr. Kennedy, and other Scotch farmers, who have adopted liquid manure, distributed by iron pipes, for the cultivation of Italian rye-grass, have not thought it advisable to use it for corn crops or root crops on their farms. That the Lombard and Piedmont farmers, who have the use of pure dung, and liquid manure from their stall-fed cattle, to a large extent, who perfectly understand irrigation, and largely employ liquid manure to green crops, carefully refrain from applying either liquid manure or sewage to cereals, although nothing would be more easy than to turn the solid manure of their stables into irrigating channels; that the Belgians are compelled to make more use of night soil than our farmers, because of the want of those great herds of stock and flocks of sheep which all good farmers keep here, and especially because they have not our commercial advantages in concentrated manures like guano, nitrates of soda, and phosphates. Agriculturists of the first class further urge, that it would be much more economical for farmers who want liquid manure for their green crops to make it with the dung of their stalls, and the contents of bags of guano and barrels of mineral manure, with water that costs nothing, than to buy it at even 2d. per ton; for at 2d. per ton, 10,000 tons, the quantity of sewage which Italian, and Scotch, and Devonshire, and Swaffham experience tells us is not too much, the cost of London sewage, besides the expenses of distribution, would be £83 6s. 8d. per acre. This estimate agrees with the calculation of Mr. Arthur Morse, who considered, from his experience at Swaffham, that the sewage of 1,000 inhabitants, viz., at least 20,000 gallons, might be put on an acre, and would grow 65 tons of Italian rye-grass.

At this point we arrive at the engineers—I mean engineers like Mr. Robert Stephenson, M.P., Mr. Simpson, the President of the Institution of Civil Engineers this year, Mr. Bidder, and others who have devoted their lives to the study and invention of great engineering works. These gentlemen unanimously assert that the estimates of Mr. Chadwick and his friends for works, working, and repairing, are under-estimated by many hundred per cent.

It seems, then, that the only points of agreement are, first, the necessity of sending sewage out of London clear of the freshwater of the Thames; and, secondly, that sewage water applied in sufficient quantity, at proper seasons, will grow enormous crops of grass. On the points of the value of sewage,—of its use as regards the rotation crops of a farmer; of its comparative value as compared with stall, manufactured, or imported manures; the modes of collecting, and cost of distributing, there is a total difference of opinion between the agricultural chemists, the most eminent English and Scotch farmers, and the Institution of Civil Engineers on the one hand, and Mr. Chadwick and Mr. Ward, and their followers, on the other.

I confess, with great admiration for Mr. Chadwick's talents as an expounder of sanitary abuses, and an advocate, I prefer the opinions and experience of chemists, farmers, and engineers, to those of the cleverest lawyers and most eloquent authors.

SAM. SIDNEY.

Farmers' Club, Blackfriars.

## MEETINGS FOR THE ENSUING WEEK.

MON. Society of Arts, 8. *Special.* Adjourned Discussion, "On the Sewage of London."
Brit. Architects, 8. Mr. W. P. Griffith, "On the Principles to be observed in Designing Mediæval Decorations and Ornaments with reference to the sources of ornament offered by the Natural Kingdom."
Chemical, 8.
Statistical, 8. Discussion "On the Loans raised by Mr. Pitt, during the First French War, 1793—1801; with some Statements in Defence of the Methods of Funding employed."

TUES. Royal Inst., 3. Prof. Tyndall, "On Electricity."
Civil Engineers, 8. Mr. R. A. Robinson, "On the Application of the Screw Propeller to the Larger Class of Sailing Vessels."
Linnæan, 8.
Pathological, 8.

THURS. Royal Inst. 3. Mr. Donne, "On English Literature."
Numismatic, 7.
Antiquaries, 8.
Royal, 8½.

FRI. Philological, 8.
Royal Inst. 8½. Rev. J. E. Ashby, "On (so called) Catalytic Action and Combustion, and Theories of Catalysis."

SAT. Royal Inst. 3. Dr. Gladstone, "On the Principles of Chemistry."
Royal Botanic, 3¾.
Medical, 8.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 8th March*, 1855.

Par. No.
78. Statute Law Commission—Return.
98. Staff Officers—Return.
99. Committee of Selection—4th Report.
51. Bill—Lunacy Regulation Act, 1853 (Amendment).

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, March 9th*, 1855.]

*Dated 30th January*, 1855.
231. H. D. Pochin, Salford—Compounds of alumina and their application.

*Dated 14th February*, 1855.
335. J. H. Johnson, 47, Lincoln's-inn-fields—Governors. (A communication.)
337. J. Nichol, Edinburgh—Bookbinding.
339. F. B. Blanchard, Maine, U.S.—Apparatus for generating motive power.

*Dated 15th February*, 1855.
341. R. Molesworth, Halfmoon-street, Bishopgate-street—Brushes.
345. H. Spencer, Rochdale—Spinning machinery.

*Dated 16th February*, 1855.
347. W. Spence, 50, Chancery-lane—Substitutes for glass for ornamental purposes. (A communication.)
349. W. Abbott, Richmond—Boot and shoe cleaning machine.
353. F. G. P. M. V. Maneglia, Turin and Genoa—Railway carriages.
355. S. B. Wright, Parkfields, Stone, and H. T. Green, Moreton—Encaustic tiles.

*Dated 17th February*, 1855.
357. J. Wright, 16, Park-street, Kennington—Consumption of smoke.
359. J. Hackett, Derby—New fabric for umbrellas, &c.
361. J. Oxley, Beverley—Wheels.
363. R. J. Mary'on, 37, York-road—Steam engines.

*Dated 19th February*, 1855.
365. R. A. Brooman, 166, Fleet-street—Capsules for stopping bottles, &c. (A communication.)

*Dated 20th February*, 1855.
366. G. Tillett, Clapham—Bedsteads.
367. D. Hulett, Holborn—Heating, cooking, and lighting by gas. (Partly a communication.)
368. S. Bellamy, Torquay—Fire-arms and ordnance.
369. C. R. Mead, Langdale-road, Peckham—Gas regulator.
370. A. L. Thirion, Asche en Refail, Namur—Pumps.
371. H. Schottlander, Paris—Ornamenting looking glasses.
372. S. Kershaw and J. Taylor, Heywood—Carding engines.
373. J. H. Brown, 4, Trafalgar-square—Ball cartridges.
375. J. Worthly, Zoffingen—Preservation of meat.

*Dated 21st February*, 1855.
376. J. Kidd, Kildwick, near Bradford—Stitching machinery.
377. R. Laming, Carlton-villas, Maida-vale—Purification of gas and obtaining products.
378. B. Goodfellow, Hyde—Pumping machinery.
380. T. Organ and G. Pitt, Birmingham—Dress fastening.
381. G. Nasmyth, Kennington—Preserving animal and vegetable matters.
382. G. Heppel, Preston—Rotary pump and engine. (A communication.)

383. F. W. Norton, Edinburgh—Warp fabrics.
384. J. H. Pidcock, Leighton Buzzard—Propelling and steering vessels.
386. F. Prince, 3, South-parade, Chelsea—Fire-arms and ordnance.
387. W. Maynes, Stockport—Temples to be used in weaving.
388. G. Noble, Sunderland—Fire-bricks.
389. P. Prince, Derby—Patterns for making moulds for railway chairs.
390. C. Low, Bodowen, Dolgelly—Extraction of gold from its ores.

*Dated 22nd February*, 1855.

391. T. Harrison, Hackney—Composition for ships' bottoms.
392. W. Kirrage, 10, Edmund-street, Camberwell—Consuming smoke.
393. R. Mc Connell, Glasgow—Dressing textile fabrics.
394. J. Bunten and G. Lamb, Glasgow—Cutting and shaping wood.
395. P. Clarke, Manchester—Locomotives. (A communication.)
396. W. Neilson, Glasgow—Locomotives.
397. F. W. East, 214, Bermondsey-street, and J. Mills, William street, Old Kent-road—Destroying noxious vapours from bone-boiling, &c.

*Dated 23rd February*, 1855.

398. W. Hartcliffe, Salford, and J. Waterhouse, Manchester—Looms.
399. A. Taylor, 21, Duke-street, Manchester-square—Communication between guard and driver.
401. W. J. M. Rankine and J. Thomson, Glasgow—Laying subaqueous electrical conductors.
402. W. H. Zahn, 13, Norfolk-street, Strand—Windmills. (A communication.)
403. N. Bennett, 7, Furnival's-inn—Substitute for scaffolding. (A communication.)
404. J. E. Gardner, Strand—Portable cooking apparatus.
405. S. M. Allaire, Paris—Hats, caps, and bonnets.
406. B. Looker, jun., Kingston-upon-Thames—Ventilating stables, &c.
407. N. Thompson, jun., New York—Life-boats.

*Dated 24th February*, 1855.

408. V. J. Lebel, J. Fourniel, and J. B. Remyon, Paris—Typographic presses.
409. B. A. Murray, Dublin—Winding silk, &c.
410. J. H. Johnson, 47, Lincoln's-inn Fields—Fountain pens. (A communication.)
411. J. H. White, Manchester—Artificial teeth.
412. J. Player, J. P. Player, and L. D. Jackson, Winchester-buildings—Drying tan peat.
413. J. S. Russell, Millwall—Water ballast for ships.

*Dated 26th February*, 1855.

414. W. Brown, 113, Albany-road, Old Kent-road—Printing.
415. H. Martin and J. Smethurst, Guide Bridge Iron Works, Manchester—Fencing for shafts, &c.
416. A. E. L. Bellford, 32, Essex-street, Strand—Railway breaks (A communication.)
417. P. A. Merchant, Paris—Grinding mills.
418. A. E. L. Bellford, 32, Essex-street, Strand—Soda. (A communication.)
419. J. W. Spurway, 4, Monmouth-place, New Cross—A travelling pass.
420. A. Brown, Tarbet, N.B.—Paper.
421. C. H. Roberts, 3, Cornwall-road, Stamford-street—Rubbers for painters.
422. T. Nash, jun., 134, Great Dover-road—Brushes and brooms.

*Dated 27th February*, 1855.

423. W. A. Gilbee, 4, South-street, Finsbury—Alcohol. (A communication.)
424. W. A. Gilbee, 4, South-street, Finsbury—Soap. (A communication.)
425. J. Brodie, Bow of Fife, N.B.—Tongs, pliers, vices, &c.
426. A. J. Berchtold, Paris—Applying photographic engravings.
427. H. Gardner, 7, Arthur-street, Old Kent-road—Horse shoes.
428. J. Cooper, Birmingham—Joiner's braces.
429. B. Fothergill and W. Weild, Manchester—Combing machinery.
430. W. Campion, Nottingham—Knitting machinery.
431. Captain A. T. Blakely, R.A., Little Ryder-street, St. James's—Ordnance.

*Dated 28th February*, 1855.

436. J. Brickles, J. Thorpe, and J. Lillie, Manchester—Manufacture of fabrics.
438. W. Holroyd, Halifax—Fencing for shafts, &c.
440. J. Gedge, 4, Wellington-street South—Stopping railway trains. (A communication.)
442. B. W. Goode and N. Brough, Birmingham—Fire-arm.
444. E. T. Bellhouse and T. Cowburn, Manchester—Vacuum and safety valves.
446. Lieut. T. Cook, R.N., Addiscombe—Working punkas for agitating air.
448. H. Penney, York-place, Baker-street—Vulcanized india-rubber.

INVENTION WITH COMPLETE SPECIFICATION FILED.

434. J. Reddie, Anstruther, N.B.—Metal shovel. 28th February, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed March 9th*, 1855.

1988. William Nash and John Jewell, Islington—Improvements in window sashes and frames.
1990. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improvements in electro-magnetic clocks.
2001. William Bramwell Hayes, Manchester—Improvements in looms for weaving.
2007. John William Perkins, Poplar-terrace, Poplar—Improvements in purifying gas, the residuum arising from which forms a new artificial manure.
2032. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improvements in machines for drilling stone.
2036. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—A new mathematical instrument, to be termed the "Horometer," for the purpose of solving problems in plane and spherical trignometry, one feature of which invention is or may be applicable in the construction of other mathematical instruments.
2068. George Spencer, 3, Alpha-road, New Cross—Improvements in the external coverings of roofs and walls of buildings and sheds, and in the windows of such buildings and sheds.
2076. Jonathan Edge, Bolton-le-Moors—Improvements in pistons.
2139. Thomas Edwin Moore, 3, Great Titchfield-street, St. Marylebone—Improvements in machinery or apparatus for curvilinear and annular cuttings in metals and other hard substances.
2226. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improvements in breech-loading fire-arms.
2580. Frederic Jolly, Turton, Lancaster—Improvements in machinery or apparatus for mangling, stiffening, filling, and finishing cotton and other piece goods.
2610. Christian Henry Richard Ebert and Lippmann Jacob Levisohn, Old-street, St. Luke's—Improvements in the mode of rendering certain cases or receptacles extensible.
2638. Robert Walker, Glasgow—Improvements in telegraphing.
2744. James Nasmyth, Barton-upon-Irwell, Lancaster—Improved machinery or apparatus for facilitating the forging of masses of iron.
154. Charles Van den Bergh, Lacken-by-Brussels—Improvements in rotatory steam engines.

*Sealed March 13th*, 1855.

2023. James Kershaw, Bury—Improvements in looms for weaving.
2045. Henry Holland, Birmingham—Improvements in the manufacture of umbrellas and parasols.
2060. Robert McConnel Glasgow—Improvements in locks.
2089. Charles William Lancaster, New Bond-street—Improvements in fire-arms, and in cartridges to be used therewith.
2127. John Kershaw, Stockport—improvements in self-acting mules.
2134. Thomas Crossley, Scots-yard, Bush-lane—An improved mode of manufacturing printing blocks.
2141. Enoch Oldfield Tindall, Scarborough—Improvements in mangles and wringing machines for smoothing and wringing clothes and woven fabrics.
2423. James Buchanan, Glasgow—Improvements in the manufacture of heddles or healds for weaving.
2761. Thomas Slater, Somers-place West, St. Pancras, and Joseph Tall, Crawford-street, Marylebone—Improvements in the construction of planes and in cutting apparatus, and in the machinery or apparatus employed therein.
41. Charles John Edwards, junior, Great Sutton-street, Clerkenwell, and Frederick Frasi, Tavistock-terrace, Holloway—An improved manufacture of bearings for carriage axles and shafts of machinery in general.
71. John Norton, Dublin—Improvements in draining land.
79. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—Improvements in tanning. (A communication.)
100. Joseph Edlyn Outridge, Constantinople—Improvements in transmitting motive power.

## EXTENSION SEALED.

*13th March*, 1855.

10. Thomas Clark, Marischal College, Aberdeen—A new mode of rendering certain waters (the water of the Thames being among the number) less impure and less hard, for the supply and use of manufactories, villages, towns, and cities.—For seven years.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3692 | March 7. | Temple Holder for Power Looms ......... | John Elce and John Bond... | Manchester. |
| 3693 | " 7. | Reservoir Protector ......................... | S. Mordan and Co. ...... ..... | 22, City-road. |
| 3694 | " 8. | Brook's Patent Glacé Thread and Universal Thread Silk Preserver ......... | Jas. Brook and Brothers ... | Meltham Mills, near Huddersfield. |

Journal of the Society of Arts.

*FRIDAY, MARCH* 23, 1855.

## EXTRA-ORDINARY MEETING.

### Monday, March 19, 1855.

An Extra-ordinary Meeting was held on the evening of Monday, the 19th inst., for the purpose of resuming the Discussion on Mr. J. B. Lawes' paper on "The Sewage of London." Colonel Challoner, as on the former occasion, presided.

The following candidates were balloted for, and duly elected Ordinary Members :—

| | |
|---|---|
| Kite, James | Trueman, Charles, |
| Mackrell, William | Vernon, Henry |

As Corresponding Members :—

| | |
|---|---|
| Audley, Charles | Maelen, Phil. Van Der |

### DISCUSSION ON THE SEWAGE OF LONDON.

Dr. Alfred S. Taylor, in a note to the Secretary, says, "I have not given much attention to the subject lately, but Mr. Wicksteed's plan appears to me to be a very good one in many respects. It most effectually precipitates a large portion of the nitrogenous matters, and, to a very great extent, deprives sewage waters of their offensive smell. As to the fertilising properties, I think more reliance is to be placed on agricultural experiments, fairly tried, than on the precise results of chemical analyses."

Mr. Lawes said, considering the very late hour to which the discussion, after the reading of his paper on the 7th inst., was carried, he was unwilling then to avail himself of the privilege of making any reply to the remarks of the various speakers. He was not sorry, therefore, for the opportunity of offering some observations on the objections raised, which was afforded by the appointment of an extra evening for the further consideration of the subject. Looking to the manifest bearing of his paper, he must say, that he thought in the discussion the subject was looked at too much from the sanatory, and too little from the agricultural, point of view. With regard to the production of a *solid sewage manure*, he would only say, that if Mr. Wicksteed or any other person could in this way economically provide the farmer with the valuable constituents contained in sewage, he would confer a great boon upon agriculture by so doing. But Mr. Wicksteed had, under the advice of distinguished chemists, ignored chemical composition as a test of value; which, however, he (Mr. Lawes) could assure him was the test to which such productions would infallibly have to yield. Mr. Chadwick, in a long speech, in which he dealt very liberally in complaints and objections in detail, and in which he at the same time afforded confirmation of his (Mr. Lawes') views on many essential points, such as it must be very gratifying to receive from so high an authority, concluded by saying—"he had noticed the chief points in which there had been serious misapprehension, or oversights of existing information." True, the result arrived at was not attained by the aid, though certainly not in ignorance of, the "Minutes of Information, &c." Mr. Chadwick's first objection was to his (Mr. Lawes') argument, that the cost of carriage must regulate the distribution of solid manures; and he supported it by stating, that he had pointed out the same rule himself some years ago, and also by illustrating its influence in the case of guano as compared with the town manures of Liverpool. Mr. Chadwick complained, that whilst he (Mr. Lawes) showed that the carriage from London of a ton of solid manure to his farm at Rothamsted was fifteen shillings, he did not call attention to the fact, that a great many tons—72 according to Mr. Chadwick's calculation—of *liquid* manure could be brought to his land for the same money. Now, any one who had neither heard nor read his paper, would surely imagine that he (Mr. Lawes) was arguing against the use of town-sewage in a liquid form; whereas, the whole of his remarks on this cost of carriage, were intended to show that the distribution of the London sewage, in the form of a solid or portable manure, was impracticable; and that liquid distribution must, therefore, be relied upon. So far, then, his own views and those of Mr. Chadwick were perfectly identical. But Mr. Chadwick, whilst he argued that 72 tons of liquid manure could be carried for the same cost as the one ton of stable dung, overlooked the fact that he (Mr. Lawes) had shown that such was the composition of the dung in relation to its bulk, that he could not afford to carry it to his farm, even if it were given to him—and Mr. Chadwick had failed to show that his 72 tons of fluid would be of manurial value equal to its cost of carriage. On this point, he (Mr. Lawes) would, however, notice in passing, that if the 72 tons of sewage so delivered to him for 15s., were to be in the state of dilution, which existing facts led him to think it probably would be, it would contain only about seven-eighths of the average annual excrements of one person, which, allowing liberally, he had valued in the solid form at 6s.; and however ardent an admirer Mr. Mechi might be of water, he would, perhaps, agree with him (Mr. Lawes), that the extra cost of 9s. or 10s., would be paying rather dear for the solution of 5s. to 6s. worth of manure. If, however, as Mr. Chadwick maintained was possible, the sewage were four times this strength, he should get on his land for 15s. the annual excrements of 3½ individuals, worth in the solid from, according to the above estimate, 21s. Here, then, was the question. This brought him to notice Mr. Chadwick's estimates of the amount or bulk of the metropolitan sewer-water. Mr. Chadwick objected to the estimate of bulk and dilution arrived at, by assuming that, taking the increased water supply and rain-fall together, the amount of fluid reaching the sewers would give an average of 50 gallons per head per day. Mr. Chadwick stated, that first-class houses in the metropolis which had been gauged, and which were well provided with water-closets, showed a consumption of only 12 or 12½ gallons of water per head per day. Now, if Mr. Chadwick would engage to supply the farmers with liquid sewage at 2½d. per ton, in 12½ gallons of which there would be—besides extraneous matters—on the average the daily excrements of one individual of the population, he might venture to say, that he, (Mr, Chadwick,) need not be in want of customers. In this way, the farmer would get upon his land, and in the liquid form, the annual excrements of one individual of the population for a sum of 4s. 2d. But what were the facts of the case? According to a parliamentary return made last year, the supply of the water companies now amounted to 25 gallons per head per day, and they were about to increase that supply. The rain-fall, too, over the same area, gave an average, though very unequally distributed as to time, of nearly another 25 gallons per head per day; and on this point, Mr. F. O. Ward had confirmed his own (Mr. Lawes) estimate. Mr. Chadwick did not say that this was not a true statement of the existing facts of the case, but that it was an exaggeration of the *necessary* or *required* amount of dilution. He told us, that two-fifths only of the water supply was actually used in carrying off the house matters, and that the remaining three-fifths were worse than waste. The rain-fall again he ignored or invoked at pleasure, leaving out of his calculation altogether when wishing to limit the *necessary* dilution of the sewage, and calling it to his aid when he wished to add to its composition, the

soot and excrements from the roofs and streets. Mr. F. O. Ward, however, had called particular attention to the *fact*, that the rain-fall does mix with the sewage matter; and further, that it does so, so irregularly, as to introduce one of the chief difficulties in the disposal of sewer-water. And when Mr. Chadwick said, that the useless three-fifths of the water supply was worse than waste, he (Mr. Lawes), supposed he meant, that though unmixed with its due proportion of valuable manurial matter, it still had to be dealt with in the disposal of the sewage. He was perfectly willing to grant, that if, as assumed by Mr. Chadwick, the water supply could, with due regard to cleanliness and sanatory efficiency, be reduced to a regular average of 12½ gallons per head per day, and that, if, as urged by Mr. Ward to be so desirable, the rainfall could be excluded from the sewage proper, a vast step would be gained towards the practicability of usefully applying the sewage of London. It was, however, notoriously not the fact, that the public had any grounds for supposing that these most desirable objects were in actual course of progress, or, in fact, that the execution of such plans was anything more than the proposition of individuals. It was not, therefore, a candid way of treating this question, to give the aspect of authority and of foundation upon existing fact, to estimates of the *necessary* or *required* amount of dilution of sewage, based on what were at present purely ideal systems, having no reference to existing and authoritatively recognised arrangements. Until, therefore, these desirable objects were practically realised, or, at least, officially decided upon, and in course of being so, he (Mr. Lawes) was bound to conclude that his estimate of the amount of fluid to be disposed of in dealing with the sewage of London would agree much more nearly with the actual and probable facts of the case than the assumption of Mr. Chadwick. But, further than this, we had it upon the testimony of Mr. Chadwick and Mr. Ward that a large proportion of the excessive amount of water would be discharged unmixed with manurial matters, for which, he supposed, equally with the stronger sewage, Mr. Chadwick would expect his 2d. or 2½d. per ton. Again, whilst Mr. Chadwick asserted that his (Mr. Lawes') estimate of the manurial constituents which *should* enter the metropolitan sewage was too low, he at the same time admitted that, owing to the want of water-closets, and other defective arrangements, by which a large portion of the human excrements even were not properly carried off in the sewer water, it was not in a state to reason upon. But, it would be obvious, the line of inquiry of his (Mr. Lawes') paper, was to determine chemically what elements of value were at the command of those dealing with sewage, and it was their affair, not his, to see that they duly availed themselves of all that was thus within their reach. Already, indeed, the strength and quality of sewer water had become a question between the seller and the buyer of it. For, it seemed, it was only the other day that Lord Essex, who rented the sewage of Watford, sent into the town the request that it might be made a little stronger! Until, then, we were clearly informed that the constituents which *ought* to enter the London sewage would really do so, and not only what was its *necessary* and *required* degree of dilution, but what this in practice actually would be, he thought the *vis inertiæ* which had been attributed to the farmer in this matter had better attach to him even a little longer. Mr. Chadwick's next allegation was, that he (Mr. Lawes) had much underrated the manurial value of sewage in assuming that, "The chief source of its valuable constituents must be the excrements of the population." That they would be the *chief source* of its *valuable* constituents, he nevertheless maintained. He could assure Mr. Chadwick, that none of the matters referred to by him were overlooked in a consideration of this question. With regard to the house refuse derived from food, he would remind Mr. Chadwick, that in his estimate he had already allowed for four fifths of its most valuable constituents in the sewage, and that of the remaining fifth, of nitrogen at least, a certain portion remained in the body and was carried to the grave, whilst another portion was known to be exhaled into the atmosphere. By how much, therefore, of the fraction of the remaining fifth would Mr. Chadwick wish to increase the estimated value of sewage on account of the kitchen refuse that might reach it? In fact a knowledge of the proceedings of that "laboratory" would show, that a very small proportion of matters *valuable as manure* was derived from that source. The "fat" and "tallow" of sewer water, which Mr. Chadwick considered such a serious exclusion, was certainly next to worthless as manure, and he was sure, if any company were disposed to convert these matters into candles, the agriculturists would receive the residue without any deduction on that account. Of the soap, and the siliceous and alkaline matters from the streets, pretty nearly the same thing might be said. Of themselves they had little estimable money value; though as adjuncts to those constitutents which do determine the money value of manures, they were not destitute of some beneficial effects. Of the excrements of horses and other animals voided in the streets, a certain portion would also be removed in the same form in the sweepings, and the remainder, which must be a small proportion of the whole, he (Mr. Lawes) had granted would enter the sewers with the street washings. Of soot, too, the large proportion certainly was collected as a solid manure, and did not reach the sewers. So far then as to the existence, if not as to the value, of the extraneous matters in sewage, he did not differ from Mr. Chadwick. Mr. Chadwick, however, stated, that the quantity of street refuse reaching the sewers would increase with sanatory reforms. How far this would be accomplished with his (Mr. Chadwick's) supposed diminished water supply, and his total exclusion of the rain-fall from his estimates of the amount of fluid to be dealt with in the sewers, might, he imagined, be a question. The next point of objection was as to the area that would probably be required to receive the metropolitan sewage. The general conclusion to which his (Mr. Lawes') calculations as a whole had led him, and which he had stated in his paper, was, that if the metropolitan sewage were applied to grass, so far as an *à priori* judgment could be formed at all on this point, an area of 20,000 acres (equal to 31¼ square miles), might suffice for its utilisation. Now let us see how far Mr. Chadwick's estimate differed from this amount,—instead of from 3,500 square miles, which he (Mr. Chadwick) had apparently attributed to him. After referring to the experience of Edinburgh, Mr. Chadwick decided that Mr. Cuthbert W. Johnson's estimate of 38 square miles, equal to 24,320 acres, was the most applicable to the proposed conditions of London sewage, which had yet been made, and that beyond this, only a little extension to absorb surface washings, &c. would be necessary. Instead, therefore, of there being an enormous discrepancy between Mr. Chadwick's estimate and his own on this important point, the coincidence between them was somewhat remarkable. With regard to this point it was true, however, that the greatest difference of opinion did exist between the estimates of different individuals. Thus, Mr. Wicksteed, and the late Mr. Smith, of Deanston, supposed that about 150 tons of sewage would be sufficient for an acre. This, according to his (Mr. Lawes') estimate of the bulk of London sewage would contain less than the annual average excrements of two persons, and at 2d. per ton for the fluid would cost about 25 shillings. In the instance given by Mr. Cuthbert W. Johnson, the sewage was applied at a rate of that of 30 persons to the acre; this would amount to about 2,450 tons of liquid per acre per annum, costing, at 2d. per ton, more than £20 for the annual dressing of sewage. But Mr. Johnson thought that the area implied in these amounts might be reduced to one-third, and in this opinion Mr. Chadwick concurred. At this rate the annual excrements of 90 persons would be put upon an acre of land, at a cost of more than £60. Mr. Morse, again, estimated that the sewage of 1,000 persons might be

put upon an acre, which, reckoning the same rate of dilution, and the same price per ton for distribution as before, would amount to about £680 per acre! These calculations were perhaps sufficient to show what was the degree of probability that we should ever be able remuneratively to distribute the total sewage of London by a systen of pipeage. This brought him lastly to Mr. Chadwick's remarks as to the crops to which the application of the metropolitan sewage was suitable. Mr. Chadwick maintained that the experience of Mr. Pusey, Mr. Mechi, and others, of the greatly increased production of corn and root crops obtained by dissolved as compared with solid manures, and the well-known physiological fact, that no plants took up their food in the solid form, were sufficient proofs of the applicability to all crops of town-sewage. He must beg entirely to differ from Mr. Chadwick as to the legitimacy of deductions, as to the *practical* and *economical* application of enormous bulks of dilute town-sewage, from any such data. The economization of the area of distribution so as to get the greatest possible concentration of produce on a limited area of land, was surely a main element in the economical application of the metropolitan sewage. And, certainly, no considerations of the efficacy of small amounts of fluid applied at given periods of the year with special objects—whether these be the manuring of land previous to the sowing of corn, or the saving a crop during a drought—were in any way admissible in this question, in which was involved the disposal, not of a limited and discretionary, but of an enormous and constant supply of fluid with a capital-outlay equally great for the distribution, whether of a large or small amount. For, it must be evident, that the amount of liquid which could with advantage be applied to land under corn, &c., and the periods of the year of its application, were such crops to any great extent relied upon, would be, as compared with those of *permanent grass*, so limited, that, therefore, the capital-outlay in pipes, or otherwise, must necessarily be much less remunerative than in the latter case. And, it was for similar reasons, that as Italian rye-grass implied a return to tillage, the cultivation even of this enormously rapid grower under liquid manuring, would not seem to offer so permanent and constant a demand for the sewage over a given area, as the less productive but permanent grasses. How far, however, a judicious interspersion of land under other crops than permanent grass might prove advantageous, for the purpose merely of absorbing the sewage during periods when it might not be applicable to the latter, was another question. But there was another point in connection with this subject to which he would particularly call attention, and which strikingly illustrated the desirableness of infusing a little of the experience of agricultural chemistry into estimates of the area and crops to which town-sewage was economically applicable. Mr. Chadwick took exception to the application of data derived from experiments with solid manures, for the purpose of deciding the comparative value of different substances; for, as he said, the constituents of manure were known to be taken up by plants only in a state of solution; and, further, that a given amount of them produced a much greater effect when applied to the land in this form. Now, how were these principles relied upon in Mr. Chadwick's, he thought judicious, limitation of the area for the application of liquid sewage to about 25,000, or we would even say 30,000 acres? And still further, how were they exemplified in his inclusion in that area of any considerable breadth of corn? According to his estimate of the human excrements alone—which, however, Mr. Chadwick said was too low—the average amount of ammonia per acre, if the whole were put upon 30,000 acres, would be about 800 lbs. per annum! He (Mr. Lawes) had already said, that about half a cwt. of ammonia was an ordinary artificial dressing for a corn crop; and certainly twice that amount, even if applied in the solid form, was more than the average of our soils and seasons would bear, without over luxuriance and the crop being laid. How would it be, then, if even this amount only were applied in the liquid form? But Mr. Chadwick, who so strongly urged the vastly greater efficacy of the liquid form, would either apply in that way seven or eight times as much as the crop would bear of the solid manure, or an equal cost in pipeage must be incurred for the application of one-tenth or less of the amount of sewage appropriated to those portions of the area under grass; in which case, a proportionally larger share of fluid must be deposited upon the latter. Upon a full consideration, then, of all that had been advanced in the discussion of his paper, he could not but repeat his opinion, that under the system of sewage management, which was as yet held out to us as probable, and with our present knowledge and experience of the use of liquid manures, a liberal distribution of the sewage on grass was the most promising means of attaining an economical result—and that, although the inhabitants must be charged for the removal on sanatory grounds, yet that they might demand that the cost should be lessened by a proper application of the sewage.

Professor Way begged to thank the Council of the Society of Arts for the opportunity thus afforded him of expressing his opinions on this very important subject, and also for the opportunity of which, owing to the lateness of the hour to which the discussion on the former occasion extended, he could not avail himself, of saying how much the agriculturists of this country, and those who devoted their attention to the science of agriculture—how much faith they placed upon the conclusions to which Mr. Lawes arrived. Everybody was acquainted with the great pains and trouble which Mr. Lawes and his able coadjutor Dr. Gilbert, had taken at Rothamstead, to establish the principles of agricultural science; and, therefore, it was with very great satisfaction that he heard the opinions of that gentleman on this subject. He should say also, from his own experiments on this subject, that there could now be no doubt as to the composition and value of sewage. Mr. Lawes had arrived at the same results which, by a different road, he (Professor Way) arrived at some two or three years ago—that was—in determining the value of the sewage by a direct reference to the composition of the excrements, and within a very trifle the results which he had arrived at agreed with those of Mr. Lawes. Mr. Lawes had found that 2 ounces of solid matter were daily ejected by each individual of the population—taking males and females and people of all ages and classes together; and that three and-a-half tenths of nitrogen were ejected in the same matter. He (Professor Way) found it to be $2\frac{1}{4}$ ounces as against Mr. Lawes' 2 ounces of solid matter and $\frac{34}{100}$ths of an ounce of nitrogen, which within a minute quantity, agreed with Mr. Lawes' results. He thought, therefore, the question of the average composition of sewage water was set at rest, and that so far the subject was exhausted; for when two persons came nearly to the same point by different routes, he thought it might be considered that they had arrived at truthful results. If, therefore, he agreed with the data of Mr. Lawes, he could not hesitate to agree also with the general conclusion as to the gross value of sewage water. He also agreed with Mr. Lawes, that solid manure could not be profitably made from sewage. He regretted to have to state an opinion of this kind, when adverse to the interests of the many persons engaged in trying to make solid manure from that source, but at the same time he thought it did not become any one whose opinion was of any weight at all, to allow people to go on with those schemes when their success was opposed to all knowledge and experience on the subject. He therefore said unhesitatingly that any existing plan for the production of solid manure from sewage water, would be a failure. He said this from a knowledge of the fact, that of the valuable matters contained in sewage water, nine-tenths exist in a liquid state, and these could not be separated by any known process of filtration, nor could they be precipitated by any substance which they had at present at command. They could not adopt any system of simple infiltration with

sewage water for these purposes, because it would not filter unless previously treated. The method proposed by the use of lime, enabled it to be filtered to a certain extent, but it threw down little or nothing but what was in suspension, and the matters thrown down from solution were in so small proportion, that if they could filter without lime, they would get a more valuable product. That these plans were good in a sanitary point of view, by dispolluting water that was before offensive, and cleansing to a certain extent the water-courses, could not be denied, but at the same time it would not produce a profitable manure. The quantity of lime required to neutralise the carbonic acid of the sewage was very great, and this being mixed with the product so obtained, materially reduced its value. Again, if the solid substances were collectable without the use of lime, the manure would not even then pay. The carriage of a cheap manure was obviously the same as that of a dear manure. Guano, for which they were paying £10 a ton, they could take into the country at a cost of not more than ten per cent. of its value, but this same cost of carriage would amount to 100 per cent. on the value of a manure costing £1 per ton, and the farmer could not afford that. The tendency was very properly now to increase the value in a given quantity of manure. If it was £30 per ton so much the better, provided it contained the same value as could be supplied by £30 worth of other descriptions of manure. Taking it for granted, then, that sewage must be supplied in a liquid condition, there were two principles to be borne in mind. He had not the same pretensions as Mr. Lawes to speak of the practical application of such a subject, because a chemist could only state his opinion upon theoretical grounds. At the same time it was the bounden duty of the chemist to point out the object to which people should direct their attention; that was—what was the utmost limit of success that theory promised, and it was then for the engineer and practical agriculturist to come, as nearly as might be consistently with economy, to these results. There were, he had said, two essential principles to be considered in the application of sewage. One was that the proper place for its application was not necessarily or usually the land to which it naturally flowed. In nine cases out of ten these were heavy clay lands, which did not require sewage. If well drained they would be naturally rich lands, and if not drained sewage could not be applied to them. But the lands which required sewage were those high-lying, or comparatively high-lying, lands, in which there was a fair admixture of sand and gravel, which would take in the sewage and allow it to pass through. He did not mean to say any sandy soils, but lands of a medium character, which benefitted by manure of all kinds; and, therefore, he said that they should endeavour not to go to the natural outfall, but to produce an artificial outfall, if that could be done at a moderate and reasonable amount of expense. It was the proper plan to pursue, and in so doing a more extended area was obtained for the deposit of the sewage. It had been stated in the course of this discussion, and he had elsewhere been informed that the pumping of a quantity of 80,000 gallons of water could be done for a shilling, raising it 100 feet in height. This was stated in one of Mr. Chadwick's reports. Now, if every person consumed 25 gallons of water per day, that would amount to 9,000 gallons a year for each individual. If the urine and fæces of 10 people were put upon an acre of land, 80,000 gallons would represent that quantity. These 80,000 gallons would be raised to the higher level of 100 feet at the expense of one shilling, and if twice or thrice that quantity were allowed, 2s. or 3s. only would be the additional cost of manuring an acre of land at a high as compared with a low level. He, therefore, would say, let it be their object to seek the high-lying land. Then he would say again, a great and an increasingly acknowledged principle was, that they should manure the land and not the crop It was not necessary, even in the case of liquid manure, that the crop should be on the land when the manure was applied. He believed there was abundant practical experience to show, that liquid containing manuring qualities produced its effects twelve months after its application, although it might be supposed to have run through before the crop was put on. But they had independent evidence of that fact, and here he must be allowed to refer to his own investigations upon this subject. He had found that soils removed nearly every particle of manuring matter from solutions which were filtered through them, allowing the water to run away and leaving the fertilising properties in the soil, and this proved that liquid manure might be applied to the soil without fear of losing the fertilising substances which it contained, although no crop was on the land at the time, a view of the subject which tended very widely to enlarge the opportunities for the application of liquid sewage manure. It was not necessary to be applied to the crop on the land, but they might take advantage of any favourable opportunity that presented itself for putting the sewage on. It was not for him to say to what description of crops sewage could be most profitably applied. All he said was, they ought to apply it to the land, rather than to the crop when it was on the land. He thought at present that principle was not properly understood. He would say a few words as to the quantity to be applied per acre to land. He thought Mr. Lawes' estimate was excessive. He had said 10,000 tons of sewage ought to be applied per acre. This amounted to something like the excrement of 100 people; now if they made a calculation of the quantity of solid mattter which 10 people would supply, they would find this would amount to twice the value of a good dressing of manure—that was, 10 people would, in a year, produce the ammonia and other matter equal to the fertilising value of between 5 cwt. and 6 cwt. of guano. He believed that manure was more effective in a liquid than in a solid state; and if they put on, as Mr. Lawes suggested, manuring matter equal to two or three tons of guano per acre, it would be wasting manure and doing harm rather that good. He repeated, he thought Mr. Lawes' estimate of the quantity per acre was much too high, and he thought it was a duty to the agriculturists to show that the sewage of a town could be profitably applied to a much larger area.

Mr. T. Scott said, in moving the adjournment of this discussion on the previous evening, his object was not so much to propound any views of his own on the sewage question, as to afford some legitimate representatives of the rural interest, if he might so speak, a fair opportunity of stating the views they at present entertained on this very important matter; for up to the close of the late meeting, it appeared to him that the professional engineers and official sanatory and sewage commissioners had it all their own way. Much of this question must undoubtedly be left to the investigation and decision of those gentlemen, but not all, although some of them, as in the case of Mr. Chadwick, had devoted many valuable years of their lives to the consideration of the subject, and it could not be said of him as it was of Lord Palmerston when Home Secretary, "that, while his *mind* was in the London sewers his *heart* was on the Danube;" for the ex-commissioner of health appeared to dote upon those subterranean streams, and to be desirous of capping his reputation as an agriculturo-sanatory reformer by securing the embryo wealth they were thought to contain! Now what this wealth consisted of had been carefully ascertained by Professor Way, and amply illustrated by Mr. Lawes, and the result appeared to show that five-sixths of it was held in solution, and one-sixth in suspension. This also was the case of the Edinburgh sewage water, according to Professor Anderson's analysis, which, however, must be noted as much richer in the elements of fertility; and this analysis confirmed the results of Professor Way and Mr. Lawes' investigations, if any confirmation were required. Now, as there was no *absolute fixer* of ammonia and of the other valuable

elements thus held in solution, enabling us to secure the above five-sixths of volatile matter in a solid or sedimentary state, and then letting the pure water go free, a pretty general unanimity of opinion was becoming prevalent in favour of appropriating the *whole sewage of London* to irrigation. When we saw the enormous cost of engineering works and material for *precipitation*, and the inferior article principally produced, namely, 60 per cent. of carbonate of lime, or chalk, this feeling was intelligibly accounted for. No one, however, had as yet ventured even to shadow forth a plan on which this theory was to be carried out in practice, and it, therefore, appeared premature to launch so much recrimination as had been done against those, the business of whose lives was *remunerative farming*, for not accepting that which had never yet been put within their reach. As a practical agriculturist, farming land mainly for profit, he differed with Mr. Lawes and with a similar sentiment contained in a letter he held in his hand from Mr. Telfer, of Ayr, as to the propriety of forcing crops up to a point at which they became injured; but he was quite willing to use manure up to the highest point at which it was profitable. He at the same time was ready to admit, and had good data for believing, that ten times the present expenditure of manure could be profitably employed, if it could be obtained in any shape at the standard price of pure super-phosphate of lime, or guano. As one who, along with Mr. Skirving, of Liverpool, used the first handful of guano brought to this country, and afterwards purchased it at £26 a ton, he thought he might venture to say this much from his own conviction of the value of genuine manure. Mr. Mechi said that sewage manure could be profitably applied to cereal crops; we had no precedent, however, for such a doubtful practice except on a very limited area of light soils in this country, or in the rice swamps of Italy, India, and America; in fact, the great desideratum in connexion with cereal crops here was how to *stiffen* and support the straw, not how to turn it into a weak aquatic reed. Just ask any farmer—he would not even stipulate for an intelligent farmer—but one possessed of only the ordinary instinct of his kind, if he would like to have the fall of rain over his wheat-fields throughout the year, doubled or quadrupled, and you would have a sound solution of the problem as to applying liquid manure to wheat crops generally. Few of us would like to miss Mr. Mechi's presence from these meetings, and from Tiptree farm at his annual gatherings, but if he persisted in the practice of applying liquid manure to grain crops, his legitimate field of operations was not Essex, with its 130 rainy days in the year, but Italy, with its 38 (see Capt. Baird Smith on Italian Irrigation), or even the arid sands of Sahara. In these countries it was a question of *irrigation and a crop*, or, *no irrigation and no crop*. This, however was seldom the case with us in this country, and it, therefore, appeared to him superfluous to adduce the case of Italy, and other countries, with their comparatively rainless climates and arid soils, and where no parallel circumstances existed. The nature and appropriation of the soil, too, was so entirely dissimilar, that he thought he should do best to confine his remarks to what existed, or was proposed to be carried out at home in connexion with sewage irrigation. The lowest estimate of the quantity of land required for the London sewage was made by Mr. Lawes, and amounted to 20,000 acres. He, at the same time, confirmed the all but universal opinion, that grass, either natural or artificial, was the only crop to which liquid manure could be profitably applied. Now, although London was surrounded by grass lands, he could not see that this 20,000 acres could practically be obtained out of a less area than 40,000 acres, or upwards of 60 square miles of land—being a larger area than that on which London stands; (and here, within parenthesis, he would say that the Italian irrigation was nearly always applied to land under alternate husbandry.) The first question that occurred was how this immense tract of land for irrigation was to be obtained; were the owners and occupiers voluntarily to combine to take the sewage, or were they to be compelled under an act of parliament? He confessed this staggered him. Again, if the sewage at the rate of 10,000 tons per acre, as proposed by Mr. Lawes, was thus concentrated on a single district, would not the nuisance created be greater than that now existing in the Thames? Surely, if we were to pay for its removal, we were not to have an equivalent elsewhere. Why, residential property for miles around would be depreciated in let-able and fee simple value, and its owners would indite the nuisance, as would all passers by, whether by road or rail—and who would answer for the consequences? Who would justify the scheme to the general public, who have no interest in getting cheap, bad milk near town, when they could by rail get better from a distance. It would be seen, by a letter he should presently read, that two eminent men, Dr. Sutherland and Professor Simpson, of Edinburgh, had reported against the fœtid irrigation of one of the newest water meadows near that city, and that medical men had condemned the milk. If, on the contrary, it was attempted to apportion out the sewage of London in driblets over a wider expanse of country, Mr. Lawes had shown that it would *not pay*, and the chairman had confirmed his calculations. When Mr. Chadwick said that it could be delivered at a distance of 10 or 15 miles from London, and 150 feet above the level of the discharging sewers, at 2½d. per ton, he surely never meant that it was to be spread over the land—which was the principal item of cost—at that rate; if so, many individual occupiers of light land could apply the sewage with advantage, but not even *then* at the rate of 10,000 tons an acre, as suggested by Mr. Lawes, which, at 2½d. per ton, would cost £104 3s. 4d. an acre. It could be used more sparingly, however, and no doubt with a profit to many crops. He had been in the habit, for 5 or 6 years, of sowing upwards of 100 acres of turnips annually with Chandler's liquid manure drill, using about three tons of water or 672 gallons per acre, with signal success; but he never could get it distributed at less than about 6s. per acre, nor did he expect to do so, though this was nearly ten times Mr. Chadwick's price. He agreed with Messrs. Chadwick and others, that Mr. Wicksteed's estimates of cost for trunk drains and pipes for irrigation, were extreme—as also his estimate of land required, and which might, to some extent, be accounted for by his being an advocate for solidifying the sewage ingredients. He had, therefore, taken the figures of those who preferred irrigation. Mr. Lawes valued the ingredients in the sewage of London at £774,525, and Mr. F. O. Ward calculated the water with which they were carried off, at 90 millions of tons. Now, if all this sewage was to be applied annually to 20,000 acres of land, we should have 100 inches deep over 60 square miles. Imagine such a putrid sea within sight of the largest and most condensed mass of human beings in Europe, and then say if such a thing was likely to be tolerated. Edinburgh, with its 600 acres, was bad enough in sultry weather, as he had personally experienced; but what was it to this! Then take the case of Edinburgh as to the effect on the animals fed on sewage grass. Mr. Stevenson, the author of the admirable prize essay on the Farming of the Lothians, lately published in the "Journal of the Royal Agricultural Society" wrote him:—"Since *pleuro-pneumonia* became so prevalent, the loss from this disease in the Edinburgh dairies exceeds all belief. During the first year or two, the veterinary surgeon was called in; but as cures were seldom effected, the butcher has taken his place. The loss has been so great that many cow-keepers have been ruined. It is rather suspicious and against the system of feeding with irrigated grass, that Mr. Telfer, at Cunningpark, has been losing an immense number of cows, and the ventilation of his cow-houses cannot be surpassed, and cleanliness is most scrupulously observed. It is quite understood here," (Edinburgh), "that the experiment at Myre-mill has been anything but profitable; and Mr.

Huxtable has, we believe, partly relinquished the practice. (Authority, Lavergne, the French agriculturist.)" Then as to the special case of Mr. Telfer, a gentleman wrote:—"So great a nuisance is Cunning-park that we have felt the most offensive smells near "Alloway Kirk," distant a mile and a half. We advised Mrs. Begg, Burns' sister, to indite him for a nuisance. This she declined doing; but we believe that other parties have been threatening a process of this kind." Another correspondent in Edinburgh, on whom he could rely, said:—"The meadows being very near the town (Edinburgh), and being irrigated so frequently as to produce three or four crops of very rank grass in the course of the season, were considered a very great nuisance by the inhabitants in this neighbourhood, and it was considered a great benefit to the city, generally, when the improvements connected with the Queen's drive, &c., led to the practice of *so* irrigating those nearest town, being done away with. In hot weather, and in certain winds, the smell from these fields was intolerable, and the grass had the thick, rank appearance of the grass of a crowded churchyard. The smell, and their insalubrity, affected the rents of the houses exposed to their influence. As to the effects of grass produced by them on the milk or meat of cattle fed with it, I can only say that the general impression on the part of the public was very much against such milk and meat." Another competent witness, and one who had assiduously laboured for the best interests of agriculture, Mr. William Wallace Fyfe, stated, in a letter to him:—"The Edinburgh cow-feeders compete for this foul produce of the irrigated meadows; but any one who has seen the interior of an Edinburgh cow-feeder's establishment (and I visited most of them during the prevalence of pleuro-pneumonia some years back), would not be astonished at his adopting anything artificial in his economy, which is all eminently abnormal." "It so happens that the parts of the meadows best adapted for this kind of irrigation are those least liable to exception. Much of it has been reclaimed from the sea, and has *not a human being living on it, or near it.* A still larger expanse has, perhaps, as many as *two houses* within its pale, and *very few near it*—and this is the only sort of solitude where it seems tolerable to introduce the foul-water irrigation. The Government, I may add, for the protection of Holyrood Palace, once questioned this right of foul-water irrigation (unsuccessfully) as injurious to health. The owners answered in behalf of 3,300 cows in Edinburgh, and 600 in Leith, mainly dependent on the meadows for subsistence, that the irrigation was absolutely necessary for the supply of milk and butter to the city." "A poor woman near where I lived had sent round her *fourteenth subscription list*, before I left Edinburgh, for *the death of her fourteenth cow*, and her supporters preferred setting her up in a greengrocer's stall to sanctioning a *fifteenth* death. What her mortality was on a small, that of many of those artificial feeders enjoyed at that time on a large scale." One more witness, and he had done; this was the agent for Scotland for the Agriculturist Insurance Company, which lost so much by insuring Edinburgh cows in 1845 and 1846, that they declined to insure this stock for several years; and, being himself an auditor of that company, he (Mr. Scott) had examined the books, and found the loss, out of 563 cows then insured, greater than in any other locality. Mr. M'Min wrote:—"I am decidedly of opinion that the grass raised on watered meadows around Edinburgh is hurtful to the cows fed upon it. Their constitution is so weakened that they cannot resist the effects of disease when attacked, and the result is, that the proportion of loss in Edinburgh cannot be less than 20 per cent. This loss cannot arise from the confinement in the town byres alone, but also from the food on which they are fed. The grass does not give flesh, but large quantities of thin bluish milk. When disease seizes the animals during the season in which they feed on grass from these meadows, *a day's illness reduces them to all but a skeleton.* From this, I would say it has a tendency to destroy the constitution of the cattle, unless mixed with food of a more substantial kind. I am as satisfied also that the milk cannot have the same good effects on those who use it, as milk from a country dairy. Shortly after I came to Edinburgh in 1849, and after I had carefully examined the state of the cows here, their housing, and manner of feeding, I would not use the milk in my family, but got a dairy opened, and had the milk brought by rail from the country. That dairy has succeeded very well, and *I understand that a good many of the principal medical gentlemen in town now use the milk there in preference to the other dairies.* This fact strengthens my opinion that town milk is not so good for use as country milk, where cows are fed on the common farm produce. I am not, however, aware whether it generates disease in those who use it, but I cannot see how milk drawn from unhealthy and unsound animals can be beneficially and safely used. In the summer season and in sultry weather the atmosphere around the meadows is far from pure. At every cutting of the grass the canals with which the meadows are intersected are opened or shut, as occasion serves, upon the cut portions. The sediment manures the root, and the damp land, when the canals are shut, being acted upon by the sun and air, renders the place unhealthy. *The Town Council has frequently discussed the matter*, but nothing has been done to remedy the evil as yet, although no doubt there will. The effluvia arising from the meadows was the cause of discussion and ground of complaint. Had I had time, I would have called upon the late Lord Provost, who took a great interest in this matter, and I doubt not he would have enabled me to lay before you such information as would have been of use. In the Transactions of the Highland and Agricultural Society for last year, we found Mr. John Barlow, W.S. Edinburgh, stating, "go into Edinburgh byres, and you immediately hear cattle cough, and the dairyman says, '*it is quite natural.*' When cattle first come in from the country they do not cough, but it comes on quite soon enough afterwards." These were the opinions of men in the east of Scotland. Now, he had one letter from a large rent-paying occupier on the Duke of Argyll's estate in the west, and with which he was familiar, having resided as his grace's agent upon it, and he stated that irrigation and house feeding were supposed to destroy the procreative powers of cattle, and added, "The irrigation works in Ayrshire are looked upon by practical farmers and good judges with great suspicion, *i.e.*, Messrs. Kennedy's and Telfer's. Mr. Ralston's is upon the gravitation principle, and is most admired, *and considered the most profitable.* Indeed, the others are considered to be the reverse, even though Mr. Telfer sells his milk at 6d. per Scotch pint; but no one can say, without seeing the honest balance-sheet." In justice, however, to Mr. Telfer, whose extensive and exact knowledge of the sciences of chemistry and physiology, and love of their pursuit, had, he had little doubt, been the main instigations to him to undertake his wonderful operations to illustrate "agricultural possibilities," at Cunning-park, and with the purest motives to instruct and not mislead—in justice to him, he (Mr. Scott) should read part of a letter to himself, dated the 14th inst. That gentleman said, "I have hurriedly read Mr. Lawes paper, delivered at the Society of Arts, and agree with him in what he says about the advantage of manuring up to the point at which the plant is injured in its growth. It is better to put a large *quantity* of manure on a small area, than a limited supply on a more extended surface, or, if you choose, better to waste manure than land. I have been acting on this view in the growth of Italian rye grass, and with most satisfactory results. I believe I could put the whole liquid of my 48 cows on one acre of Italian rye grass, not only without doing injury to the plant, but with a decidedly more profitable return than if applied to a larger area." It must not, however, from this be supposed that Mr. Telfer would be able to feed his 48 cows off the acre so manured, for he saw by a report of

the Board of Health, that he had *always* been under the necessity of purchasing not only foreign cake, but home grown corn and hay to sustain his cattle under his present system. But even if this irrigating system were found to be desirable and remunerative, the cost of carrying it out, generally, would absorb more than all the surplus capital of the kingdom. Take the case of the Duke of Portland, and who could imitate it by sinking £39,000 on 300 acres. But this proof was entirely wanting up to the present time, and we had as yet no pecuniary inducement, and certainly no sanatory one, to adopt the system, and, after banishing the ague by drainage, to bring it back by pestilential irrigation! How to render town sewage available to agriculture, remained one of the most urgent, but he feared unsolved, economical problems of the day, and the offer of £1000 for its solution, by Mr. S. Brooks, of Manchester, remained unclaimed. But the discoveries that science had made during the last few years, left no man at liberty to dogmatise of the future. In the meantime, he would venture to suggest that a Commission of two first class practical agriculturists, aided by a competent chemist and a hydraulic engineer, might be sent to examine the sewage of continental towns to see how it was disposed of, and if used, to ascertain the results. Until something of this kind be done, we must, he thought, be content to obtain for agriculture from our cities only such solid matter as blood, and, in many cases, night soil, as we could intercept from the sewers, and which the Sanatory and Sewerage Commissioners might much facilitate; and, afterwards, we might intercept the sediment by an inexpensive process, which he purposed recommending to the notice of the Commissioners. Our present information led to the conclusions, 1st. That precipitation produced an inferior manure, and would not pay for preparing; 2nd. That open-drain, foul water irrigation would not be tolerated; 3rd. That underground pipe irrigation was unsuitable for either low or elevated *clay soils*, was doubtfully remunerative *on any*, impracticable on a large scale, and would create an indictable nuisance; 4th. Intercepted solids and settled sediment, inexpensively obtained, seemed, then, the only residue we could secure out of this mine of liquid wealth. It was a *scientific* mistake to suppose that this water, or any kind of manure containing by analysis, the elements of fertility required, was, *per se*, adapted to all soils; for in many cases we required to alter the mechanical texture of the soil by *bulk*—hence sewage as rich as that of Edinburgh, might injure a clay soil, whilst the poorest solid manure might produce a beneficial effect. In the stewartry of Kirkcudbright he had seen land where, after the stones had been gathered off the land, it became unmanageable and unproductive, and these had to be restored to their original bed. And in Kent, he had seen land, on Sir Percival Dyke's estate, where flints were obliged to be brought back, for the same reasons, after having been sold for road metal. So, after all, the bulk of Mr. Wicksteed's precipitated manure might constitute its chief value, and thus *practically* modify the theory of the analytic chemists. A few experiments would shortly prove this, and it was to be regretted that we had no national experimental farm where such experiments could be made, and reliable results obtained.

Mr. Caird considered the conclusion which the preceding speaker had arrived at, regarding the alleged unwholesomeness of grass produced by liquid manure, to be without adequate foundation. Pleuro-pneumonia affected cows fed in every way. It had, no doubt, been most virulent in towns where the stock were crowded together and the air was foul. But on farms he had seen it equally fatal, whether the stock were fed on artificial grass or natural grass. The great importance of this question was shown by the elaborate calculations of Mr. Lawes, that the excrementitious matter of the population of London, if all collected, would yield manure equivalent to the production of 600,000 quarters of wheat, which was equal to the whole wheat produce of Scotland. The ammonia would be equal to that yielded by 40,000 tons of guano, or one-fifth the annual importation of that substance, and worth upwards of £400,000. It seemed to be generally admitted that, with our present knowledge, it was impracticable to make a solid manure of high value from sewage, and the plan hinted at by Mr. Ward, of separating the valuable portion from the rain-water, might be open to the fatal objection of so rendering the small sewers detrimental to health. Any result of that kind would be infinitely more injurious than even the total waste of the sewage under the present system. The conclusion seemed to be that the sewage of London possessed no money value except as a liquid manure. He was not aware of any facts yet published which showed that value satisfactorily. The Report of the Board of Health, so far as he could recollect, gave many instances of the advantage of farm sewage, but not one of London sewage; and the case of Edinburgh was not in point, for that was a system of irrigation *en masse*, nor could that adduced by Mr. Morse, of Swaffham, (though a very valuable fact) be deemed conclusive as to London. If we took Professor Way's estimate of the solid and liquid excrements contained in London sewage, we found it to be 1 in 1,400. If that *one* was equal in quality to Peruvian guano, then 140 tons of sewage would supply as much manure as 2 cwt. of guano, with the water to wash it in besides. Now this quantity, at the price mentioned by Mr. Chadwick, 2d. per ton, costs almost exactly the same money as 2 cwt. of guano, viz., £1 3s. 4d. But the water itself was of very considerable value to a grass crop in the dry months of summer. In Ayrshire, Mr. Morton told us that the use of 100 tons of water an acre in washing in guano, was found to give two cuttings, instead of one when the same quantity of guano was applied dry. Was the *one* then in sewage equal in value to the same weight of guano? That was a point to be determined by analysis and actual trial. If it could be satisfactorily proved, there could not be a doubt of the agricultural benefit to be derived from London sewage so applied. Even should it be of somewhat less value, the water in which it floated might make up the difference. Mr. Pusey had shown the enormous produce his meadows in Berkshire yielded by the application of water alone. We all knew the value of a shower of rain in dry hot weather, and if we had the power of throwing on something better than rain when we liked, it would be well worth paying for. But it might no doubt be said, why not use the water which you would get for nothing on your farm instead of paying for it? He had no doubt that this might be done occasionally with great advantage in washing in guano to Italian rye grass, but it could not be done for nothing. In a trial which he had made with horses, water barrels, and tank, he found that to pump, carry out, and apply liquid at a distance of only 120 yards, cost 2½d. a ton. Now sewage, at 2d. a ton, must be cheaper, for if guano paid to be washed in with 100 tons of water, you had the cost of the guano—

| | £ | s. | d. |
|---|---|---|---|
| Two cwt. at 11s. 6d. | 1 | 3 | 0 |
| Cost of applying 100 tons of water by water-cart, at 2½d. | 1 | 0 | 10 |
| | £2 | 3 | 10 |
| Against 140 tons of sewage at 2d. | 1 | 3 | 4 |
| Showing a saving by the use of sewage of | £1 | 0 | 6 |

Let it be proved then by actual experiment that the *one* of sewage was equal in its effects to guano, and there would be an abundant sale for it anywhere within 10 miles of London, provided you could deliver it from hydrants in the farmer's field at 2d. a ton. The position of the metropolis and other large towns was highly favourable to the use of this manure, for, within a circle of 10 miles, the land would be found to be chiefly under grass and market gardens, to both of which it might be applied with peculiar advantage. And when gentlemen spoke of the danger of using so large a quantity of liquid to crops, it was not considered that Italian rye grass under this

system yielded five crops in a season, and could, therefore, absorb with advantage a much larger supply of liquid than a single corn crop. He thought the solution of the question now rested with the engineer. If the engineer could construct his works so as to deliver sewage in the farmers' fields for 2d. a ton, the point was gained. For even though the water had but a very small portion of actual manure, who would not, as he had already said, gladly pay for an abundant supply of water at certain seasons? An inch of rain in the end of May might save the hay crop, and at 2d. a ton this could then be had at a cost of 16s. 8d. The advantage of the water drill was well known in the south; now the timely application of a quarter of an inch of water, at a cost of 4s. 2d. an acre, might make the difference between success and failure in starting the turnip crop. But do not let them blame the stolidity of the farmers, as had been done by a speaker in the previous night's discussion, for any part of the failure of this system hitherto. It was quite a mistake to suppose that, as individuals, the farmers were averse to the introduction of improvements, or unable to comprehend their value, or to appreciate their own interests. Let the gentleman who thought them so simple try them by dealing with them. Look at the rapidity with which they adopted guano as a manure. In 1841 it was scarcely known. In 1845 nearly 300,000 tons, at a cost of two millions sterling, were used by the farmers of this country. Prove to them, as clearly as guano had proved itself, that you could give them a valuable manure for even less money, and you would have a demand larger than you could supply.

Mr. Mechi observed that allusion had been made to the effect the sewage treatment of the land had on the health of the cattle, and the bad quality of the food they produced. He wished to be allowed, from an experience of three years, to say that the milk produced was of the most nutritive quality—better than he could obtain in any other way. It was brought up to London for the use of his own children, and he was now supplying the child of a friend of his with it. The child might be seen in St. Paul's-churchyard, and the young mother had expressed her gratitude to him for it. The same remark applied to the quality of the butter, and the meat was most excellent. With regard to the health of his cattle he was happy to say that he had not lost a single animal in three years, notwithstanding their filthy pasture. His tank contained dead animals, and all the refuse from the house, and it was no uncommon thing for the cattle to be feeding on the pasture twenty-four hours after the application of the manure, and they had the result, in the shape of milk, in forty-eight hours. He thought they ought to form their judgment in some measure on facts like these; and he would venture to suggest that the Sewage Commissioners should be asked to make arrangements with farmers occupying four or five hundred acres of land for a constant supply of the sewage, to ensure its value being properly tested.

Mr. Haywood (Engineer to the City Commissioners of Sewers) thought they would be arguing upon wrong premises, and that it was likely to mislead agriculturists, if it was understood, from what had fallen from Mr. Chadwick, that sewage could be delivered on to land 25 miles distant from any point at 2½d. per ton. It was true, that in some cases water might be raised 100 ft., and delivered a distance of 10 or 15 miles for about 3d. a ton. But that was only delivered in bulk, and, whether for household supply or for agricultural purposes, it would only be on the edge of the estate or house, where it was to be used. Now it was the provision of the distributing apparatus, and the cost of distributing, which was the principal item of charge in irrigating land. In most of the pamphlets of the Board of Health, which were not remarkable for giving estimates at a very high figure, the cost of this distributing apparatus was from £1 10s. to £3 per acre, and the interest upon this had to be taken into account, and above all the current working expenses, if the pipeage would not distribute by itself, but require manual labour, and above all a large supply of hose. The cost of this hose would be found to be a large element in the cost of the distribution, and this fact appeared to him to have been kept much in the back-ground in the argument; the wear and tear of this hose was exceedingly great, and the charges for this indispensable article, in distribution, would go far to prevent the general application of the sewage water of the metropolis. In the Board of Health estimates canvas hose was generally taken, because the first cost was less than that of other hose; but that which was cheapest at first was not always the best. He had used, he believed, every species of hose that had yet been submitted to the public, and he had no hesitation in saying, that canvas hose was the worst kind there was. He had found it wear out much more quickly than any other. This was his experience in the use of hose in paved streets, not in agricultural operations. If this experience would apply in agricultural operations, it followed that the estimates given by the late Board of Health were of little value. With regard to Mr. Wicksteed's estimate of the cost of distributing the sewage water of the metropolis, which had been impugned, the data used by him in framing it should be held in mind. He had taken the figures of a late eminent agriculturist, (Mr. Smith, of Deanston,) who said that the quantity of town sewage water which, upon an average, could be applied, would be 150 tons per acre per annum. If that was an error, Mr. Wicksteed's calculations were so far wrong; and doubtless, if the sewage was diluted as it appeared to be, 150 tons of water would not convey to the land a sufficient quantity of fertilising matter. But how much water land could take would be a matter for practical agriculturists to determine. If it could take ten times that quantity, then Mr. Wicksteed's estimate could be reduced. Mr. Chadwick had, however, objected to Mr. Wicksteed's calculations, on the ground that the real sewage need not be mixed with so much water, and that by gaugings of the sewers 12 gallons per head per diem were shewn to be sufficient for all purposes; and all running off beyond that was waste; and that by it the sewage was diluted threefold. Now, this seemed to be holding out the idea that before long the same quantity of fertilising matter produced by the metropolitan population, might be reduced in quantity to about two-thirds of its present bulk. Now the valuable paper of Mr. Lawes had for its object to lead to the expression of some definite views with regard to the sewage of the metropolis as it was; and if it was essential that no chimerical views should hinder this, what was the probability of the sewage water being reduced in quantity, and of a given quantity of it conveying to the soil a larger quantity of manure than at present. The present supply of water was about 25 gallons per head per diem; and we were about to have the constant supply given to us. Now the experience of those towns where this mode of supply was most fully developed, showed a large increase over the present metropolitan consumption. At Glasgow it was more than 30 gallons per head per diem. According to latest returns from American towns, which were represented as models of water supply, it was more, thus—at Philadelphia it was 35 gallons; at Boston 53 gallons; and at New York 90 gallons per head per diem. With this before him, he did not anticipate the sewage of London would in future be much less diluted. He agreed that, by economical usage, 12 gallons per head per diem might really be sufficient; but he did not see how the inhabitants of London, when they had in every house a tap over a sink, and had the power of wasting water to any extent, could be kept to using that quantity. And when he considered that we were anticipating increased habits of cleanliness, when all persons were in the coming time to take their daily bath, like the Romans of old, (and, indeed, be somewhat cleaner than the Romans, for he believed that, although they bathed more, they washed their linen considerably less

than the denizens of this metropolis) and they contemplated applying water as a mechanical aid, &c., he could not but think the consumption of water would increase until it reached the figure given by Mr. Wicksteed, of 35 gallons per head per diem, and the sewage would be more diluted than at present, and consequently of less value, for the value of most applications appeared to be in the ratio of the fertilising matter it held to its bulk. This, then, after all, was the sewage water which agriculturists would have to deal with, and in this light it should be discussed. But, then, it was also attempted to be shown that the sewage water was not so good as it might and would be, by stating that the sewers of London held back the valuable matter until it soaked away, or was evaporated,—the phrase was, the drains and sewers "formed one system of extended cesspools." This was a favourite phrase with some people—a former officer of a Commission of Sewers first used it, and it had been constantly repeated ever since, no pamphlet of the Board of Health ever appearing without reiterating it in some shape or another—and most of the evidence which had been given on sanitary subjects, he could not help saying, had been given by those who knew practically very little upon the subjects of which they spoke, and that statement of Mr. Chadwick's, as to the whole of the metropolitan sewers being a cesspool, was incorrect. He did not mean to deny that some sewers were bad enough to deserve that term, nor that some drains were not, or that there was not room for improvement in the sewerage, but it was incorrect as applied to the metropolitan sewers as a whole, and they were not in such a condition as to allow all the sewage either to be collected in them, or to ooze out through them, so as to leave what ran off of little value. This was proved by the fact that the quantity of water discharged from the sewers daily was about the same as the water daily consumed by the population. Instead of it being the tendency generally of water to escape to the surrounding earth, those who traversed sewers knew that the water from all sides found its way through into the sewers. Again, if there was deposit anywhere, it was of the more solid portions, and that was known to be of the least value, the best of the sewage being the supernatant water; so that the sewage water of the metropolis at present might perhaps be considered to be as rich as it was ever likely to be. Some evaporation of the valuable volatile portions might be reckoned upon in any system, so that chemical analysis of the human fæces would not altogether help them as to the practical value of sewage water as now constituted. As the irrigated meadows at Edinburgh had been most frequently quoted as an illustration of the profitable application of sewage water, it should be stated that the sewer itself, which was in fact a large stinking black ditch, ran right through the centre of some of these meadows; on the line of sewer was an undershot wheel, worked by the sewage water, which pumped up the water to the surrounding land, which was not above 30ft. in the highest point above the sewer; it would be seen how favourably these lands therefore, were situated, and how economically the water could be applied to it. Mr. Chadwick stated that a quarter of the sewage of Edinburgh was applied to these 600 acres of irrigated meadows. As the population of Edinburgh was, in 1851, 258,000, there was then the sewage matter of 107 persons applied per acre. To get the same quantity upon an acre of land, it would be necessary to apply annually between 4000 and 5000 tons of metropolitan sewage water as at present constituted, and infinitely more if the usage of water increased by the constant supply being given to the inhabitants. It was for agriculturists to determine whether any land could bear such an amount of water to be placed upon it, or whether it could be profitably applied. Again, they had been told that Mr. Johnson considered 33 acres of land would take the sewage of 1000 persons, but to put the excreta of 1000 persons upon the land, it would require about 1200 tons of metropolitan sewage, as at present diluted, to be thrown on to it; therefore, Mr. Johnson's experience with a more highly concentrated fluid, did not much help them as to the agricultural value of metropolitan sewage water. He thought it most probable that at all the places by which the value of this fluid manure was sought to be illustrated, the fluid used was far richer, and far more highly concentrated, and, therefore, more valuable, as requiring less cost for its distribution, and being far more adaptable, as being capable of dilution at pleasure. When these cases were compared with the sewage water of the metropolis, all the circumstances of locality, soil, strength of manure, facilities for its economical distribution, &c., should be taken into account, or they would only lead to results which would cause dissatisfaction. He did not wish it to be understood that he thought the sewage water of the metropolis valueless; his convictions were, that with the sewage applied as it was, some lands might yield wonderfully; that the application of mere water alone must, in many cases, be highly beneficial, and, indeed, the plant could only feed from liquid manure; that manures, when applied solid, must, therefore, be put into a comparative state of solution before they could be absorbed, and it had been conjectured with much reason that plants were fed by gaseous products slowly evolved from manures. But the fertilising agents in the London sewage were in a greater state of dilution than elsewhere, and with this fluid it was that agriculturists had to deal; and the disposal of this fluid as it was, not as they could wish it to be, was the question. Practical tests by competent and unprejudiced agriculturists could alone decide its value, and whether it would bring such profits from its application as would enable it to compete with the best manures of the day. If it did not do this it would, of course, be a failure. The cost of applying it was the real question. It was a very different thing, as regarded cost, to apply the sewage of a small town, with the country fit for its reception almost within the town, and to apply the sewage of the metropolis, most of which was produced at points miles distant from any lands fitted for its application; and not only that, but at such a level as would enhance the cost of its delivery at the point of its usage considerably. He feared greatly he should never, certainly not for a great many years to come, see more than a very small quantity of the metropolitan sewage so applied, and that, if the river was to be freed from its pollution, we must look to some other and more immediate means than the application of the sewage to the purposes of agriculture. He would just add one or two remarks upon what had fallen from Mr. Ward. He would not trespass upon their time by descanting upon the merits of pipe sewers, but would allude to the probability Mr. Ward held out of their being able to save the Thames from pollution, and increase the value of the sewage manure. Mr. Ward said he had propounded the principle, "The whole of the rainfall due to the river, the whole of the sewage due to the soil." He then told you that the question of sewage interception had been hitherto an unsolved problem, and it had baffled the skill of the most eminent engineers; and then (which was very satisfactory) he told the meeting he had solved the problem. Now Mr. Ward's solution of the difficulty, he understood, was by dispolluting the large surface water sewers, which were formerly, and still were, small tributary streams; so that they might discharge still into the river, and collecting the sewage by other channels, and discharging it whenever it was desirable. Now, most people would desire this, but in the metropolis he feared it could not be accomplished—the scheme involved double sets of sewers and house-drains. There were now about 1,000 miles of sewers in London, and 100,000 houses draining into them. The first thing to be done, then, would be to lay 1,000 miles of other sewers by the sides of those already existing, and 100,000 additional house-drains in the houses already having drains. He merely mentioned this, which was one, only, of the difficulties, and would not go fur-

ther into it, as it was a subject which, doubtless, would soon be discussed in another arena. But on this point Mr. Ward apparently differed from Mr. Chadwick, who, in extolling the virtues of sewage water, alluded to its enrichment by soapsuds, street sweepings, soot, and those fertilizers which found their way into the sewers at times even of the least rain. By the separation proposed by Mr. Ward the Thames was still to be treated to this, whilst the sewage water was to be deprived of it. This matter, however, which had really little to do with the subject of the paper, he would not further allude to.

Mr. Paine said he would not have obtruded on the attention of the meeting had he not been invited by the secretary to offer some remarks upon the subject of Mr. Lawes' paper. He was simply an agriculturist, and knew nothing of London sewage excepting what he had gathered from the researches of others; but he was glad thus to have an opportunity of publicly thanking Mr. Lawes for the great benefits he had conferred on the agricultural interest, by his most careful investigations and experiments at Rothamstead, as well as for the information he had so liberally made known to all his co-operators in the art of farming. He, Mr. Paine, had had the gratifying privilege of frequently viewing those experiments, and had largely availed himself of the knowledge thus obtained from Mr. Lawes, by carrying out upon his own farm, on a tolerably extensive scale, those manuring principles which he had seen developed at Rothamstead, and, he was happy to add, with invariable success. To the conclusions of Mr. Lawes, that we must measure the value of manures by their chemical ingredients, he gave his most hearty assent —and he thought that the enunciation of the maxim, that we should chiefly estimate the worth of manures by reference to the proportions of nitrogen and phosphoric acid they might contain, to have been of immense service to all those farmers who had availed themselves of that information. Mr. Scott had just now alluded to the rank luxuriance of the Edinburgh meadows, as an instance of extravagant liquid manuring, and had attributed the disease so prevalent amongst the cattle fed on those meadows to the bad quality of their food; while Mr. Caird altogether dissented from this view on the ground that his own cattle, receiving a different kind of food, were quite as severely visited by the epidemic. But whether the rank quality of the grass in the Edinburgh meadows, predisposed the cattle fed thereon to the taking of this particular disease or not, still he (Mr. Paine) felt satisfied that even grass lands might be over-manured by too large doses of sewage, so as not to allow it time to form those chemical combinations with the soil which Professor Way had spoken of, and which he had good reason to believe, always took place in the land before the manure could be healthily assimilated by the plant, the manure being as it were digested by the soil, and thus fitted for vegetable use; and if so, it was highly probable that excessive manuring would produce a growth of crude vegetation of a poisonous rather than a nutritive character. But, returning to the uses of the London sewage, it had been generally admitted during this discussion that the several processes for converting it into a dry manure, were failures, on account of the low chemical value of their results. To the liquid form of application our attention was chiefly directed, but from the many practical difficulties which had been started, he (Mr. Paine) was not very hopeful of a speedy realisation of the advantages which the theory of the subject would lead us to expect. In the onset of any such undertaking, it seemed pretty clear that unless the City of London, for its own sanatory purposes, lent a strong helping hand to the agriculturist, there was not much prospect of so large a scheme being attempted; there must be, in fact, a combination of both interests. Now, as to the theoretical value of this London sewage, we learned from Mr. Lawes' Tables that each individual in the course of the year supplied about 8lbs. of nitrogen and 4½lbs. of phosphates, which substances would, if available, be worth at least 4s. and 3d. respectively; and, taking the population at 2,500,000, we had a money representation of £531,250 per annum. This was supposing there was no loss of nitrogen in respiration, but this loss would be more than compensated by other refuse matters which flowed into the sewers along with human excreta. Then, again, 80lbs. of nitrogen in the sewage, combined with the accompanying phosphates and alkalies, would be a most liberal manuring per acre for any description of crop: ten persons produced this quantity, consequently 250,000 acres ought to be manured. Such capabilities of manuring, and so large a money value, ought not, and we might be allowed to hope would not, be eventually lost. The chemist and the agriculturist recognised the value of this sewage, but they must look to the civil engineer for the means of application. Mr. Way told us, in the early part of the evening, that we were not to expect much advantage from the application of sewage to the low-lying alluvial lands near the Thames, as they could not be properly drained for this purpose; and he (Mr. Way) differed from the opinion of Mr. Lawes, and many others, in thinking that it might be advantageously used for cereal crops; and he stated that he had arrived at this conclusion from the facts which he had discovered in his investigation of the absorbent properties of soils, and, therefore, especially recommended the use of sewage *prior* to the crops being sown. He (Mr. Paine) would be able to adduce a few facts presently, illustrative and confirmatory of Mr. Way's views, which, he considered, had a most important bearing upon the useful application of liquid manure. He fully believed that the metropolitan sewage might be beneficially used as a manure to *every crop*, provided due regard were paid to the time and mode of distribution, and provided always that the land were, either naturally or artificially, drained, so as to ensure a porous subsoil. Upon grass land, and on Italian rye-grass, there was no difference of opinion—you had only to put on plenty of it. Mr. Mechi, too, had shown in his practice how much good liquid manure had done to his root crops, though, it appeared, he had not yet reached the *acmé* of perfection, since we had seen that Mr. Wilkins, on the poor sands of Wokingham, as much transcended Mr. Mechi as that gentleman had ordinary cultivators. He would say nothing of the profitableness of this underground scheme of irrigation, and merely mentioned it now, as what might become the germ of important consequences in the mode of applying liquid manure. For his own part he would fearlessly place the sewage upon the soil destined for root crops at any convenient time, *before* as well as after the plants came up. And here he could not but refer to Mr. Caird's valuable remark, that if sewage, or even water alone, could be obtained when wanted, at the prices stated by some of the speakers, it would prove a great boon in certain dry seasons in saving the crop of upland hay, and in starting the young root plants. Mr. Paine would now detail a few facts which had recently occurred on his own farm, which would tend to prove the soundness of Mr. Way's opinions relative to the possibility of successfully using liquid manure for corn crops, if placed upon the land at the proper time. 1. A field on a gravelly soil, resting upon chalk, was manured, in September 1853, with about 8,000 gallons of liquid per acre, from the farm-yard tank. It was sown, in the beginning of November, with Payne's "Defiance Wheat," the same sort that the Rev. S. Smith, of Lois Weedon, sowed in his experimental crop last year. It was a rather coarse variety. The rick being the produce of this field was threshed out in the autumn, the crop was 64½ bushels per acre, and was sold for £18 per load of 40 bushels. The crop of straw was fully 3 tons per acre. 2. Part of another large field of a similar geological character had been in Italian rye grass for three years previous to the spring of 1853, and during this period it had occasionally been liberally dressed with strong tank manure. It was sown, late in the spring of 1853, with wheat, and the whole

field was much blighted. Last year, 1854, the field was sown with oats, and the part which had previously been manured with the liquid grew the strongest crop of oats he ever saw. The crop of the whole field was a good one; indeed, the average growth of oats on his farm was upwards of 13 quarters, but this portion of about three acres greatly surpassed any other. The straw stood fully six feet high. 3. Another instance was on hops, in a field adjoining another farm-yard, in which there were spots where the chalk subsoil was faulty near the surface, and which were naturally less fertile than the rest of the field. Upon these spots in the winter time, when of course there was no growth in the plant, the liquid from the manure tank was pumped. This happened during two successive winters, and the result was the bringing of these poorer spots of land to the average fertility of the whole garden. He, Mr. Paine, regarded these "facts from the fields" as highly confirmatory of his friend Professor Way's researches in the laboratory, and he could confidently recommend them to the attention of his brother farmers, and he hoped they might tend to lead others to make similar experiments, as it was manifest that the safe application of liquid manure to the cereal crops had a most important bearing on the sewage question. He would only add another word in conclusion. Some of his friends who had visited his farm, might ask him why he had partially discontinued the use of liquid manure. His answer was, that with the aid of Mr. Way he had discovered an inexhaustible supply of soluble silica on his estate. It was a porous rock, similar, in many respects, to charcoal, especially in its deodorising and absorbent characters. He, therefore, now ground this rock into powder, and the liquid manure from the tanks was absorbed by it. This enabled him to give all his root crops a moist seed bed of highly stimulating properties. It might seem curious that he thus fell back upon manures obtained by absorbtion, the making of which from sewage he deprecated at the commencement of his remarks. But, then, let it be remembered, that the manufactory was on the farm, and, therefore, the cost of carriage constituted a very trifling expense.

Mr. Edward Wilkins here directed attention to some specimens of crops of hemp and flax, also mangold wurzel and potatoes, which he said were grown upon land in Wokingham not worth half-a-crown an acre. Those specimens, he said, were the result of his method of applying air and liquid manure to the roots of the plants. A potato set in sand produced 84 potatoes, and a crop of peas under his treatment showed an increase of sixfold, whilst in the root crops the results were equally astonishing. He mentioned that he had patented a process for the disposal of town sewage in a way different from any which had hitherto been practised, and also for deodorising the sewage. He had communicated with the Metropolitan Commissioners of Sewers on the subject, and personally with Sir John Shelley, but he had received no answer from either quarter, and if, he said, people were treated by the authorities in that way, they could not expect to get much useful information conveyed to them. With reference to the use of solid manure, he would state that when he applied it to potatoes, he found the plant was attacked by the grub worm, from which the liquid manure was entirely free, and by the application of it in that form, he obtained a better crop.

Mr. Bailey Denton said, he was happy to express his concurrence in the opinion that agriculturists should be heard on this question, and although he was but a farmer to the extent of some 100 acres or so, and did not profess to be an agriculturist, yet he was much interested in agriculture professionally, and took especial interest in the matter before the meeting. He should tell them that the question of irrigation had become to him a question of great moment, from the situation he held as engineer to a company incorporated by Act of Parliament, allowing the cost of irrigation to be charged upon the inheritance of estates. In order to warrant the charge of the cost of works, like those which had been proposed for the application of town sewage by irrigation, as a permanent improvement of the land, he had taken considerable pains to inform himself upon the subject, and he must admit that he had come to conclusions very unsatisfactory with regard to it. He could not see that their present knowledge and experience would allow of its being profitably done. It was necessarily a matter of great importance with the Company whom he humbly took upon himself to represent on that occasion, to encourage, if practicable, the cause of irrigation, particularly in the application of sewage manure by any tried processes. He alluded particularly to the process advocated by Mr. Telfer, Mr. Mechi, Mr. Kennedy, and others, and he must confess he was far from satisfied that that process could ever be a profitable one. In order to charge the cost of applying liquid manure on the inheritance of land benefitted by it, it must be shown to be profitable, upon that doctrine which ought to govern the affairs of all men engaged in agriculture, viz., that they ought to have a larger annual profit than a bare interest upon the outlay. With this principle before him he had tried to prosecute that inquiry, and he had come to a most unsatisfactory conclusion upon it. Mr. Caird had said this was an engineering question, that if they could deliver the sewage water as ejected from the London sewers—not concentrated sewage manure—at 2d. per ton, it would be freely applied to the land. He (Mr. Denton) was not of that opinion. Mr. Haywood had most properly said that when it was delivered at 2d. per ton up to a certain point, it did not mean that it was delivered upon the farm at that price; it did not mean that it was supplied to the hydrants upon the farm, including the cost of the iron pipes and hose, and the cost of other means of mechanical appliance. No such thing! As he understood it, it was the delivery to a point adjacent to the farm or estate, or to a certain highway or byeway, and the landowner must apply it from thence. What more might be done, was a question yet to be solved. No one could for an instant doubt that sewage manure was valuable; but to be profitable it must be applied, and he had not yet seen nor had he yet heard of any means by which it could be profitably applied. Mr. Lawes, to whom they were very much indebted for his valuable paper, had said that it might be applied to 20,000 acres at the rate of 10,000 tons per acre. Did anyone know what that meant? Twenty-four inches fall per annum was the average rain-fall of the neighbourhood of London; but this meant, if he could read aright, 100 inches per annum, or four times the rain-fall! Could anything be more futile? He had visited Mr. Telfer's farm, and that of Mr. Mechi, and he had witnessed the application of liquid manure on the "Marcite" system at Edinburgh, and by various processes, but it seemed to him, that in the consideration of the subject all soils and all subsoils were viewed alike! A more fallacious proposition never was made! If he went to Mr. Telfer's farm, he found the soil to be sandy, and that, owing to this circumstance, it took in, and rapidly infiltered or discharged the water that it took in, thereby leaving, he presumed, in its passage through the soil, the fertilizing matter of that liquid for the benefit of vegetation. But what was the maximum amount that Mr. Telfer applied in a year?—and in this instance they had before them the case of the farmer who had succeeded best, and who had fed his forty cows to his forty acres,—and who, in his desire to economise every ounce of straw and liquidise every ounce of manure, housed his cows on cocoa-nut matting—why, they knew very well they were dealing with five inches of liquid, and that they were not dealing with a hundred! At each application of liquid manure he applied one-inch surface flooding. Now, what meant 100 inches application? What did it mean if applied to the London clay, in contradistinction to the sandy soils? If five inches was sufficient in the case of a soil where there was a quick discharge, how could they think of applying 100 inches per acre to a clay

soil absorbent and retentive, and which of course must be, in a question of this sort, a most material element, for we must not forget that when the sewers were issuing their full quantities, in consequence of the rainfall being mixed, as proposed, with the sewage, the land itself was in a wet state, and least able to receive a liquid, particularly if it were of the character of the clay soil round London. Mr. Lawes had spoken of the application of liquid manure to grass lands. He (Mr. Denton) could readily understand if permanent grass was put against the rotation of crops to arable land, grass was the best vegetation to which to apply it. But he had himself taken some pains with experiments (with a view to espouse, if practically sound and profitable), the application of liquid manure by means of iron pipes; he had gone through a variety of experiments, and he only found that as he approached to that point where the liquid manure was perfectly unhealthy to the persons in the neighbourhood, did he come to a profitable application of it. He knew enough of farming to be able to say, that upon clay lands, even well-drained clay soils, they must apply the liquid manure in a very concentrated form to make it valuable at all. In undrained clay lands liquid manure was altogether valueless. He had gone through a series of careful experiments, putting on liquid manure, and increasing the quantity of fertilizing matter till he got to the maximum, and decreasing the water till he got to the minimum, and then he saw an effect; but when he compared these several applications to equal dressings of farm-yard manure applied to pasture land, he found that the straw of farm-yard manure gave encouragement to the growth of the grass, as arose in the operation called "Gurneyism." He found a greater growth under the influence of farm-yard manure than was the case with the application of liquid manure, unless of an obnoxious strength. He repeated, there was in the straw of farm-yard manure a warmth which encouraged the vegetation beneath it, whereas the occasional use of liquid manure chilled the land by the evaporation which followed. Passing, then, from grass land, he came to arable land. He was, himself, at present most undecided upon the question, whether it was possible profitably to apply liquid manure to arable land. He did not mean to say it would not ultimately be proved to be profitable; he hoped it would be, but at present they were not in the position to apply it profitably. He confessed that his opinions on this subject had been somewhat shaken by the testimony of Mr. Paine—a most valuable testimony certainly with regard to cereal crops, and it had somewhat taken him by surprise. From all that he had learned upon the subject he had formed an opinion that it was not valuable for cereal crops, and with due deference to the statement of Mr. Paine, he still thought it would be found so in the long run. With regard to root crops, he had some evidence that it was not profitable even as applied to them. He went to Mr. Telfer's farm last year, in consequence of what was stated by Mr. Caird at Mr. Mechi's gathering, and Mr. Telfer showed him a field of root crop, part of which had been irrigated and part not. He asked Mr. Telfer to point out which was which, but he was unable himself to do so, and he had to call his bailiff in order to distinguish between the two methods of treatment. Those were facts which a man like himself—prosecuting the application of science to practice, must ascertain with precision. Now came the question to what could they apply the liquid manure most profitably. Mr. Caird, Mr. Morton, and Mr. Telfer, spoke of rye-grass. No doubt Italian rye-grass would be benefitted by it; but where would be the advantage of so applying it, when every other crop rejected it as unproductive of profit? He put the question, because in his mind it involved the whole subject. He had yet to ascertain that a rotation crop would be benefitted. For example, let us take a four-course system—two straws, one pulse or seed, and one root crop. Two out of the four it would not touch, and they would have gone to all the expense for, possibly, two, probably only one, out of the four crops. Mr. Haywood had alluded to the expense of the pipes and hose, and that, no doubt, was a material item in the consideration of the question of maintenance, as well as cost. To recur, however, to the rye crop, about which so much has been said in praise, he begged to express his doubts as to the true economy of such exhausting and succulent crops, although he should, doubtless, be reminded by Mr. Mechi, as he was the other night, that a rump steak contained 75 per cent. of water and 25 per cent. only of nutritious matter. But that was to speak as though we were to forget to cook the steak before eating it—by which the quantity of water would, he presumed, be diminished. He submitted that the proper way to test the value of such succulent crops as Italian rye grass was not by ascertaining their bulk, for there were disadvantages attaching to so much waste as 75 per cent., when consumed, which could hardly be over estimated. For instance, if we regarded past experience, we should find that it was not healthy to animals consuming such crops to devour so much fluid when in a hungry state. Abernethy used a favourite saying, "that you should never eat and drink at the same time, but follow the instinct of animals, which leads them to eat at one time, and drink at another." By the use of Italian rye-grass the life of the animal was shortened for the advantage of milk, which that succulent grass provoked, and thus the doctor's precept was negatived. Again, consider the loss of time and labour attending the appropriation of such succulent vegetation. Were we not losing sight of the advantage of concentration? At this moment we were sending out to the army in the Crimea, concentrated food as a matter of economy, while with a view to utilize the sewage of London, we were advocating the growth of succulent grass, as food for animals, with a known waste of 75 per cent. of fluid. These points might appear irrelevant, but when the question of the general economy of liquid manure came to be fully considered, we should find that each would have a place in the minds of those who desired to test practically the permanent value of prevailing theories.

Mr. Caird wished to explain that his arguments had been based upon the supposition that a large quantity of sewage could be delivered at 2d. per ton, and he believed that Mr. Chadwick meant that it would be so delivered to different farms, in such a manner that the occupier would have nothing more to do than apply his hose for its distribution. With regard to what he had said of grass crops, there were five such in a season, and only one of corn; therefore it was that it was more advantageous and economical for grass than for corn.

Mr. J. W. Bazalgette (Engineer to the Metropolitan Commission of Sewers,) said that he could add but little to the very able statements which had already been made upon the chemical and agricultural portion of this question, and at that late hour of the evening he would only detain the meeting for a very short period. He had listened with great interest to the various opinions which had been expressed with regard to the conveyance and application of town sewage as a solid or liquid manure, and he entertained various doubts whether it would be found practicable to apply the whole of the London sewage to the surrounding lands in the form of liquid manure advantageously. Mr. Lawes had stated, in his very valuable paper, that the sewage of London contained about 10,000 tons of ammonia, which would be sufficient to manure 400,000 acres of corn land, and had assumed that this manure could be received in the form of irrigation upon 20,000 acres of land, or one-twentieth of the first estimate. This latter must, therefore, in Mr. Bazalgette's opinion be considerably under the mark. Mr. Sidney had shown that the Italian meadows, which were so advantageously laid out for irrigation, were not at all times in a condition to receive the liquid sewage, which would more frequently be the case in this climate; therefore it would become

necessary either to duplicate the area to be irrigated by the London sewage, so that when one portion could not receive it, it might be turned upon another tract of land, or it must at such periods be turned into the river. Professor Way had shewn that the only lands to which liquid sewage could be advantageously applied, were high lands, with a porous soil. These considerations would, in his opinion, vastly increase the cost of distribution in a liquid form; and Mr. Wicksteed's estimate of the cost of distribution would, to a large extent, be realised. He (Mr. Bazalgette) had some time since visited the Stanley-bridge liquid sewage works, where engines had been erected and distributary pipes laid down to supply the market gardeners with liquid sewage; but he found that its distribution had been almost entirely abandoned, and that the company were manufacturing and selling the solid sewage manure. This was an experiment made near home, and one worth inquiring into, and he had hoped that some person present would have been enabled to inform them why it was that after they had gone to the expense of erecting engines and laying down distributary pipes, they had abandoned the application of the liquid sewage. The point, however, to which he more particularly desired to call the attention of the meeting was the consideration of this as a sanatory question, which was annually becoming one of more serious importance. In London there were at the present time about 100,000 houses, or one-third of the whole number, drained into the sewers, and the Metropolitan Commission of Sewers were now destroying cesspools and draining into the sewers at the rate of 20,000 houses per annum. If, then, the Thames was now polluted, it must, when all London was drained, become threefold worse than at present, and in this respect he differed from his friend Mr. Haywood, in supposing that the sewage would become more diluted; on the contrary, he believed that the increased quantity of sewage would at least keep pace with an improved water supply. Throughout this country sanatory reformers had, during the last few years, actively prosecuted the drainage of our provincial towns, but they had not at the same time sufficiently attended to this portion of the subject, so that whilst on the one hand they had removed the nuisances from their towns, they had on the other hand polluted their rivers and brooks. He considered that it was as much the duty of a sanatory board to defray the cost of deodorising the sewage, instead of polluting their streams, as it was to pay for the construction of the sewers. This part of sanatory reform had been too long neglected, and whilst for the last ten years persons had been discussing and waiting for the discovery of the most profitable mode of applying town sewage as a manure, little or nothing had been done, and sewage was becoming a serious evil. If every town which had been drained would at once adopt that mode of deodorising or disposing of its sewage, which appeared to them the most promising in a commercial point of view, this question would then be soon practically solved. Much valuable information had already been obtained, as was proved by Mr. Lawes' paper and the discussion upon it, but unless some such course as above suggested, be adopted, we should, some five or six years hence, find ourselves at this or some other scientific society, discussing various opinions as to the best mode of distributing sewage manure, whilst our rivers and brooks would have become more unwholesome and polluted than ever. Mr. Wicksteed and the town of Leicester had at least, in this respect, set us a good example, and whilst he (Mr. Bazalgette) offered no opinion as to the value of the manure there manufactured, or whether it would pay a profit, or even defray the cost of its own manufacture, it would at least demonstrate that the sewage of a large town could be rendered inoffensive. The question of a cost and profit to that town must now soon be known, and he submitted that Mr. Wicksteed deserved our thanks for the prominent position which he had taken in this respect, and it was to be hoped that the time would ere long arrive when every town in England would profitably apply its manure in a liquid or solid form, but at any rate render it harmless and inoffensive.

Dr. Thomas Littleton said that, owing to the advanced hour, and as other gentlemen might still wish to address the meeting, his observations would necessarily be brief. This question was, as Professor Way very properly remarked, a compound one—sanatory and agricultural. That gentleman had said (*vide* "Royal Agricultural Journal," No. XXXIII., p. 167)—"The policy of towns, their primary concern, should be to effect the sanatory objects thoroughly, looking to the manure as a set off, greater or less." That gentleman made objections, similar to those of Mr. Lawes, regarding the different plans which had been propounded for securing the valuable constituents present in sewage, viz., that they failed to secure the ammonia which it contained, the greater proportion—nine-tenths—of which was discharged into the air, as in Mr. Wicksteed's process, or otherwise lost, being carried away in the large amount of water used. If this ammonia, and the other volatile compounds—sulphuretted hydrogen and carbonic acid gas—could be advantageously dealt with, the result mainly to be desired would be secured, so far as a sanatory point of view was concerned. The amount of these gases evolved into the atmosphere of London was calculated by one authority as equal to the enormous volume of 10,290,320 cubic feet annually—upwards of three-fourths of which emanated from an evaporating surface in the sewers, equal in extent to $145\frac{1}{2}$ acres ("Hopley on Respiration," p. 58). If this evaporating surface were connected at different points with a vacuum apparatus, the draught thus created would enable us to collect these gases, which now become diffused in the atmosphere, within a small compass, and thus readily to deal with them, sulphuric acid being used to absorb the ammonia. A vacuum process, to be available, must fulfil the following conditions:—It must be one cheaply obtained—such could be had, in one form, ready at hand, by an outfall of water of 34 feet. The amount of the water at present supplied to London, under a pressure very much exceeding the column of water required, might thus be made to effect the chief amount of the exhaustion; so that but a small addition of mechanical power would be needed to attain all that was required. And, further, it must have a two-fold connection established with it—one with the liquid contents of the sewer, by pipes having bell-shaped openings; another with the air in the sewer for occasions when the temperature of the atmosphere became unusually high, and the gases were evolved in greatly increased quantities; and at such times the air should be made to pass through a chamber containing charcoal. He then exhibited a specimen of the salt, sulphate of ammonia, obtained in the manner proposed, from an aqueous solution of ammonia, containing four per cent. of real ammonia; the temperature at the time of the experiment was 45° (Fahr.). In four hours the whole of the sulphuric acid, a fluid half drachm, of specific gravity 1·804, was converted into the salt here presented, under a small bell jar about 60 cubic inches in its content, by one exhaustion. The amount of the ammoniacal solution operated on was such as would render neutral to test paper the half drachm of sulphuric acid. He begged to call attention to the rapidity with which this was effected; and, further, that in several other experiments he had found that, by maintaining the vacuum for a period of 24 hours, every particle of ammonia was given off, the remaining liquid ceasing to give any indication of an alkali, with reddened litmus paper. The just inference from which was, that *however dilute* the solution of ammonia was, it might be entirely exhausted in this manner. He would only add that no correspondingly increased advantage was obtained by a degree of exhaustion beyond that of one-third of an atmosphere.

Mr. Wren Hoskyns assured the Society that he had attended these two interesting meetings merely as a listener, and found himself unexpectedly called on, and

little able to advance the question beyond the point it had reached. He confessed that, from the general testimony that had been elicited in the course of the debate, from practical and scientific speakers, both as to the precise value and the engineering availability to the agriculturist, of sewage manure, the hopes he had always encouraged upon the subject had received less confirmation than the fears he had latterly been led to admit. Still, the problem appeared to him not without hope. And the ground upon which he founded it was this: That the problem had *two* heads to work it, two sets of shoulders to bear it—the agriculturist at the one end, and the sanatory commissioner on the other, both equally and interestedly bent upon its solution. "Nothing will ever be undertaken," says the poet Imlac to Rasselas, "if all difficulties must be first overcome." He felt an instinctive assurance that this subject would not end with this night's discussion; the question was too important, and the parties interested in it too many, to forbid the belief that further knowledge and research would be brought to bear on it, and further opportunity of its discussion afforded at some future day. He would admit that his mind was not unprepared altogether for the low estimate which chemical analysis had conclusively disclosed in the case of sewage manure. There were, it seemed to him, *reasons* calculated to mislead a judgment formed merely from the *physical senses*, as to the fertilising value of this manure. For obvious reasons no animal consumed so little food, in proportion to the living bulk, as man, whilst in no animals were the resulting organised tissues so important and *expensive*, physiologically speaking. Four pounds of new blood in the 24 hours (the quantity produced from the food of a healthy man), was a heavy *draw* upon less, on an average, than a pound of meat, with the relative proportion of farinaceous and vegetable food; and though from this, of course, a considerable residuum passed off in excretion, still, after due allowance for respiration and perspiration, the aggregate loss in the formation of new tissue, suggested *à priori*, ground for somewhat disappointing results in the agricultural value of the manure. In illustration of this, Mr. Hoskyns referred to some recent experiments at the Hatton Lunatic Asylum, in Warwickshire, the sewage of which, when distributed over the surrounding soil, under local circumstances peculiarly favourable for the experiment, seemed to have produced results in no degree commensurate with the anticipations based upon the amount of the nuisance experienced prior to its utilisation upon the soil. As he believed he was the last speaker upon the chairman's list, Mr. Hoskyns begged to be allowed to conclude this most interesting and instructive debate by proposing a hearty vote of thanks, on the part of the Society, to Colonel Challoner, for his most able and courteous occupation of the chair during this and their former meeting.

Mr. Higgs trusted that before the vote of thanks to the Chairman was put, he might be allowed to make a few observations. The subject before them was one of great importance, and ten years since he was the first person to propose to collect the sewage for manure in its solid form. Much had been said about Mr. Wicksteed's method, but that method belonged to him (Mr. Higgs), he having patented it ten years since, and expended a large amount of money, and a great portion of his life in bringing it to bear. Much had been said in depreciation of the value of this sewage, but he would ask them why should they confine their estimate of its value to its contents of excrementitious matter. Was not the refuse of slaughter-houses and many factories poured down to it in large quantities. Mr. Lawes had alluded to calculations made upon data, through the report of Mr. Herapath, on the value of sewage from Cardiff gaol. But they must recollect that that only contained the excrementitious matter of prisoners employed in sedentary manufactures, under a diet peculiarly low. Certainly, he had not seen what that dietary was of later years, but formerly it only consisted of meat once a year, namely, at Christmas, the remainder of the year the dietary being confined to gruel, bread, and potatoes. This showed how incorrect any comparison must be between the sewage of Cardiff gaol and the general sewage of London. He knew from experience and comparison that the sewage at Puddle-dock contained upwards of 40 per cent. of matter. Mr. Lawes spoke of bringing the chemical constituents of manure together, as though they could be so amalgamated as by the natural process; and he said, "such then are the constituents which it may be calculated would be contained in one ton of Mr. Wicksteed's sewage manure." Supposing that you could get these constituents together, would they be of the same value for manure as when elaborated through the processes of nature? He further said, "I find one and three-quarter cwts. of Peruvian guano would supply all the nitrogen or ammonia and the phosphoric acid of such a sewage manure; three or four cwts. of rotted straw would supply all its organic matter, and the residue I could obtain from the chalk and sand pits. Thus, for about 25s., I could bring upon my land the constituents of a ton of this manure, and for 30s. less money." As well might Mr. Lawes tell them that they could obtain all they wanted from the water flowing in the gutters of London. He called their attention to this fact, more particularly because he defied them, by any chemical amalgamation, to produce those results to be obtained from natural sewage. It was impossible by synthesis to obtain such results, whilst by a precipitation of lime by carbonic acid they would have 69 $\frac{8}{10}$ths of chalk and manure. He had seen in Wales, at Epsom, and other places, the results of this system, and he had no doubt that ultimately the agricultural world would admit the value of solid sewage manure. Happily, he would say, that ere long the case must be relieved of all doubt. At Nottingham the Board of Health had had patriotism enough to agree to assist them, by which the sewage would be collected for distribution on the land, and he trusted it would prove profitable to the agriculturists, and satisfactory to the sanatory reformers.

The Chairman said at that late hour he was sure it would be most agreeable to the feelings of the meeting that he should compress his remarks into as small a compass as he could. With the exception of the gentleman who had spoken last, the impression upon his (the chairman's) mind was, and of the greater proportion of those who had addressed them—backed both with science and practice—was that the attempt to get a solid manure from sewage, appeared to be almost impracticable—that was, impracticable at a profit, for it was of no use to do it without it could be done at a profit. Mr. Caird had given them some valuable experience on his own part, a good deal of which agreed with the theory they had heard from other quarters, viz., that the application of water alone to crops, particularly on light soils, was in itself remunerative and amply repaid the cost; and in that opinion he believed Mr. Mechi agreed. Then they had another most valuable piece of information from Mr. Haywood, who said, this was all very well, but what was the cost of delivery; and he very properly put the question, whether the cost of delivery at 2d. per ton, was to carry it to the roadside, or to one corner of the estate, or whether it was that amount over the whole of their property, which materially altered the cost at which it could be applied upon the farm. Mr. Paine, than whom from his large experience, no one was more qualified to give an opinion, had brought a very strong point before them in stating, that not only had this liquid manure been of advantage on grass lands, but he had shown them that it had been advantageously applied to his other crops, and that was a very material point. As far as he (the chairman) was concerned, he could in some degree confirm the statement of Mr. Paine in that respect, inasmuch as for the last five or six years he had been in the habit of sending tank water in a water cart upon his lighter corn land, and particularly he had done so with great advantage a month or two before putting in his root crops. Mr.

Denton on the other hand, had said it was of no use at all, that it was absurd to put water only upon the land in that way, but he thought the difference of opinion in this respect between Mr. Denton and Mr. Paine, lay somewhat in this—Mr. Denton's remarks applied more to clay soils, and he agreed that it was very little use in that case, as far as his own experience went. He believed Mr. Paine was right, and no doubt Mr. Denton was also right, because with what little experience he had had with clay soils, he had not found the same advantage as upon the sandy soils. Then Mr. Wren Hoskyns had given them the fact of a lunatic asylum situated upon a hill, so that they could get the sewage round the hill with great advantage sanatorily, but agriculturally speaking, with little advantage, inasmuch as the crop did not pay for the smell that was created. That was the plain English of the matter. He had asked Mr. Hoskyns what the soil was, and he said it was retentive—moderately retentive, but probably the surface had not been broken.

Mr. Wren Hoskyns said the land had been ploughed.

The Chairman—At all events it seemed to have gone off in evaporation into the air. He would conclude by thanking those gentlemen who had brought to bear both practice and science in informing their brethren upon this subject, and he thought discussions of this kind would ultimately bring them to a right conclusion upon it at last.

Mr. Paine having seconded the vote of thanks to the chairman for his conduct in the chair, the motion was put to the meeting, and carried by acclamation.

The Chairman having returned thanks, the meeting separated.

The Secretary announced that the paper to be read on Wednesday, the 28th inst., was " The Utilisation of the Molten Mineral Products of Smelting Furnaces," by Dr. William H. Smith, of Philadelphia, U.S.

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The Secretary has been favoured with the following communication from Mr. J. C. Morton, who was unable to attend the discussion .—

## ITALIAN RYE-GRASS AND TOWN-SEWAGE.

Sir,—To those interested in the discussion which has lately been conducted before the Society of Arts on the value of town-sewage as manure, it will be satisfactory to learn that the London Farmers' Club—a body whose opinion will be received with respect by the agriculturists of this country—adopted at their last monthly meeting a resolution affirming the profitableness of those enormous dressings of dilute liquid manure, by which those large growths of Italian rye-grass are obtained, that have given such celebrity to a few farms in the neighbourhood of Ayr. What those growths are, may be gathered from the fact, that on the produce of 35 Scotch acres of young Italian rye-grass, and of 35 Scotch acres of one-year old Italian rye-grass, Mr. Kennedy, of Myre-mill, keeps a herd of 250 large cattle, 25 horses, 450 sheep, and from 180 to 200 pigs, for five months of the year. The cattle and the horses are large, the sheep are small, the pigs are of all ages. Their daily consumption may average one cwt. a piece for the first, and 16 lbs. daily for the others ; their total consumption throughout this period, therefore, must amount to nearly 3,000 tons, which is an enormous produce of grass from 70 Scotch—84 imperial—acres of land. This produce appears in Mr. Telfer's case, in the fact that from 7 Scotch acres, at Cunning-park, near Ayr, he obtains enough grass in this way for 48 cattle during 5½ months of the year, that extent yielding, according to his calculation, about 270 tons of green food. This produce appears still further remarkable in an instance where it was actually weighed. Mr. Kennedy told me that, on the 21st of April last year, a field of sixteen Scotch acres of Italian rye-grass was begun, and on each day subsequently a perch was measured, and its produce weighed, and the weight of the first cutting per acre, calculated by a perch weight, ascertained each day, was 16 tons ; a second cutting, ascertained in like manner, was 25 tons; and a third was 17½ tons ; and the fourth, in September, was 16 tons; and after this a foot high of grass was eaten down by sheep, which, if it had been cut, would have weighed 8 or 10 tons per acre. Here, then, was a produce of 74 tons per Scotch acre in a year.

These growths of grass are obtained by heavy manuring. Mr. Telfer, after each cutting of Italian rye-grass applied between three and four cwts. of mixed Peruvian guano and sulphate of ammonia per acre, and by his system of underground pipes, fixed hydrants, and moveable hose and jet, he then floods the land with one inch thick, or 100 tons per acre of liquid manure. This is chiefly water, but it contains, distributed through it, such a proportion as belong to the time since the last application, of all the solid and liquid excrements of the cattle fed upon this grass.

The liquid manure is all applied on the grass during the summer, and on the land intended for corn and root crops during the winter.

It is, I think, in the success which attends the application of it to Italian rye-grass that Mr. Telfer and Mr. Kennedy's experience with it has a bearing on the town sewage question. If it be profitable for the former of these gentlemen to make butter, on produce thus obtained, 400 miles from the market where it is sold, it is, I think, possible that a method of applying town sewage in the cultivation of the same grass, close by this market, may yet be devised which shall reimburse the outlay. As to the quality of the dairy produce from grass thus grown, I can only say that Mr. Telfer's butter sells at the highest price obtained in London, and finds its way to the tables of West-end consumers; and as to the health of the animals, *that* is insured by attention to ventilation and to cleanliness, their food being kept at the requisite degree of moisture by attention to the age at which it is cut.

No doubt farm sewage is a very much more dilute manure than Mr. Telfer's 3 cwts. of guano are, even though they are washed into the land by 100 tons of water,—but heavier dressings of the former must be used in some degree to compensate for this deficiency in quality, and if it should find its way on to the land, it is to fertilize simply by its own weight, and without the use of artificial force ; these heavier dressings might, I should think, be applied cheaply enough to ensure a profitable result.

It all depends, however, I believe, upon this " if,"—for however efficient for soil this dilute sewage is, and therefore however profitable an expenditure incurred in its removal as a nuisance, its power for good—its value *per ton* as a manure—is so very small, that the smallest possible expenditure incurred in providing against the loss of it *may* be unprofitable.

I am sir, yours respectfully,
JOHN C. MORTON.

Farmers' Club, Blackfriars.

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# Home Correspondence.

## THE DISCUSSION ON THE WATER SUPPLY.

Sir,—My attention has been called to a letter from Mr. John Evans, that appeared in your Journal of the 16th February last ; to a letter from Mr. Homersham in your Journal of the 23rd Feb. last, and to another letter from Mr. John Evans, in your Journal of the 9th inst. ; all referring to the gauge used by Messrs. Dickinson and Co., at Apsley Mills, near Hemel Hempsted, Herts.

The drawing, showing the sectional elevation of the gauge, which appeared in your Journal of the 23rd Feb. last, was made in 1842 under my directions, and accu-

rately represents the gauge made by me for Messrs. Dickinson and Co. in 1835, and as it existed from that time till the year 1849, when I left the service of Messrs. Dickenson and Co. I may state, also, that I have every reason to believe that the gauge was not altered in any way until after the Bill of the London (Watford) Spring Water Company was before the Committee of the House of Commons, in 1852. I have heard that after this time, the gauge was taken down, examined, and found to be so decayed, that a new gauge was made to replace it; but I am not acquainted with the particulars of the gauge after the sitting of the Committee in 1852.

The gauge as stated by Mr. Homersham, was filled by myself, with my own hands; the mould, peat, gravel, and chalk, were put in the gauge exactly as shown in the section; the thickness of the layer of each was taken from a pencil sketch, made at the time of filling the guage, and kept by me ever since.

For several years after the gauge was first made I registered the amount of water that passed through it, if any did; no vessel was placed to catch any water that might come from the overflow pipe, and no means were taken to know if any water passed through it or not.

I may state, that for nine or ten years after the gauge was made, Mr. Evans never saw the gauge, and, therefore, he should not be so positive in his statements.

With respect to the amount of water raised at Messrs. Dickinson's Mills from the borings sunk into the chalk by Mr. Paten, I may mention that the statements made in Mr. Homersham's letter were given on my authority, and are as correct as possible. I may also state, that the amount of water raised from the borings is in proportion to the quantity of water required for the manufacture of the paper, and that from experiments I have made on the amount of water yielded by three of these borings, I am satisfied that double or treble the quantity of water actually raised could be procured from the borings, if wanted.

The water from the borings is infinitely superior in quality to the water from the river Colne, and for this reason it is so useful for washing and mixing with the pulp in the making of paper.

I am, sir, your's obediently,
WILLIAM LONG TYERS.

18, Ann-street, Plumstead, March 10, 1855.

*** This letter was omitted last week owing to want of space. It must conclude the discussion on this subject.—Ed.

## DECIMAL COINAGE.

### Comparative View of the Different Systems.

Sir,—One great obstacle to the introduction of the decimal method of money reckoning, is the unsettled state of the public mind as to the best system to be adopted. It may, therefore, be useful to direct attention more particularly to a comparison of the rival systems.

1. I shall assume it as desirable that the new system shall be thoroughly decimal, not composed of a decimal and a non-decimal part; that there shall be two coins of account, the unit and its hundredth; that the lower coin of account must be nearly about the value of the present farthing; and that the new and old monies of account shall be as easily convertible into each other as may be.

2. It may be observed at once, that two of our present coins of account, the shilling and the penny, are unsuitable as coins of account under a decimal system; because the $\frac{1}{10}$s. ($1\frac{1}{5}$d.) and the penny are too large for a lowest coin; and the tenth of either of these ($\frac{3}{25}$d. and $\frac{1}{10}$d.) are too small for the lowest coin. This may be disputed by those who do not consider that the farthing is about the right value for the smallest coin of account: at present, our previous practice and the general opinion seem to concur in recommending that our money scale should descend to near that value, but that it is unnecessary to carry it lower down. At all events, it is manifest that this ought to be a primary consideration in determining our new money of account; but it is often overlooked. It appears incumbent on those who advocate any material departure from our present lowest coin, to show that it is too large or too small, and that what they propose is more suitable in this important point.

3. The present silver and copper coins are decimally incompatible, so that one or other must be sacrificed. If we retain the silver coinage, we may preserve our present pound standard, or have the easiest possible transition to it (by 10); but it will be impossible to convert a less sum than 6d. exactly into the new coinage; in every such interchange, there must be a fraction of a farthing to be lost on one side or other, or to be made up in some other way.

4. On the other hand, if we retain the copper coinage at its present value, and decimalise upwards from the farthing, we have the advantage of being able to convert any sum in the old into the new coinage exactly, without any surplus of fractions to be lost or allowed for; but the relations of the new coins to our present standard, the pound, and to the shilling, become intricate, and the mutual conversion is tedious and troublesome.

5. It is very important to bear in mind (and it is often overlooked), *that the penny and the farthing are decimally incompatible*, so that if we decimalise from the penny, dividing it into tenths, ¼d. and ¾d. will be inconvertible into these tenths, and 1, 2, 3, 4, 6, 7, 8, and 9 of these tenths, will be inconvertible exactly into farthings.

6. It thus appears that whether we decimalise from the silver coinage or from the penny, there must be the inconvenience of inconvertibility to a certain extent; and that the complete convertibility of the old and new coins is to be attained only by decimalising upwards from the farthing.

7. These seem to be the general considerations by which the question between the silver and the copper coinage must be determined; but to judge correctly on the subject, it is necessary to enter into more detail as to the advantages and disadvantages on either side; the materials for this more exact comparison will be found in the following tables and rules, showing the numerical relations of our present leading coins with both decimal systems.

8. The first table exhibits the *florin* as the basis; practically the same as the *pound* system; the florin being taken as the unit, that there may be only two coins of account, and only two figures of the less coin, which I have called a *cent*, meaning $\frac{1}{100}$ of a florin, being the same as the *mil* of the Parliamentary Committee.

| £ | s. | d. | | Florins. | | Cents. |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | equal to | 10 | or | 1000 |
| 0 | 1 | 0 | " | $\frac{1}{2}$ | " | 50 |
| 0 | 0 | 6 | " | $\frac{1}{4}$ | " | 25 |
| 0 | 0 | 1 | " | $\frac{1}{24}$ | " | $4\frac{1}{6}$ |
| 0 | 0 | $0\frac{1}{4}$ | " | $\frac{1}{96}$ | " | $1\frac{1}{24}$ |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 Fl. | equal to | £$\frac{1}{10}$ | or | 2s. | or | 24d. | or | 96f. |
| 1 Ct. | " | £$\frac{1}{1000}$ | " | $\frac{1}{50}$s. | " | $\frac{6}{25}$d. | " | $\frac{24}{25}$f. |

9. The system shown in the next table is adapted to the copper coinage so as to ensure complete convertibility, the farthing being the basis, and a coin of the value of 100 farthings (2s. 1d.) the unit, which we may call a *half-dollar*.

| £ | s. | d. | | Half-Dollar. | | Farth. |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | equal to | $\frac{48}{5}$ | or | 960 |
| 0 | 1 | 0 | " | $\frac{12}{25}$ | " | 48 |
| 0 | 0 | 6 | " | $\frac{6}{25}$ | " | 24 |
| 0 | 0 | 1 | " | $\frac{1}{25}$ | " | 4 |
| 0 | 0 | $0\frac{1}{4}$ | " | $\frac{1}{100}$ | " | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2s. 1d. | equal to | £$\frac{5}{48}$ | or | $\frac{25}{12}$s. | or | 25d. | or | 100f. |
| 0s. $0\frac{1}{4}$d. | " | £$\frac{1}{960}$ | or | $\frac{1}{48}$s. | or | $\frac{1}{4}$d. | or | 1f. |

These two systems are practically the same as the £1 and £1 0s. 10d. systems, £1 being 10 times the florin, and £1 0s. 10d. 10 times the 2s. 1d.

10. These appear to be the only two systems calculated to carry out the objects referred to in paragraph 1, and the contest will probably be finally between these two. But many others have been proposed, which it will be well to dispose of before comparing these.

11. Some have proposed the half-sovereign as unit, the shilling being thus retained as a coin of account, new coins of $1\frac{1}{5}$d., and $\frac{3}{25}$d. being introduced as the 10th and 100th of the shilling. But this is objectionable, as involving the trouble of multiplying or dividing by 2 in changing pounds to half-sovereigns, or *vice versa;* and in having its lowest coin, $\frac{3}{25}$d., smaller than is necessary, besides the objection on account of the want of complete convertibility; while, if $1\frac{1}{5}$d. be taken as the lowest coin, that would be too great. It is to be observed also, that there is no great end gained by having the shilling as a coin of account. It will be retained as a useful coin under the florin system; and florins and shillings will be mutually convertible by multiplying or dividing by 2, which will not be troublesome in this case, as there never will be more than 19 to divide, or 9 to multiply by 2, operations easily done mentally and almost instantaneously.

12. Another system, which has made some noise by the activity of its author, Mr. Theodore Rathbone, is that of the tenpenny piece and the penny. To this there appear many and insuperable objections. It is not decimal; to bring tenpences to pounds we must divide by 24, or, which is little less trouble, perform the operation described by Mr. Minasi, in p. 259 of No. 119 of the Journal. Either of these operations is nearly as troublesome as the present method of bringing farthings to pounds—dividing by 4, 12, and 20; so that it is difficult to see what object would be gained by the change if we keep to the pound; and if we give it up the transition is still very troublesome. Besides, it has both the inconvenience of inconvertibility, and of too small a lowest coin if we divide the penny into tenths; and the lowest coin is too large if we do not descend below the penny.

13. Then there is the 8s. 4d., or 100 pence system. But this also seems inadmissible, as the penny is too large for a lowest coin, while the $\frac{1}{10}$d. is too small and has the inconvenience of inconvertibility; also, the conversion of 8s. 4d. coins into pounds would be troublesome.

14. Another method is to take the halfpenny as the lowest coin of account, the leading coin or unit being the dollar (100 halfpence, or 4s. 2d.). But it is questionable if the halfpenny is sufficiently low in value for the smallest coin of account; the tenth of the halfpenny would be undoubtedly too small; and bringing dollars to pounds and shillings are troublesome operations. The dollar is $\frac{5}{24}$ of the pound, and $\frac{25}{6}$ of the shilling.

15. Thus, by the method of exhaustion, we arrive at the two systems of which tables are given above, as the only practicable plans for a new coinage arranged decimally, and have now to compare these. It must be observed that, in aiming to make the mutual conversion of the old and new money easy, our object is to enable ordinary arithmeticians to execute it with quickness and accuracy. This will be best ensured when few acts of computation and few figures are required — when the operation approaches, as near as may be, to the simple inspection and separation of figures.

16. To change any sum in the new coinage, on the florin (or pound) system to our present money is an easy and almost instantaneous operation, except with sums under 6d. The fourth figure, and all to the left of it, are pounds; the third figure doubled gives shillings; the two right-hand figures are cents, of which 50 give a shilling, or every 25, 6d., and for any number less than 25 take one farthing less than the number of cents. Thus, to find the value of 236 fl. 70 cents, the fourth and fifth figures taken as pounds, give £23; the third figure doubled gives 12s., 50 cents give 1s., and 20 cents give 19 farthings or $4\frac{3}{4}$d.—in all £23 13s. $4\frac{3}{4}$d. This is within less than one farthing of the exact value. If the exact value is required, subtract the number of surplus cents (less than 25) from 25, the remainder will give the number of 25ths of a farthing—thus, 20 from 25 leaves 5; accordingly 20 cents are worth exactly $4\frac{3}{4}$d. and $\frac{5}{25}$ of a farthing. Changing the old coinage into the new, is also a simple process, the reverse of that just given. The pounds will occupy the fourth place, and those to the left; the shillings, divided by 2, give the florins, to be put in the third place; for an odd shilling take 50 cents; for 6d., 25 cents; and for less than 6d. take as many cents, and as many 24ths of a cent as there are farthings. The latter can be disregarded, if thought proper. Thus, £437 17s. $7\frac{3}{4}$d. becomes in the new coinage 4378 fl. 82 cents, and $\frac{7}{24}$ cent, which is obtained in a moment, as follows:—the £437 give the same figures in the fourth, fifth, and sixth places; the 17s., divided by 2, give 8 florins, for the 3rd place with 1s. over, which gives 50 cents for the 1st and 2nd places; 6d. gives 25 cents; $1\frac{3}{4}$d. gives as many cents as farthings, or 7 cents and as many 24ths of a cent, in all 82 $\frac{7}{24}$ cents.

17. Such are the easy and quick operations by which, on the pound system, the old and the new coinage would be mutually convertible with perfect accuracy for all sums of any number of sixpences; and within a farthing for a less sum than 6d. Some might prefer the usual arithmetical rule for the conversion of money into the decimal of a pound; but the above rules are equally expeditious and seem simpler for those not acquainted with decimal fractions.

18. On the other system, in which the farthing is taken as the lowest coin, and we decimalise upwards from it, the two right-hand figures are farthings, the 3rd. and others represent coins of 2s. 1d. each. To change any sum in a new coinage of this description to the old monies of account, the simplest method seems to be to view the whole as farthings, and divide by 4, 12, and 20; and conversely, to express our present money in such a decimal system, reduce it to farthings by multiplying by 20, 12, and 4: the two right-hand figures will be farthings, the others, coins of 2s. 1d. Thus, 227·23 or 227 half-dollars, 23 farthings, will be £23 13s. $4\frac{3}{4}$d.*

19. Each of these two systems may be considered as meeting the three first requirements mentioned in par. 1. They are thoroughly decimal, of two coins of account, and the lower coin is, in one, $\frac{1}{4}$d., in the other $\frac{24}{25}$ of $\frac{1}{4}$d. It is in their relations to the existing coinage that they differ. One is more easily convertible into the existing gold and silver coinage; the other into the existing copper coinage. The dealings of the poor man are greatly in copper, those of the richer classes in silver and gold. Hence it has been thought to be a question of the convenience of the rich *versus* that of the poor. But it is very doubtful indeed if this is a correct view of the case.

20. With respect to this question, the poorer or humbler orders may be divided into two classes; those who buy and sell and must keep accounts, either in books or in their heads, and those who receive daily or weekly wages, and have no occasion for any reckonings beyond a few shillings of wages or a few pence for the small quantities in which they make their purchases for their own consumption.

21. There is a very large class of poor, ill-educated persons, engaged in trade, who make a scanty living by means of small profits on considerable quantities of goods passing through their hands; the pound and shilling columns are the important columns to them; the pound is their standard of value, the ultimate form to which they bring their cash transactions—the measure of value to which they have been accustomed—the test of the result

* If the dollar (4s. 2d.) were taken as the unit, then the whole must be taken to express halfpence, which would be brought to our present money by dividing by 2, 12, and 20, (or 12 and 40); and conversely, from £ s. d. to halfpence, by multiplying by 20, 12, and 2, the two right-hand figures being halfpence, the 3rd and others, dollars.

of their operations. That very numerous and useful class of small dealers would be greatly incommoded by any new system of money-reckoning that did not harmonise with the pound sterling; and for their sakes alone, to say nothing of tradesmen and merchants with more extensive dealings, it seems important that the decimal system to be adopted should rest upon the pound as a basis, or bear some very simple relation to it.

22. The poor of the other class live from hand to mouth, seldom see or possess a pound, keep no accounts, and use largely the copper coinage. It is chiefly for the benefit of these that the outcry about "the poor man's penny" has been raised. No doubt it would be a convenience to that class were the copper coins retained of their present value. But their very poverty would sharpen their intelligence, and make them learn very quickly the value of the new coins or altered value of the old ones; the vast educational power now in the country would instruct their children in less than a fortnight; simple tables would show them at a glance the comparative values of the old and new coins; 25 cents for 6d., and any number of farthings being equal to a trifle more than the same number of cents, would prevent them being materially wrong in any case; and the competition among dealers, which now adjusts prices fairly to the varying value of commodities, would soon fairly adjust the quantities of the latter to the changed value of the small coins. These considerations, it appears to me, render it perfectly unnecessary to take into account any little and short-lived inconvenience that this class may suffer from the change.

23. Much has been said about the inconvenience of a change in those public rates that have been fixed at a penny, or a certain number of pennies, as the stamp for newspapers or receipts, the postage stamp, tolls, &c. This difficulty has been very much exaggerated; there are many ways of adjusting it, as by a discount for a number, charging 5 cents ($1\frac{1}{5}$d.) for the receipt stamp, 4 cents, ($\frac{24}{25}$d.) for the postage stamp, &c., not quite so easy, of course, as if the same coin at the same value were retained, but still so simple and manageable, that it is surprising that any such difficulty should have been brought forward at all.

24. If, then, we determine the question by the convenience of that very large class, of both rich and poor, that have to keep accounts, the decision must be in favour of the pound system; and that not only because the *pound* is preserved, but on account of the simple relation it bears to the *shilling*, which, next to the pound, is the great measure of value; wages, and the prices of so many commodities being usually expressed in shillings. For the reasons already assigned (pars. 2 and 5), the much lauded penny cannot be used as a coin of account; and a tedious operation, involving many figures, and very apt to cause errors, is required to show us the number of pence, shillings, and pounds in any sum expressed on the farthing system. Every convenience, save one of secondary importance, is in favour of the pound.

I am, sir,
Yours, &c.,
H. REID.

March 5, 1855.

## PROFESSOR WILSON'S PAPER, AND THE DISCUSSION ON THE IRON INDUSTRY OF THE UNITED STATES.

Sir,—I have read with considerable interest, the paper on this subject in your last number and the ensuing discussion, especially the part which refers to producing wrought-iron direct from the ore. It is well-known that my late father, in a very early stage of his career, directed attention to this subject; he more than once produced specimens at the meetings of the British Association, and at the period of his decease had been engaged in more complete experiments as to its practical realisation. In treating the hæmatites of the North of England, and indeed generally, he found that a great defect in the produce arose from interlamination of earthy matter, which, in the absence of the fusion of the blast furnace, remained attached and tended to exfoliate the bars; and the great loss by oxidation experienced in balling up the deoxidated material, proved a serious drawback to economical success. But preliminary difficulties quite as serious were surmounted, by perseverance and skill, at the commencement of the modes of manufacture now prevailing. The arrangement described by Dr. Percy seems extremely suited to prevent such undue waste, and it also appears, that Mr. Renton's process is about to be tested in Wales. But though I have no doubt that, by experiment and moderate outlay, excellent iron may be produced from properly selected ores, and even profitably for some purposes, it remains extremely improbable if this mode of manufacture will become general, much less supersede the existing modes by fusion and subsequent de-carbonisation, in which such a vast plant and capital are embarked. The spirit of the age promotes *quantity* of production far more than *quality*, as well illustrated by various speakers in reference to railway iron. The blast furnace is suitable for the reduction of every kind of ore, either separately or in mixture, and the immense convenience of such a process is not likely to be generally superseded by a means, to whatever perfection it may be brought, which needs more careful manipulation and exclusive selection. Details requiring much nicety do not soon find general favour. They demand peculiar intelligence in the manager, and give extra trouble with the workmen. The best railway iron in Wales is, I believe, from the works of the Messrs. Hill, of Plymouth, and it is manufactured by the aid of a patent process of my father's (now expired,) in which pure hæmatite is introduced to the puddling furnace; thus by a double decomposition metallising the oxide with the carbon of the pig iron. But Mr. Anthony Hill has long been distinguished for his attainments in scientific metallurgy, and it is by his skill that the process has been worked to a perfection which ordinary managers would not be, and have not been, at the pains to realise, even though a vast economy as well as improved quality is the result. I am, therefore, less sanguine than Professor Wilson on the introduction of a new process, requiring the rare and difficult union of practice and science. Indeed, an invention likely to change our present establishments would have to overwhelm them, rather by a proportionate increase in obtaining quantity. It was thus that the puddling process, by the facility it afforded of manufacturing on an enlarged scale, displaced the previous method with its superior quality, while even this last feature, when an especial object, is amply obtained by judicious care in the later method. The clay ironstones contain too much earthy matter for treatment by direct deoxidation, and the similar enormous deposits now discovered in the oolitic group, will tend still further to retard in this country any recurrence to the primitive manufacture of blooms without fusion. As to the importation of ores from America, I concur in thinking that event is at a still greater distance. There are magnetic ores of great richness in this country, which remain unworked, solely because there is a sufficient supply without them, though it certainly may be added, in favour of Mr. Renton's or some other such process, that protoxides of iron possess properties not so favourable to the reducing action of the blast furnace as the ordinary peroxides, and especially when used in mixture with them. As to the ten per cent. in imported weight by absence of water which it is alleged would be gained over the ordinary hæmatites, this is not entirely correct. The hematites of Ulverstone and Whitehaven, which form the principal supply, are not chemically combined with water; they are mere peroxides, combined with twelve to fifteen per cent. of earthy matter, principally silex, with traces of sulphur. The English hydrates are the hæmatitic ores of the Forest of Dean, and of the southern basset of the Welsh carboniferous limestone at the gorge of the Taff Valley. They contain above eight per cent. of water, without a trace of sulphur, and an

appreciable quantity of potash and soda. Such hydrates are peculiarly suited for deoxidation, assuming a porosity by the discharge of the watery constituent, which facilitates the entrance of the carbonic oxide, now generally understood to be the agent which removes the oxygen, and imparts carbon during reduction. The alkali is likewise favourable to the elimination of the earthy alloys, and it was from such ores that my father obtained the most successful results of a perfect malleable iron direct from the ore, convertible into steel equal to the best Swedish. But no quantity of compact ore could be raised for the scale of manufacture.

I see reference in the discussion to an alleged new discovery, which has been circulated with much sensation. I can hardly account for the error, except from the unfortunate habit, which has long prevailed in mining publications, of falling upon incorrect intelligence. The iron ore of the Brenden Hills, in Somersetshire, is by no means the novelty now represented. It is twenty years, at least, since the late Sir T. Lethbridge supplied this ore from the old workings scattered over the hill, to the Victoria Works, in Monmouthshire; since which numerous parties have either leased or treated for leases of the veins. In 1846 I myself had 100 tons of the ore smelted at my works in the Forest of Dean. It was a massive red ore or hæmatite (so called), extremely dense, principally protoxide of iron, with six to eight per cent. of earthy matter, lime, silex, and alumina in nearly equal proportions, and something less than one per cent. of sulphur. Used in mixture I cannot positively assert the quality of the product, but incline to judge it hard and refractory. To demonstrate this "spathose," *i.e.*, sparry ore, is quite a misnomer. But the novelty is this:—there are three veins indicated by the old workings; my ore was from the most northerly. Early in 1849 I inspected an adit being driven on the south slope of the hill, by a lessee from Sir Thomas, to meet the southern vein. In 1851 I was informed the vein was struck, and, instead of cutting the dense red ore, similar to the fragments seen at the cross-workings (which at this point is unusually wide), a deposit was intersected of what the Cornishmen term white carbonate, yielding about thirty per cent of iron, with traces of copper. Surely, such a vein, about four feet average width, intermittent with dead ground, and to be wrought by deep mining, is very inappropriately brought into comparison with the enormous deposits of Northamptonshire, where the ore, royalty and every charge included, is loaded on the canals at less than 2s. per ton! It is not this "spathic ore," but the dense red ore, which will serve the purpose of the ironmasters over the channel. Excepting the specular protoxide of Buckfastleigh, it is, indeed, the richest English ore I have ever seen, the masses yielding 72 per cent. of iron, and with a liberal outlay a good deal of this may be raised, provided the veins do not *metamorphose* into the "*spathic ore.*" Pockets of rich ore, a few feet thick, embedded in soft watery slate, with considerable intervals of dead ground, do not, however, present the mining facilities afforded by the caverns or chasms of ore in the hard carboniferous limestone. In fact, I was much discouraged, in the end of 1849, on inspecting the results of a deeper adit of Sir T. Lethbridge's, on the north side of the hill, brought up by a water-wheel, a few yards below the pocket which produced the above 100 tons of rich ore. As to "novelty," Mr. Blackwell, and others, in 1849, sank trial-pits for the red ore, under advice (I was told) of Sir H. De la Beche. In 1852 some hundred tons of the lean "spathic" were shipped to Wales, but could not obtain a price that was remunerative. Much or little, rich or poor, the ore would, undoubtedly, be carried more economically to the shipping port by a railway, and such a means of carrying up lime for all the Exmoor district would be more beneficial to the land. The distance to the mines from Watchet is just that from Balaclava to Sebastopol, and the elevation of ground twice as high; but I do not see why this useful event should be promoted by startling both the old and new worlds with a geological announcement that is incorrect.

Of all situations where a good process, such as Renton's, or any other for producing malleable iron by direct deoxidation, would be invaluable, I should point out the works of the East India Iron Company, on the Malabar Coast. Here the material, the celebrated wootz ore, is already pulverised;—it is an iron sand, from which every particle of earthy matter can be easily removed by mechanical means. Does it not appear a great anomaly to subject such a pure protoxide to the process of the British blast furnace, devised and perfected especially for extracting a minority of metal from a majority of earths in our clay ironstones? For cast-iron the blast furnace must, of course, be employed; but to make wrought iron by first carbonising, and then decarbonising such a material, seems, surely, a circuitous and mistaken process. No attention whatever has been given to perfecting the primitive process of ironmaking, by applying to them the lights of increased skill and science. They have been merely superseded by circumstances. A new class of materials—pit-coal and ironstone—have dictated a new mode of treatment, very much by rule of thumb, for it has been by very slow degrees that any scientific principle has been able to find its way into practice. To import a child of circumstances to circumstances entirely opposite, is scarcely scientific in a sound sense. The knowledge but so lately acquired of the nature and action of carbonic oxide gas opens a vast field for intelligent improvements upon the early and then entirely empirical process of ironmaking. The furnace described by Dr. Percy seems to coincide with some plans of my own for employing carbonic oxide to prevent waste in balling the deoxidated ore, and I should recommend it to the earnest attention of those who possess the suitable material. I am, sir,

Your obedient servant,

DAVID MUSHET.

London, March 8th, 1855.

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Sir,—May I request insertion for a few remarks upon the letters which appeared in the *Society's Journal* of last week, in reference to my recent paper on the "Iron Industry of the United States." The principal part which I wish to notice, in Mr. W. B. Adams's lengthened communication, is that in which he *mis-quotes* my statement explanatory of the increased cost of English pig-iron in the United States, and then, basing his own calculations upon this *error*, complains that "the statement is not clear." If instead of 20 shillings, he reads 20 dollars as the price at New York, I think his calculations will come out the same as those given. In the sentence following, also, I must differ from him. He says, "if it be practicable to pay freight for American ores *from* New York, as Mr. Wilson intimates, as ballast, English pigs can also go as ballast *to* New York." I think this is a *sequitur* that but few persons will be inclined to admit, especially those at all acquainted with the export trade of the two countries. The questions of labour, wages, climate, can probably be revived, if desirable, after Dr. Smith's paper on the 28th. They cannot be discussed satisfactorily in this Journal.

In my paper I avoided giving more statistics than were necessary for the objects which I wished to bring more particularly before the Society, from a desire to reduce the time occupied by it, and thus allow more for the discussion. I regret that Mr. Simmonds has not made his contribution more complete; at the same time I ought to mention that the Census returns are open to some doubt, as in the iron returns for the states of New York and Pennsylvania, furnished respectively by the state and by the Ironmasters' Convention, a very considerable difference is exhibited, amounting in the one case to about 23 per cent., and in the other to 40 per cent.

In another branch of production which I had to investigate, I was led to draw the same conclusion. The dis-

cussion hardly took the turn I wished, inasmuch as the really *practical parts* were barely touched upon, most of the speakers contenting themselves with discussing the *political* instead of the *industrial economics* of the subject, and with defending our ironmasters from a charge which at the utmost could only be an *inference* from what I said in speaking of the readiness of the Americans to adopt new processes to economise labour and to utilise waste products.

I am, &c.,
JOHN WILSON.

Iver, March 20th, 1855.

## THE SMOKE NUISANCE.

Sir,—Mr. Muir's elaborate reply, in your Journal of the 2nd instant, to my brief remarks of the 29th of January, does not meet the main point at issue by any narration of *facts;* although his "*opinions*" are repeated in the tone of one who expects to have his individual *dicta* accepted as that of an unquestionable authority.

It is very easy for Mr. Muir to say, where the boiler capacity and fire surface are in due proportion, and the other local conditions are good, that proper attention by the fireman will enable him to prevent the formation of smoke as well *without* as *with* a smoke preventing apparatus; but if that statement be based upon actual demonstration, he certainly ought to furnish the particulars; and until he submits such *data* to examination—until he proves what he has affirmed—relying on my own practical proofs to the contrary, I shall maintain a decided negative to his conclusions.

After so long a lapse of time, it had no doubt escaped Mr. Muir's recollection, that the fireman at Messrs. Miller, Ravenhill, and Salkeld's works, explained (apparently to his satisfaction) the accident (not inattention) which caused the emission of smoke on our entering the premises. But even adopting Mr. Muir's version of the matter, his influence in my disfavour, in the single case adduced out of examination of my system, which he says occupied two "forenoons," is amply covered by the more enduring satisfaction of the eminent engineering firm referred to, who have since then had the remaining steam-engine furnaces at Glasshouse-fields fitted in the same manner as the first, and to whom I am indebted for many recommendations to their neighbours and other friends.

Mr. Muir, referring to my affirmative observations, says "I did not omit all mention of my experience as inspector at Glasgow;" but he fails to point out a single passage, either in the paper he read to the Society or the discussion which followed, wherein any such mention can be found. His reference to "Juckes' furnace" carried with it no such interpretation. On the contrary, it rather conveyed the impression that he was then acting as an agent for Juckes' furnaces.

With respect to the relative opinions of Mr. Fairbairn and Mr. Muir, I am bound to admit that the new evidence produced by the latter is essentially and materially in his favour; and Mr. Muir may well be pleased at an approximation to his own ideas, on some points, by a gentleman of such high attainments, practical and scientific, notwithstanding the difference that *still* remains between them as to the best legal means of suppressing the smoke nuisance.

And unshaken in my preference to practical experience over theory and imperfect exposition,

I am, sir,
Yours very truly,
J. LEE STEVENS.

1, Fish-street hill, City, 14th March, 1855.

Sir,—I am afraid that a prolonged discussion on the Smoke Nuisance will not be very acceptable to your readers, for the understanding of the subject requires an acquaintance with the construction and action of manufacturers' furnaces, which the public generally have not the means of acquiring. This discussion is the more irksome because, really and truly, the matter at issue is not of the very slightest practical importance. If smoke can be *prevented* from issuing into the atmosphere, it is not of the least consequence whether that result arise from preventing its formation, or burning it after it has been formed. The writings of Mr. Williams have given a mischievous currency to his peculiar notions, which, however theoretically correct, and distinguished from others, are, nevertheless, practically useless. Mr. Williams's review is a continuous sneer at my presumption in appearing as an instructor before so important a body as the Society of Arts. I might, sir, have been justly liable to some censure, if I had appeared after having spent the lengthened period of 20 years, which Mr. Williams has done, and made as little progress to a knowledge of the subject.

But, sir, let your readers remember that the points upon which I at first differed with Mr. Williams were but two, viz., 1st. the non-combustibility of smoke; and 2nd, the alleged *necessity* for admitting air to the interior of the furnace above the fuel, not in one volume, but in *numerous films or jets.*

Let it be observed also, that in his long review, Mr. Williams does not notice the second head of difference, I imagine for the very simple reason, that the evidence of Mr. Houldsworth, which I quoted at large, (and to which Mr. Houldsworth has since informed me he adheres,) was quite conclusive proof, that it is not only *not necessary* to admit the air in films or jets, but that it makes little practical difference how or where it be admitted, provided only that the requisite *quantity* be admitted. There remains, then, but the solitary question of the combustibility or incombustibility of what is called *smoke*, Mr. Williams contending that it is incombustible, while I consider that the term "Smoke Combustion" is correct, both *practically and scientifically.* Now, it may save confusion if I here explain what I mean by a thing being combustible. By that term I understand the property of being decomposable, the decomposition being accompanied by the production of light or heat, and in this sense smoke is combustible. Mr. Williams, though in general he makes the broad assertion, that smoke once formed is incombustible, says in the second sentence of his treatise, new edition, "when smoke is once produced in a furnace or flue, it is as impossible to burn it or convert it to heating purposes, as it would be to convert the smoke issuing from the flame of a candle to the purposes of heat or light." Sometimes this unqualified and most incorrect assertion is guarded, (see page 235 of his treatise) as follows:—"we see, then, how palpably erroneous is the idea, that smoke, once formed, can be consumed *in the furnace in which it is generated.*" In his evidence before Mr. McKinnon's committee, Q. 1230, Mr. Williams says, "I consider the *combustion of smoke* where it is generated, to be a physical impossibility, because, if the oxygen is there it will be consumed; if the oxygen is not there smoke will be formed." I am quite willing to give Mr. Williams the benefit of this qualification, and yet undertake to prove him wrong; and to show beyond dispute that smoke may be formed, and afterwards burned in the furnace, or in the flues leading from the same furnace in which it has been generated.

Though not a disciple of Bentham's, I am accustomed to follow his excellent rule of always calling the same thing by the same name, and, generally speaking, I am quite content to apply the term usually employed to designate an object. Thus I am accustomed to call smoke, smoke; and gas, gas. Mr. Williams, however, says that is *not* smoke which the public call smoke—he says it is *gas*, not smoke. And then he will triumphantly turn round and say, *gas can be* burned, but *smoke cannot.* Let Mr. Williams call the thing by whatever name he pleases, it will remain the same thing still. He may try to change the term "smoke nuisance" to "gas nuisance," but if he does he will not be understood. If his analysis of smoke be correct, the term "carbon nuisance" would be the

most appropriate; but what difference would that make, further than proving Mr. Williams to be utterly wrong when he asserts that smoke, viz., carbon, is incombustible? I confess I was puzzled when I began to study this question, but nothing puzzles me now except Mr. Williams' pertinacious adherence to his distinction without a difference. I know what smoke is, and, moreover, I know how to burn it, much better than any of Mr. Williams' high chemical authorities, who have no practical knowledge of the matter, could teach me. But even these very authorities either support my position, or confess their want of practical knowledge. What did Mr. Solly, of the Royal Institution, say, when examined before Mr. M'Kinnon's committee?

Q. 1741 "Do you think perfect combustion is likely to be produced better by admitting air entirely through the bars, or by admitting the air both under and above the bars?"—Answer. "That must depend upon the operations of the stoker, AND THE QUANTITY OF COALS. If the coals are very evenly and smoothly spread all over the surface of the bars, *you may have perfect combustion from the air entering through the bars;* but if you have the coals heaped on only at one particular part, you cannot completely burn by the air merely introduced through the bars—*it will entirely depend upon the stoker.*" Mr. Solly is quite right, and surely I am entitled to claim him as a witness in proof of my assertion, that even with a well-constructed furnace and adjuncts, *management is necessary.* With a good draft and a good stoker, smoke may be burned without the admission of air above the fuel. What does Mr. Faraday say?

Q. 2005. Is it the impure coal-gas evolved after the fresh charge of fuel which originates the smoke, when not properly supplied with air?—Answer. Partly. It is a very mixed question. When a fresh charge of coal is put upon the fire, a great quantity of evaporable matter, which would be called *impure coal-gas,* according to the language of the question, is produced; and as *that matter travels on in the heated flue,* if there be a sufficient supply of air, both the hydrogen and the carbon are entirely burnt. But if there be an insufficient supply of air the hydrogen is taken possession of first, and the carbon is set free in its black and solid form; and if that goes into the cold part of the chimney *before fresh air gets to it,* that carbon is so carried out into the atmosphere, and *is the smoke in question.*"

Now Mr. Faraday may be claimed as a witness to prove that the discharge of carbon in its black visible form into the atmosphere, depends upon its meeting with a fresh supply of air *on its way to the chimney after formation;* and thus his evidence may be accepted as proof against Mr. Williams' assertion, that "smoke once formed cannot be consumed in the same furnace where it is generated;" but he elsewhere confesses to a want of practical knowledge on the subject, for, in answer to Question 2015, "Can the consumption of smoke take place after it is formed, with a saving of fuel?" he says, "I have not practical experience enough to answer the question." But Mr. Williams' chief dependence is placed upon the certificate of Professor Brande. Now, I consider that gentleman's opinion is not worth much, because he frankly stated to Mr. M'Kinnon's committee that his experience was very small. Here are his own words in answer to Q. 1869—"I should beg leave to state to the committee *that my practical knowledge upon the subject is very limited,* and that I cannot put that at all in competition with the practical knowledge of the gentlemen who have been before you. With reference to the *theory* of combustion, if there are any points relating to it upon which the committee require any information which I can give them, it will probably be more within my scope."

I have before referred to the evidence of Dr. D. B. Reid. I shall finish my reference to *authorities* by another quotation from his evidence. In reply to question 2098, he says:—"Take an ordinary boiler, where you have, as is adverted to by other witnesses, no extraneous admission of air whatever, none but what comes through the furnace bars, none let in on the top, none admitted behind, none admitted at the side, but where you have a careful stoker, and where you have, in an especial degree, large fire room in proportion to the duty to be done, what is the effect in such a case? If a certain amount of air be permitted to enter, and the bars have a certain width or opening, air may be introduced (if the bars be not overloaded with fuel, which is a necessary position in this case,) in sufficient quantity to consume the actually produced cinders, and there may be introduced *enough also to pass by the cinders* (if they are sufficiently free and open) *to lay hold of the material above, that would otherwise appear ultimately as black smoke.*" Surely, sir, I am entitled to take Dr. Reid as an authority against Mr. Williams' assertion, that it is *necessary* to admit air above the fuel to consume the gases. The necessity truly depends (as Dr. Reid has correctly put it) upon the depth of fuel laid on the bars, that, in other words, is, on the careful *management* of the furnace. But, further, the appendix to the report of Mr. M'Kinnon's committee, contains a formal definition of smoke, carefully prepared by Dr. Reid. As my object is simply to aim at the truth, and not to support any preconceived theory, I will give the Doctor's definition, which your readers may compare with Mr. Williams's.

"BLACK SMOKE, *that nuisance to which the attention of the Committee is directed,* consists essentially of carbon separated by heat from coal or other substances, and is commonly mixed mechanically with carbonic acid gas, carbonic acid, and other matters mentioned in the following paragraphs:—

"1. If this smoke shall have been produced at a very high temperature, the carbon forms a very loose and powdery soot, comparatively free from other substances.

"2. The lower the temperature at which black soot is formed, the larger the amount of other substances with which it is mingled, among which the following may be more particularly mentioned.—Carbon, water, resin, oily and other inflammable products of various volatilities, ammonia, carbonate of ammonia.

"3. When the carbon, oils, resin, and water, are associated together in certain proportions, they constitute *tar.* Soft pitch is produced if the tar be so far heated that the water is expelled, and hard pitch, *i.e.*, resin blackened by the carbon when the oils are volatilised. A further heat resolves the pitch into permanent gases and carbon.

* * * * * *

"7. Black smoke is always *associated with* carburetted hydrogen gases, composed of carbon and hydrogen in various proportions. These may be mechanically blended with the oils and resins, but must be carefully disguished from them. They form, more especially when in a state of combustion, the inflammable matters that constitute flame—the luminousness of that flame being enriched by the amount of carbon and of oily and resinous matters associated with it."

I beg particular attention to the following; as I read it, it is decisive as to Dr. Reid's opinion that smoke may be produced in one part of the furnace and consumed at another.

"8. Smoke that contains much oily and resinous matter at one part of a furnace, may become in a great measure carbonaceous and gaseous at another."

I am no theorist, sir, but a plain, practical man, who entered on the examination of the smoke question with unbounded faith in patented apparatus, and have been driven from that faith by stubborn facts, showing their utter uselessness; and my practical experience enables me to distinguish between sound science and that which is falsely so called.

But, moreover, Mr. Williams has, in his own elaborate work proved conclusively that—whatever he may say or think—he is truly a smoke-burner. To go no further, look at diagram No. 41, page 95 of his treatise. There

the coals are exhibited burning and evolving smoke upon the fire-bars, and behind the bars is shown his diffusion boxes supplying air for the combustion of the *smoke after it has been formed* out of the furnace into the flue. Mr. Williams' process is identical with that of some fifty other patents. He has very justly and effectively written of late against *re-inventions*; is he not aware that his own patent was but a re-invention? In the year 1828 a Mr. Gilbertson patented a mode of supplying air behind the bridge by means of a box, the upper part of which was formed so as to divide the air into thin films, for the purpose, as he says in his specification, of *diffusing* it.

That the great bulk of visible smoke (and we have nothing to do with that which is invisible) is formed from the fresh fuel being thrown upon the top of the incandescent, and not from flame insufficiently supplied with oxygen, as in the case of an oil lamp, is proved by the action of Juckes' furnace, where the flame produces no smoke, although no air is admitted into that furnace but through the bars among the fuel. Mr. Williams quotes the opinion of Mr. Newlands, of Liverpool; why, the last time I saw Mr. Newlands, and conversed with him on this very subject, he said, "the best plan of smoke burning that I know of is to have a boiler larger than is otherwise requisite." Mr. Newlands, is, however, no authority on smoke burning. If he were, how is it that the Liverpool Committee on Smoke Nuisance consult Mr. Fairbairn, and send deputations to Manchester, to get information about smoke nuisance prevention? Against the opinion of Mr. Newlands I will quote that of Mr. Bourne, who, as editor of the Artisan Club treatise on the Steam-engine, thus speaks of Mr. Williams' patent:—"Of all the smoke burning schemes that have been brought forward at this or any other epoch, there is none that has been ushered before the public with more noisy pretension than that of Mr. C. W. Williams, yet the project is one of very slender merit; and so hard are its perfections to be discovered that Mr. Williams has had to write an octavo volume to point them out. This furnace, which we need not delineate, differs in scarcely any respect from the previous schemes of Gregson and others, except in the single feature of admitting the air by many holes instead of by two or three; but even this innovation had been brought into use before the date of Mr. Williams' plans, though, indeed, it is hardly worth while to rob him of the praise of this originality, seeing how small must be its value. Mr. Williams says his is not a smoke-burning furnace, and we are sorry to hear it. It is certainly a smoke generating furnace, and if the smoke be not *burned* it must pass off unconsumed. We know, indeed, that it will be argued that it is *gas*, and not *smoke*, that this furnace produces, and we have not the least objection to call the aëriform matter passing over the bridge by that name if it gives Mr. Williams any gratification. But in that case it is obvious that it must have been gas that Mr. Gregson, and others of his fraternity, burnt also; so that Mr. Williams' scheme is as far from enjoying any distinction on that score as ever, whatever name be given to its gaseous products. It is no doubt better, if air is to be admitted into the flues of a boiler, that it should be let in by many orifices instead of by one or two; and it would, we think, be a further improvement to *divide the smoke in the same manner*. But in whatever way the air be admitted, the aëriform matter is the same in Mr. Williams' furnace as in any other; and to pretend that a mere difference in the number of holes can change its nature, is just about as absurd as it would be to allege that water would be turned into wine by passing it through a sieve."

The above was written many years ago. What is the latest opinion of a competent authority "as to the *efficacy* of Mr. Williams' plan for the prevention of smoke?"

In the case of Goodall, at the Police Court at Clerkenwell, reported in the *Times* but a few days ago, Mr. Wright, the government inspector, is reported to have said:—"The apparatus in use is Mr. Williams' apparatus, but although it is one of the original inventions, it fails oftener than any other." The fact that an apparatus succeeds in one place and not another, is itself proof that success is not the effect of the apparatus, but of conditions which exist in some places and not in others.

Mr. Williams joins issue with me on the point as to whether chemistry or mechanics is the more important science connected with furnaces. If the chemist could supply us with a new fuel, or change the nature of that we now use, I would at once place that science in the first rank, but, sir, when I find that no such change is made, and that the effect to be produced depends upon mechanical arrangements, and not chemistry, then I am justified in giving the place of honour to the mechanician and not to the chemist. But that is not the true issue; it is, whether Mr. Williams be right or wrong in his assertions, "that smoke once formed cannot be consumed, and that to prevent it, the supply of air must be admitted above the fuel, in jets or films." These two points are all that distinguish Mr. Williams from other inventors or writers on this subject. As to the manner of admission, Mr. Williams has not ventured to impugn the decision of his own witness, Mr. Houldsworth, and as to the terms *prevention* or *combustion* of smoke being the more correct, I hope I have made it clear that smoke, though once formed, may be *consumed*, aye, CONSUMED. I do not know a writer on any scientific subject, whose use of terms is so loose as Mr. Williams'. If he burns *gas* and not *smoke*, what kind of gas is it? There are many gases. If it be coal gas, that is carburetted hydrogen, which, Dr. Reid says, is largely mixed mechanically with black smoke. I really gave Mr. Williams credit for greater ability and a better cause, than to be driven, not to misquote me, but to pretend not to understand me, when I said, "Smoke is a compound of soot, dust, steam, and *gas*, of the same description as is supplied by the gas companies." Will Mr. Williams deny that the gas so supplied is carburetted hydrogen, and will he further deny that that gas is mixed mechanically with black smoke, not when supplied to him, but when smoke is discharged from a furnace? But, suppose the gas companies did not purify the products of distillation in the retorts, but distributed them as they are thrown off from the coal, what would Mr. Williams call the stuff that would then issue into his house?

Further, how does Mr. Williams now despise the eye, which he formerly called "that INFALLIBLE corrector of fallacies." What can be more fallacious than Mr. Williams' method of suppressing the smoke nuisance. If he be right, there is no such thing as vast volumes of blacks. It appears, from his analysis, that in smoke the visible matter is, compared with the invisible, "*utterly insignificant*." The elements of smoke, according to Mr. Williams, are:—*steam*, in *enormous* quantity, invisible and incombustible; *nitrogen*, also invisible and incombustible; *carbonic acid*, likewise invisible and incombustible; lastly, an "utterly insignificant" quantity of *carbon*, *visible*, but incombustible. If this be so, what has become of all the combustibles which Dr. Reid found in smoke? Mr. Williams thinks I have been led away by the once-prevailing error of imagining that all coloured vapours coming from burning substances are smoke. Has Mr. Williams forgotten a work written and published some ten years ago, entitled "On Increasing the Evaporative Power of Boilers"? Is it not the fact that at page 47 of that work, colour is mentioned as the only test in the furnace of the nature of gases, and is not the eye, at page 53 of that same work, called "that infallible corrector of theoretic fallacies."

I can assure Mr. Williams, that some years ago I carefully perused the first edition of his work, with a view to learn how to prevent smoke; but I rose from its perusal without having acquired one practical idea. I can assure him, moreover, that I have seen numbers of furnaces erected on his patent, and that their action in prevent-

ing smoke was identically the same as that of furnaces constructed according to the plans of those who professed only to prevent smoke issuing from the chimney by consuming it in the furnace.

As soon as the last edition of his work appeared I purchased it, and do not now regret the investment, but esteem it highly as a work from which much may be learned, but all that is peculiar to Mr. Williams' expired patent is practically worthless; and the assertion that smoke may be prevented from forming, but cannot be consumed if once formed, is, in Mr. Williams' own very expressive language, a "theoretic fallacy."

Though distressed by the length to which this paper has extended, I cannot conclude without giving an analogical argument to show how much more important it is to know how to cure an evil than merely to know what that evil is.

A furnace may with much propriety be likened to the human lungs, and a furnace with an insufficient draught may be likened to a person afflicted with shortness of breath, whether from asthma, bronchitis, or other diseases. In the case of the furnace the *breath* will, by its *blackness*, indicate the nature of the trouble, viz., the want of oxygen, and in the human sufferer the want of oxygen will be indicated by the convulsive efforts to obtain a supply for the decarbonising of the blood. Now men of science can tell exactly how much oxygen is required to combine with a certain quantity of carbon, but is the value of that knowledge at all to be compared with that of the man who can tell the patient how he can obtain an adequate supply?

There is such a thing as too much learning,—too much theorising, without having the ideas checked by practice. That, sir, is Mr. Williams' unfortunate condition. With a person in such a state of mind it is needless to contend so far as benefit to himself is concerned; but some service may be done by exposing his errors, and showing the estimation in which his opinions are held by such competent critics as Mr. Bourne.

Mr. Williams has become so theoretically exact as to be practically absurd. For example, in a note at foot of page 7 of his work he takes Dr. Lardner to task for saying that coal, when dropped into a furnace, is ignited. According to Mr. Williams, "*Coal gas* may be converted into flame, and *coke* may be ignited, but *coal* can neither be ignited nor converted into flame." The theoretical accuracy and practical value of this distinction is at par with his oft-repeated assertion that smoke is gas, and that, though smoke cannot be burned, gas may.

I am, sir, yours, &c.,

G. W. MUIR.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

Par. No.

*Delivered on 9th March*, 1855.

88. Vaccination—Copy of Memorial.
93. Metropolitan Buildings Act—Return.
94. Promotion and Retirement (Ordnance)—Copy of the Royal Warrant.
108. Tyne Conservancy—Correspondence.
109. Railway and Canal Bills Committee—1st Report.
52. Bill—Public Libraries and Museums (amended).

*Delivered on 10th and 12th March*, 1855.

95. Wheat, &c.—Return.
96. Savings Banks—Account.
97. Victoria—Copy of an Order of Council.
91. Blind Inmates of Workhouses (Ireland)—Abstract of Returns.
106. Incumbered Estates Court (Ireland)—Return.
107. Charity Commission—2nd Report.
112. Committee of Selection—5th Report.
110. Local Acts—(1. Belfast and County Down Railway; 2. Carlisle and Silloth Bay Railway and Dock; 3. Carmarthen and Cardigan Railway; 4. Cork and Youghall Railway; 5. Glasgow, Dumbarton, and Helensburgh Railway; 6. Stockton and Darlington Railway; 7. Swansea Vale Railway)—Reports from the Admiralty.

*Delivered on 13th March*, 1855.

101. Hops—Account.
102. Malt, &c.—Returns.
103. Brewers—Return.
104. Wool and Woollen Manufactures—Returns.
111. District Lunatic Asylums (Ireland)—Account.
115. Theological Professors, &c. (Belfast)—Amended and Supplemental Returns.

*Delivered on 14th March*, 1855.

War with Russia—Despatches from the Secretary of State in Reply to Communications from Governors of British Colonies.

SESSION 1854.

448. Indexes to Reports of Commissioners, 1832-1854 (Parliamentary Representation).

*Delivered on 15th March*, 1855.

85. Revenue Departments—Estimates.
105. Sewers (Houses of Parliament)—Report of Mr. Gurney.
53. Bills—Militia (Ireland.) (Amended)
55. Bills—Vacating of Seats in Parliament.

Trade and Navigation—Annual Statement.

Loss of the "Charlotte"—Report of an Investigation by Commander Robertson.

Lodging Houses (Metropolis)—Report by Mr. George Glover.

General Board of Health (Operation of Pipe Sewers)—Reports, &c.

*Delivered on 16th March*, 1855.

111. District Lunatic Asylums (Ireland)—Return. (A corrected Copy).
114. Education (Ireland)—Return.
116. Army (Regulation Price for the Purchase of a Commission, &c.)—Return.
117. Malt—Return.
118. Harbours, &c.—Report from the Board of Trade.
54. Bills—Price's Indemnity.
56. Bills—Marriage Law Amendment.
57. Bills—Friendly Societies. (amended.)

*Delivered on the 17th and 19th March*, 1855.

100. Barnstaple Election Petition—Minutes of Evidence.
121. Railway and Canal Bills—Report of the Board of Trade.
123. Lieut. General the Earl of Lucan—Correspondence.
58. Bill—Burial Grounds (Scotland)

Statistical Abstract for the United Kingdom, 1840 to 1854.

General Board of Health (Epidemic Cholera in the Metropolis in 1854): Dr. Sutherland's Report, &c.

Maynooth Commission—Report and Appendix; Part 1.

Maynooth Commission—Minutes of Evidence; Part 2.

Sardinia—(Co-operation in the War—Acts and Conventions.)

## MEETINGS FOR THE ENSUING WEEK.

MON. Actuaries, 7. Mr. Charles Jellicoe, "An Examination of the Objections urged against the Plan of Decimal Coinage proposed by the Royal Commissioners and the Select Committee of the House of Commons.
Geographical, 8½. 1. "Extract of a Letter from Admiral Matthieu, on the Progress of the Survey in the Straits of Gibraltar." 2. "Despatch from Loanda respecting Dr. Livingston's Exploration in Central Africa." 3. Don Vicente T. D. B. Castellanos, "On the Ruins of Tical, near the Lake of Peten, in Central America."

TUES. Royal Inst., 3. Prof. Tyndall, "On Electricity."
Meteorological, 7. "On the recent Cold Weather, and on the Crystals of Snow observed during its continuance."
Civil Engineers, 8. Discussion upon Mr. Robinson's paper, "On the Application of the Screw Propeller to the Larger Class of Sailing Vessels."
Lond. Inst., 8. Mr. B. Waterhouse Hawkins, "On the Restoration ef the Extinct Animals at the Crystal Palace." (Illustrated.)
Medical and Chirurgical, 8½.
Zoological, 9.

WED. Royal Soc. Literature, 4½.
Society of Arts, 8. Dr. W. H. Smith, "The Utilisation of the Molten Mineral Products of Smelting Furnaces."
Microscopical, 8.

THURS. Royal Inst. 3. Mr. Donne, "On English Literature."
Antiquaries, 8.
Royal, 8½.

FRI. Chemical, 8. Anniversary.
Royal Inst. 8½. Rev. J. Barlow, "On the Application of Chemistry to the Preservation of Food."

SAT. Royal Inst. 3. Dr. Gladstone, "On the Principles of Chemistry."
Medical, 8.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, March 16th*, 1855.]

*Dated 26th January*, 1855.

197. W. Binns, Claremont-villa, Brompton, and J. Haughton, Oldham—Valves.

*Dated 10th February*, 1855.

313. E. Sparkfield, 142, Cheapside—Exhibition of pictorial representations.

*Dated 28th February*, 1855.

433. A. Symons, Strand—Egg-cooking apparatus. (A communication.)
435. F. Allarton, High-street, Southwark—Administering iron as a remedy.
437. J. Higgin, Manchester—Treating waste-soap liquors.
439. C. F. Stansbury, 17, Cornhill—Ringing fog-bells. (A communication.)
441. G. M. Miller and J. Wakefield, Dublin—Pistons.
443. F. A. Wilson, Kennington—Closing and unclosing bottles.
445. H. C. Jennings, 8, Great Tower-street—Soap.
447. G. Ritchie, New-cross—Dress linings.
449. B. Blackburn, Clapham-common—Pipes.

*Dated 1st March*, 1855.

450. R. A. Brooman, 166, Fleet-street—Rollers used in spinning. (A communication.)
452. S. Vigoureux, Rheims—Printing, &c., textile fabrics.
453. T. Sadleir, Tullamore—Manufacturing charcoal.
454. G. M. Miller, Dublin—Railway axles and axles boxes.
455. A. Small, Glasgow—Marine compasses.
457. J. H. Johnson, 47, Lincoln's-inn-fields—Rolling and shaping metals. (A communication.)

*Dated 2nd March*, 1855.

458. J. Lewis, Abergavenny—Stench-traps.
459. T. Dodds, and R. Leake, 4 Horse Shoe-court, Ludgate-hill, and W. Fletcher, 2, St. James-street, Old Kent-road—Machine for heating furnaces.
460. G. Lowry, Manchester—Spinning machinery.
461. C. J. Dumery, Paris—Steam-whistles.
462. C. F. Stansbury, 17, Cornhill—Drill and bit stock. (A communication.)
463. J. H. Johnson, 47, Lincoln's-inn-fields—Slide valves. (A communication.)
464. W. Hodges, Stafford—Boots and shoes.
465. J. Johnson, Bow—Temporary rudders.
466. W. G. H. Taunton, Liverpool—Pumps and their gear.
467. A. V. Newton, 66, Chancery-lane—Printing-presses. (A communication.)
468. J. Correy, Birmingham—Gun lock.

*Dated 3rd March*, 1855.

469. J. Woodley and H. H. Swinford, Limehouse—Fire alarum.
470. A. B. Vabro, St. Thomas'-street East—Floors and roofs. (A communication.)
471. B. Dickinson and J. Platts, Huddersfield—Finishing machinery for textile fabrics.
472. W. Hunt, Tipton—Utilising compounds produced in galvanising iron.
473. T. H. Ryland, Birmingham—Neck and dress chains, bracelets, &c.
474. W. Johnson, 47, Lincoln's-inn-fields—Cleansing and preparing fibrous materials. (A communication.)
475. J. Revell, Duckinfield—Propelling vessels.
476. J. O. Williams, Torquay—Camp stoves and cooking apparatus.
477. T. Metcalfe, High-street, Camden-town—Window sashes.
478. R. Boby and T. C. Bridgman, Bury St. Edmunds—Corn dressing and winnowing machines.
479. T. W. Carter, Massachussetts—Firearms. (A communication.)
480. C. Iles, Birmingham—Polishing, &c., metal substances.
481. C. Iles, Birmingham—Door furniture, castors, and cotton reels.

*Dated 5th March*, 1855.

483. L. J. Paine, Camberwell, and J. Ryan, Hatcham—Portable utensils for containing liquids.
485. I. Dawson, Northwich—Saddles.
487. R. A. Brooman, 166, Fleet-street—Projectiles. (A communication.)
489. J. Lewis, Elizabethtown, New Jersey—Rigging and sparring vessels.
493. A. E. L. Bellford, 32, Essex-street, Strand—Oscillating steam-engines. (A communication.)

*Dated 6th March*, 1855.

495. W. Jenkins, Neath Abbey—Casting copper cylinders, &c.
497. G. W. Bowlsby, Castle hotel, Oxford-street—Closing windage when discharging cannon.
499. A. J. Burr, 42, Alfred-road, Paddington—Gas meters.
501. E. Tardiff, Bruxelles—Numbering apparatus.

WEEKLY LIST OF PATENTS SEALED.

*Sealed March 16th*, 1855.

2029. Victor Athanase Pierret, Paris—Improvements in watches and clocks.
2037. Henry Hudson, Flint Glass Works, South Shields—Improvements in the manufacture of vessels for measuring fluids.
2039. Jean Antoine Passet, Paris—Improved machinery or apparatus for pressing or calendering fabrics.
2047. Peter Spence, Pendleton—Improvements in obtaining sulphur from iron pyrites, and other substances containing sulphur.

*Sealed March 20th*, 1855.

2043. James Egleson Anderson Gwynne, Essex Wharf, Essex-street, Strand—Improvements in machinery for lifting, forcing, and exhausting.
2048. George Collier, Halifax, and Samuel Thornton, Rochdale—Improvements in looms for weaving.
2055. Robert Pinkney, 26, Long-acre—Improvements in stoppers, corks, or valvular apparatus for bottles or receptacles for liquids, and in the machinery or apparatus employed for making the same.
2058. Henry Alexandre Genetreau, Paris—An improved system of carriage shafts, poles, or beams.
2061. Philip James Chabot, Spitalfields—Improvements in supplying air to furnaces.
2063. Henri Catherine Camille de Ruolz, and Anselme Louis Marie de Fontenay, Paris—Improvements in the treatment of certain metals for producing an improved metallic alloy.
2065. Joshua Bacheler Halsey, 4, Norfolk-street, Strand—An improved machine or apparatus for crushing and pulverizing ores, and for separating the gold therefrom by amalgamation.
2070. Thomas Clayton, Oldham, and Robert Harrop, Lowside, near Oldham—Improvements in ornamenting wood, and in the machinery or apparatus connected therewith.
2072. Thomas Griffiths, Madeley, Shropshire—An improved pump for raising and forcing water.
2082. John Rogerson and James Brimelow, Bolton—Improvements in certain parts of steam engines.
2125. Wright Townend, Harden Bingley—An improvement in combing wool and other fibres.
2140. William Bridges Adams, 1, Adam-street, Adelphi—Improvements in rails for railways, and in the connections and fastenings for rails.
2144. William Frost, Wine Office Court, Fleet-street—Improvements in steam engines.
2152. William Chambers, Hampson-mill, near Bury—Improvements in machinery for beetling cotton and other fabrics.
2159. Robert Maynard, Wittlesford—Improvements in machinery for threshing and dressing grain.
2171. William Chubb, Clifton—Improvements in the construction of beams and parts of ships, ships' masts and spars, and other like structures.
2224. Richard Green, 12, Sydney-street, Brompton—Improvements in propelling vessels.
2274. Richard Hugh Hughes, 95, Hatton-garden—Improvements in transmitting motive power.
2279. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in circular looms—(A communication.)
2309. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in axle boxes. (A communication.)
2362. Leone Glukman, Sackville-street, Dublin—Improvements in effecting electric communications in railway trains.
2583. Thomas Brown and Peter MacGregor, Manchester—Improvements in machinery or apparatus for cutting velvets or other similar piled fabrics.
2602. William James Harvey, Exeter—Improvements in fire-arms when revolving barrels are used.
2645. Robert Adams, King William-street—Improvements in fire-arms called revolvers.
2751. Thomas Thorneycroft, Wolverhampton—Improvements in ship-building.
82. Joseph Ray Hodgson, Sunderland—Improvements in the construction of anchors.
165. John Henry Pape, Paris—Improvements in pianofortes.
166. Robert Johnston, Drums-lane, Lock street, Aberdeen—The use of certain portions of fish in the manufacture of soap.
170. William Kilgour, Liverpool—An improved manufacture of naphtha, paraffine, and paraffine oil.
191. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the construction and arrangement of electric telegraphs, and in the application thereof—(A communication.)
196. John Lamacraft, Westbourne-grove—Improvements in envelopes or means for securing letters, notes, and similar documents.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3695 | March 19. | Improvements in Beer Engines ............ | James Deacon .................. | St. John-street, Clerkenwell. |
| 3696 | " 20. | Letter Damper and Stamper ............... | Hardy and Jolly.................. | Denby-road, Westbourne grove. |
| 3697 | " " | Throstle or Mule Spring for the Under Clearers of Spinning Machines ...... | William Standring ............ | Rochdale, Lancashire. |
| 3698 | " " | Fixed Light Oil Burner ...................... | James Bower Harman ...... | 11, Bucklersbury. |

Journal of the Society of Arts.

*FRIDAY, MARCH* 30, 1855.

## EXHIBITIONS.

The members are reminded that the Seventh Exhibition of Inventions will be opened on Saturday evening next, with a conversazione of the members and their friends, for which cards of invitation have been issued. A catalogue of the Exhibition forms a supplement to this number of the Journal. On Monday, the Exhibition opens to the public, and will remain open daily from ten till four o'clock, closing at the end of the month of April. On the 23rd of May, the Collection of Raw and Manufactured Animal Produce (Trade Museum) will be opened, with a paper by Professor Solly, "On the Mutual Relations of Trade and Manufactures."

## CHALON EXHIBITION.

The Council have great satisfaction in announcing that, in continuation of the plan of collecting for exhibition the works of our eminent English painters, as already illustrated in the works of Mr. Mulready, R.A., and Mr. Etty, R.A., they are preparing this season to exhibit, in the Society's Rooms, with the kind assistance of Mr. Alfred Chalon, R.A., the works of his esteemed late brother, Mr. John Chalon, R.A., together with a selection from his own works.

## FIFTEENTH ORDINARY MEETING.

Wednesday, March 28, 1855.

The Fifteenth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 28th inst., Joseph Glynn, Esq., F.R.S., in the Chair.

The following Candidate was balloted for, and duly elected an Ordinary Member :—

King, David.

The Paper read was

### THE UTILIZATION OF THE MOLTEN MINERAL PRODUCTS OF SMELTING FURNACES.

By Dr. William H. Smith, of Philadelphia, U.S.

The paper which I have been invited to read, is "On the Utilization of the Slags or Molten Mineral Products of Smelting Furnaces." The term "slag" has been defined by most standard authorities as the "refuse vitreous products of smelting furnaces." This definition, being only applicable to slag in its altered conditions, after having been rendered brittle and worthless by improper treatment subsequent to its withdrawal from the smelting furnace, we reject as erroneous.

Indeed, it would be as fair and philosophical to limit mathematics to the "science of right-angles," or chemistry to the "art of dyeing wool," as to limit an extensive class of mineral products, which under proper treatment is susceptible of a wonderful variety of forms, combinations, colours, and vitreous or devitrified properties, to one single and most objectionable condition, viz., that of a refuse vitreous and brittle substance.

In order to be fairly viewed and justly appreciated, slag must be considered both in its molten state, as a fused mineral product, and in the variety of combinations, forms, and general properties it may be made to assume, under scientific treatment, subsequently to its removal from the smelting furnace. The first general view which slags, thus considered, naturally presents, is that which relates to their scientific interest. This we will briefly notice, before passing to consider a more important aspect, viz., their commercial value.

In the wide range of geological science, we find but few general phenomena which cannot be elucidated by the chemico-mineralogical transformations of the smelting furnace. Toiling amid the vast laboratory of nature in deciphering the rocky hieroglyphics of consecutive ages, or perusing the diversified characters of modern formations, the geologist finds it no easy task to reconcile the seeming contradictions, or account for the almost infinite varieties that occur in the form, position, colour, density, brittleness, hardness, softness, amorphous or regular crystallisation, vitreous or devitrified structure, and other characteristics of the mineral kingdom. In the smelting furnace, by the study of existing operations, agencies, and laws, he finds a clue to the geological history of the earth, an exponent of those laws and phenomena which have modified and determined the condition of the rocky crust of the globe. He has but to build his cupola and start his blast, and he is at once ready to daguerreotype, or rather reproduce, although in miniature, the mountainous deposits and diversified formations of igneous rocks; and if his researches verge upon chemical science, he has but to study the agency of heat in altering the form, colour, and other properties of matter, and carefully to observe the influences that determine the crystalline or amorphous structure of slag, or those wonderful chemical affinities that bind together in definite atomic proportions the elementary molecules of slag, however complex the combinations it may assume under the smelting operation. We regret, however, to be compelled to add, that much of this scientific interest has been overlooked by the metallurgist, to the no small detriment of the practical details of his art, and the enormous waste of most valuable material.

In discussing the commercial value of slag, for which we trust our previous remarks have in some degree prepared the way, we propose a fivefold argument, to wit—

1st. The value of that class of mineral formations to which slag belongs.

2nd. The regularity of the laws involved in the formation of slag.

3rd. The superior properties which slag possesses as an industrial product, especially as adapted for architectural uses.

4th. The economy of its production.

5th. The abundance of its supply.

And, first, we argue the commercial value of slag from the value of that class of rocks to which, geologically speaking, it belongs, or, in other words, to which it is analagous in its origin, and with which it is identical in its crystalline and amorphous, its vitreous and devitrified varieties of structure, and numerous other essential properties. The rocks of igneous origin are too well known to the scientific world, and too highly appreciated by the practical architect, to need enlarged description as to their character or recommendation as regards their valuable uses. They are, in a word, the rocks of which nature builds her loftiest mountains, and man constructs his most enduring monuments and palaces. We find them towering in majestic grandeur, as the oldest and most durable mountainous formations of the globe.

The Grampians in Scotland, the mountains of Cumberland and Cornwall in England, the Wicklow mountains of Ireland, the Dofrafields in Scandinavia, the Alps in Switzerland, the Pyrenees in Spain, the Oural and Hima-

laya ranges in Asia, the Abyssinian and other chains in Africa, and the Andes in South America, are all, more or less, composed of these rocks, or of primary strata, which have been thrown up and altered in mineral aspect by molten masses and veins, which present no traces of deposition or stratification, and which, like slag, are of igneous rigin.

Granite, syenite, protogine, serpentine, porphyry, basalt, felspar, greenstone, clinkstone, amygdaloid, trap-tuff, tufaceous conglomerates, lava, trachyte, obsidian, &c., are the chief varieties of these igneous rocks. The industrial purposes to which they are applied are numerous and of primary importance.

Now, if we admit the existence of some deep-seated source of heat to which these rocks owe their origin, and acknowledge, as we must, the analogy between them and the products of smelting furnaces, which are composed of the same elements, fused by the same igneous agency, and modified in form, colour, and character, by the same fixed chemical laws, we cannot entertain a doubt as to the value of slag as a mineral product capable of profitable utilization. And if we extend the above argument to an analytical investigation of the elementary ingredients of which slag is composed, we find additional corroboration of its validiy. Selecting, for example, the slags of iron furnaces, (which, being more abundantly manufactured than those of lead, copper, and other metals, are of greater commercial value,) we find them composed of silica, lime, and alumina, as their chief ingredients, in combination with traces of magnesia, protoxide of iron, sodium, potassium, carbon, manganese, sulphur, titanium, and phosphorus.

According to the analysis of M. Berthier, the slag or cinder of the Dowlais furnaces (from which some of the manufactured samples upon the table were made) consists of silica, 40·4; lime, 38·4; alumina, 11·2; magnesia, 5·2; protoxide of iron, 3·8; and a trace of sulphur. Slags from the Dudley furnace, and others from St. Etienne, in France, presented similar analytical results, varying slightly as to the relative quantities of manganese and sulphur. A mean average of the anthracite furnaces of America, consists of silex, 51; lime, 21; and alumina, 15; and although by reference to the more extended tabular statistics upon the Pantograph, page 337, it will be seen that the proportions of these ingredients vary slightly in the analysis of the cinders of charcoal, coke, and anthracite furnaces, yet these variations are too slight to affect our present argument.

Now regarding silica, lime, and alumina as the chief constituents of slag, we are furnished with the very ingredients out of which nature has fashioned and annealed nearly all the valuable building material of the mineral kingdom. "The rocks of our globe," says Professor Dana, in his standard treatise on Mineralogy, "are made up of about 13 of the 59 elementary substances found in nature. These are the GASES, oxygen, hydrogen, nitrogen, chlorine; the NON-METALLIC ELEMENTS, carbon, sulphur, silicon; the METALS, calcium, sodium, potassium, magnesium, aluminum. The element silicon, combined with oxygen, forms silica, combined with lime, it forms nearly all the other mineral ingredients of granite, mica-slates, volcanic rocks, shales, sandstones, and various soils. No element," he adds "is, therefore, more important than this in the constitution of the earth's strata; and it is especially fitted for this pre-eminence by its superior hardness, a character which it communicates to the rocks in which it prevails. Next to silica rank lime and carbon."

Professor Phillips, in his mineralogical work, remarks:—"But if we look more narrowly into the composition of the crust of the globe, as consisting chiefly of the earths and earthy minerals, we shall find that only three of the earths which have been discovered, viz., silica, alumina, and lime, are found to constitute its great bulk."

And here let me remark that a second powerful argument in favour of the commercial value of slag, is adducible from the uniformity and infallibility of those laws of chemical affinity, which are alike involved in the mineral formation of nature—and in the mineral formations that continually occur, although upon a smaller scale, in the smelting furnace. By reference to the Pantograph illustrative of the decomposition and recompositions of the smelting furnace, it will be seen that the chemical changes that take place during the reducing process, are numerous and important. Yet it must be remembered, that there is no change, however simple or complex, that is not uniformly regulated and infallibly determined by one and the same law of nature, viz., that of chemical equivalents.

By this law the elements which combine to form cinder, are invariably united in definite proportions. It is well-known to every ironmaster, that a certain amount of silex or acid, when associated with the ore from which metal is to be extracted, requires the saturation of a certain amount of base, such as lime or magnesia, or protoxide of iron in order to liberate the metal, and leave no base or acid uncombined. And it is a proposition equally as familiar, that a large surplus of acid or alkali in the furnace will prove refractory and obstruct the smelting operation.

From the above law, then, it results that slag, as a mineral compound, must and can only be formed by the intimate chemical union, in definite atomic proportions, of the various earthy ingredients which enter into its composition. So important is this principle of chemical equivalents, that it not only constitutes one of the strongest links in the chain of analogy between slag and igneous rocks of natural origin, but it also affords a sure guarantee, that it is possible to impart to slag the same valuable properties by which igneous rocks are characterized, provided that the treatment of slag subsequently to its withdrawal from the smelting furnace be in accordance with those natural laws and agencies which are known to modify the form, colour, and crystalline arrangement of minerals whilst passing from a molten to a solid condition.

Again, we would argue the commercial value of slag, from the superior advantages it possesses as an industrial product, and especially from its superior fitness for architectural purposes. In the utilisation of slag, by the processes of refining, casting, pressing, rolling, moulding, and annealing, we can avail ourselves of the facilities afforded by the extremely liquid molten state to which the slag is reduced in the smelting furnace, so that we have only to prepare suitable appliances to be able to impart to it any desired form, colour, or texture.

According to the treatment it receives, slag can be rendered brittle or tough, hard or soft, compact or porous, rough or smooth. It can be cast into as great a variety of forms, solid and hollow, as iron itself, with the superior advantage of being susceptible of the admixture and blendings of colour, so as to render it equal in brilliancy to agate, jasper, malachite, the variegated marbles, and other more valuable varieties of the mineral kingdom. When properly annealed, it can be made to acquire a surface, or texture, at least ten times as durable as that of marble, and is susceptible of a polish equal to agate or cornelian.

As a building material slag can be readily adapted to any variety of architectural design, from the simple slab to the most ornate and complex decoration; whilst its beauty and durability chiefly recommend it as an article of luxury.

Possessing the above properties, and being capable of application to a thousand uses, the question of the value of slag finally resolves itself into a question of economy of production and abundance of supply. Now in both these essential elements of commercial value slag offers unusual advantages. The economy of production may be shown both relatively and directly. Thus, by calculating the relative cost of bricks or blocks of slag, as compared with that of ordinary clay brick, we can arrive at a proximate result, if we simply estimate, in both cases, the cost of the raw material, and the amount of time and labour spent in the consecutive stages of the manufacturing.

# PANTOGRAPH.

EXHIBITING THE

## MINERAL CHANGES AND FORMATIONS OF THE SMELTING FURNACE.

| | Materials. | Elements. | Equivalents. |
|---|---|---|---|
| Atmospheric Air, Composed of | | Oxygen | 8 |
| | | Nitrogen | 14 |
| | Steam | Oxygen | 8 |
| | | Hydrogen | 1 |
| | Carbonic Acid | Oxygen | 8 |
| | | Carbon | 6 |
| Iron Ore, Composed of. | | Iron | 28 |
| | | Oxygen | 8 |
| | Carbonic Acid | Oxygen | 8 |
| | | Carbon | 6 |
| | Silex | Oxygen | 8 |
| | | Silicium | 21·35 |
| | Alumina | Oxygen | 8 |
| | | Aluminum | 13·69 |
| | Manganese | Oxygen | 8 |
| | | Manganium | 19·67 |
| | Lime | Oxygen | 8 |
| | | Calcium | 20 |
| | | Phosphorus | 32·02 |
| | | Sulphur | 16 |
| Fuel, Composed of. | | Carbon | 6 |
| | | Hydrogen | 1 |
| | | Nitrogen | 14 |
| | | Oxygen | 8 |
| | | Potassium | 39 |
| | Silex | Oxygen | 8 |
| | | Silicium | 21·35 |
| | | Sulphur | 16 |
| Flux, Composed of | Lime | Oxygen | 8 |
| | | Calcium | 20 |
| | Carbonic Acid | Carbon | 6 |
| | | Oxygen | 8 |
| | Silex | Oxygen | 8 |
| | | Silicium | 21·35 |
| | Alum | Oxygen | 8 |
| | | Aluminum | 13·69 |

**PRODUCTS.**

1.—*Tunnel Head.*

Carbonic Acid.
Carbonic Oxide.
Steam.
Hydrogen.
Metallic Oxides.
Metallic Vapours.

2.—*Upper Hearth*

SLAG.

Silicates.
Aluminates.
Carbonates.
Phosphates.
Sulphurets.
Phosphurets.
Lime.
Protoxide of Manganese.
Protoxide of Iron.
Potash, &c.

3.—*Lower Hearth*

IRON.

Iron.
Carbon.
Silicon.
Manganium.
Phosphorus.
Sulphur.
Nitrogen.
Aluminum.
Calcium.

**COMPOSITION OF CINDER, OR SLAG.**

| | Charcoal Furnaces. | | | | | | | Coke. | | | Anthracite. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peroxide Ores. | | | Sparry Carbonate Ores. | | | | Carbonates of the Coal Formations. | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Silica | 51·84 | 63·6 | 31·1 | 52·0 | 71·0 | 37·8 | 49·6 | 40·6 | 43·2 | 35·4 | 50 | 58 | 51 |
| Lime | 21·80 | 24·0 | 14·1 | 30·2 | 7·2 | | | 32·2 | 35·2 | 38·4 | 30 | 22 | 21 |
| Magnesia | 4·82 | 1·2 | 34·2 | 5·2 | 5·2 | 8·6 | 15·2 | | 4·0 | 1·5 | | 10 | 4 |
| Alumina | 15·21 | 3·8 | 8·9 | 5·0 | 2·5 | 2·1 | 9·0 | 16·8 | 12·0 | 16·2 | 17 | 6 | 15 |
| Protoxide of Iron | 3·73 | 1·7 | 1·0 | 1·6 | 5·0 | 21·5 | 0·4 | 10·4 | 4·2 | 1·2 | 3 | 2 | 5 |
| Do. of Manganese | 1·16 | 3·9 | 4·4 | 4·7 | 6·5 | 29·2 | 25·8 | | | 2·6 | | 2 | Traces. |
| Oxide of Titanium. | | | 9·0 | | | | | | | | | | |
| Sulphur | | | Trace. | | | Trace. | | | | 1·4 | | Traces. | |
| Phosphoric Acid | | Trace. | | | | | | | | | | | |
| Carbon | | | | | | | | | | | Traces. | Traces. | |
| Potash | | | | | | | | | | | | | Traces. |
| REMARKS. | Average cinder of good iron | Bog ore cinder | Swedish Furnace | Furnace in France | Savoy Furnace, in bad condition | German Furnace, in bad condition | German Furnace, in good condition | Furnace in Wales | " " | " " | Pennsylvania Furnace | " | " |

In making bricks of slag the raw material costs less than nothing, inasmuch as the ironmaster saves by its utilisation the heavy expenditure now attendant upon its removal from the furnace premises. In fusing slag to prepare it for the operation of casting no expense is incurred, inasmuch as this item of expenditure is charged by the metallurgist to the metallic and not earthy products of the smelting operation. In casting and annealing slag the processes are as simple, expeditious, and economical as in those of pressing and annealing clay brick.

Now, in making bricks of clay (the cheapest analagous manufacture that could be selected), the elements in our calculation become more numerous. The raw material has an intrinsic value, while the consecutive operations of digging the clay, preparing it for use, and transporting it frequently, added to the processes of pressing and annealing it, consume at least twice as much time and labour as that employed in working slag. From these simple, yet clear data, we can fairly infer that the cost of making clay brick will be double that of making blocks, tiles, or more decorative and valuable articles from slag. By extending this calculation to other products, such as marble slabs, columns, carved architectural ornaments of stone, &c., and in our estimate contrasting the plastic power of fusion available in slag with the laborious hewing and fashioning by mechanical means required for blocks of marble and other stones, we may arrive at still more satisfactory results in proving the commercial value of slag.

A direct calculation, however, based upon practical manufacturing operations, may perhaps prove still more satisfactory; and the following estimate of the cost of manufacturing 40 tons of slag per diem, to which is added the number of square feet of surface contained therein, and the value of the manufactured article, may be regarded as a safe approximation to the real economical commercial value of slag.

In manufacturing 40 tons of slag daily, we require an outlay for building and machinery as follows:—

| | |
|---|---|
| Cost of erecting 40 ovens | £1,600 |
| ,, steam-engine | 1,500 |
| ,, casting tables | 200 |
| ,, rolling ditto | 200 |
| ,, moulds | 300 |
| ,, sheds | 300 |
| ,, bars or refining furnace | 300 |
| ,, apparatus for machinery | 300 |
| ,, contingencies, wear and tear, &c. | 300 |
| | £5,000 |

Daily expenditure in wages, &c,—for 24 hours:—

4 furnace men
18 moulders
11 firemen
4 stokers
8 packers
—

| | £. | s. |
|---|---|---|
| 45, at 4s. per day | 9 | 0 |
| Overlookers | 1 | 10 |
| Gen. superintendant and office | 3 | 10 |
| 8 tons of coal, at 6s. 6d. | 2 | 12 |
| Wear and tear | 4 | 0 |
| | 20 | 12 |
| Freight, at 15s. per ton | 30 | 0 |
| | £50 | 12 |

There are 180 square feet of material of one inch thickness to the ton; and 120 square feet at 1½ inch. Forty tons would produce 7,200 feet at 1 inch, and 4,800 feet at 1½ inches thickness.

Grinding and polishing costs 3d. per foot extra, if appropriate machinery be employed, or £2 5s. per ton at 1 inch, and £1 10s. at 1½ inch thickness.

If the manufactured slabs or tiles were sold in the proportion of one-fourth polished and three-fourths rough, and the former realised 1s. 6d. per foot, and the latter only 4½d., then forty tons at 1 inch would produce £236 5s.; and at 1½ inch would produce £157 10s.

Or, 100 tons would produce at 1 inch £590 12s. 6d.
,, ,, 1½ inch £393 15s.

| | £ | s. | d. |
|---|---|---|---|
| Commercial value of 100 tons, at 1 inch, gross | 590 | 12 | 6 |
| Less cost | 126 | 5 | 0 |
| | £464 | 7 | 6 |

Value of annual product at 500 tons per day, £696,562 10s.

| | £ | s. | d. |
|---|---|---|---|
| Commercial value of 100 tons, at 1½ inch, gross | 393 | 15 | 0 |
| Less cost | 126 | 10 | 0 |
| | £267 | 5 | 0 |

Value of annual product, at 500 tons per day, £400,875.

In the above calculation we have estimated the manufactured material, when polished, as worth 1s. 6d. per foot. This estimate, however, essentially varies in accordance with the form into which the material is cast;—the ornaments, patterns, and variety of colour imparted to it, and the uses for which it is designed. Thus, when cast into the form of table-tops, or architectural ornaments, it becomes worth from 6s. to 20s. per foot, while the cost of manufacturing is but little augmented.

We have preferred, however, to base our calculation upon such a minimum price as will show the value of the material even when applied to the most ordinary uses.

To enter into the details of the processes employed in the manufacturing of slag, is foreign to the design, and incompatible with the limits, of the present paper. My own system of utilization of the products of smelting-furnaces has been for years before the public, and being described in several lengthy specifications, it is not necessary for me to dwell upon its peculiarities. It may not be amiss for me, however, briefly to notice the most important desiderata towards the successful treatment of these products. The quality of the slag, as with the quality of iron or other reduced metal, essentially depends upon the proper management of the smelting-furnace. The suitable admixture of fluxes—the proper regulation of the heat, &c., being, however, of primary importance in making good metal, generally receive adequate attention, and I believe the best managed furnaces of the world are those which I have met with in Great Britain.

Great care is required in the withdrawal of the slag from the furnace, to prevent the incorporation or mechanical admixture therewith of miscellaneous debris, loose cinder, or other foreign ingredient. Such an admixture produces a heterogeneous material which (as may be seen in the rough blocks cast directly from the furnace mouth, for many years past, at copper and at some iron works,) is not susceptible of polish, and soon changes its appearance on exposure to the air. By withdrawing the slag at stated intervals, say once every hour, it can be obtained in better condition than if allowed to run out of the furnace in a continuous stream.

After its removal from the furnace, the liquid slag should be carefully refined, either by mechanical subsidization or chemical treatment, in order to regulate its specific gravity, and thus ensure a homogeneous product

Other essential elements of success consist in the protection of the moulten and hot material from the sectional polarization of its heat, or thermal-electricity; the employment of suitably-constructed moulds, made of the best non-conducting materials; the proper construction of the ovens for annealing; the regulation of the temperature of the ovens, so as to ensure a vitreous or devitrified product, as may be desired; the employment of

the proper alkalies and acids for varying, when requisite, the colour, texture, and other properties of the slag; and, suitable appliances for rolling, pressing, stamping, grinding, polishing, &c.

By examining the beauty and durability of the manufactured material as seen in the samples upon the table, some of which I have made from the slags of American furnaces, others from furnaces in England and France, it will be seen that the estimate set upon its commercial value in the above calculation is by no means extravagant.

The chief commercial value of slag, however, arises out of the abundance of its supply. The iron smelting works of Great Britain, annually produce some 6 to 10,000,000 tons of slag. If to this we add the amount of slag, likewise available, yielded in the reduction of ores of copper and lead, without considering zinc and other metalliferous sources, the supply is found to be sufficient to create a new channel of productive industry, almost, if not entirely, equal in extent, interest, and importance, to any that now affords employment to the capital and labour of civilised nations.

To the metallurgist, the chemist, and the political economist, the field of scientific research and industrial enterprise, which, by your kind permission, we have attempted to explore this evening, although novel, cannot fail to be other than attractive.

The existence of an uncultivated, yet productive source of mineral wealth, a source which if viewed in all its national advantages, is of more intrinsic value than all the gold fields in either the old or the new world, has, we trust, been satisfactorily demonstrated. The elements mainly required, in order to develop its now despised treasures, are energy and skill. Of capital, but little is required in addition to that already invested therein, although unprofitably, by the metallurgist, while its claims upon the industrial energies of the world, as already presented, and which I beg permission briefly to recapitulate, are:—

*a.* The scientific interest which invests the mineral changes and formation of the smelting furnace.

*b.* The commercial value of slag or the mineral products of the smelting furnace, as demonstrated from—

1. The importance of the rocks of igneous origin, to which they are analagous, and with which they must be geologically classified.
2. The regularity and uniformity of the chemical laws involved in their formation.
3. The superior properties which they possess as an industrial product, especially in their adaptedness for architectural uses.
4. The economy of their production.
5. The abundance of their supply.

## DISCUSSION.

The Chairman remarked that the paper with which they had been favoured was one of great importance. No one who had not visited the extensive ironworks of Staffordshire and South Wales, such as those of Mr. Crawshay and the late Sir John Guest, and had not seen the cinder tips, as they were called, rivalling in size the surrounding hills, could conceive the enormous quantity of material, that was thrown to waste. The quantity of this material resembling lava, might be understood in this way. The iron made in this country annually was about 3,000,000 of tons, and the quantity of lava, so to speak—for it was neither glass nor stone, but something between the two—had been estimated at two tons of slag to one ton of iron. Many attempts had been made to render this material commercially useful, but hitherto without much success; and, therefore, he thought no one present could have failed to have listened with interest to the paper of Dr. Smith. It, however, appeared to him (the chairman) desirable, before the discussion commenced, that Dr. Smith should favour them with a general statement as to the mode of operating upon this material to produce the specimens exhibited; the meeting would then, he thought, be in a better position to discuss the subject. He had been told that this was not a mere experiment, but that in the United States of America it had been carried out commercially to a very considerable extent.

Dr. Smith said, in compliance with the wishes of the Chairman, he availed himself of the opportunity for further explanations of the process by which he purposed effecting the economical utilization of slag. The process, as already stated, was based upon the philosophical and chemical principles developed in the paper just read, and, although simple, it necessarily called into requisition—in the various processes of casting, rolling, pressing, annealing, grinding, polishing, &c.—many applications, combinations, and modifications of machinery which it would be tedious to enumerate. The main features of the process, however, consisted in the use of *pure* slag, in its most favourable molten condition—protecting the slag from all admixture of foreign ingredients, or debris—carefully refining it, so as to secure a uniform homogeneous product, and subsequently, by appropriate machinery, casting, stamping, pressing, cutting, rolling, &c. He did not use the slag by running it directly out of the smelting furnace into moulds, inasmuch as that mode (heretofore generally adopted) rendered the material unfit for adaptation to the production of articles of commercial value. He preferred to work the slag out of a chamber in connection with the furnace hearth, in which chamber the slag was allowed to accumulate for use; or, if this arrangement were attended by local inconvenience, he withdrew the slag, through covered conduits, from the smelting furnace, into a wagon or car, or large ladle. In this car it was refined by subsidization, and then run out into moulds from orifices made in the side of the car at different elevations from its bottom. The slag received from the bottom of the car was found to be more dense and valuable than that obtained from the top. This improved condition was caused in part by pressure, in part by the separation of matters in mechanical combination, and in part by the escape of uncombined gas. In making more valuable classes of manufactured articles, he substituted a reverberatory furnace for the above described car, or constructed the car so as to allow of the elevation or uniform maintenance of the heat of the slag while it was being refined, coloured, &c. The furnaces for annealing could be located near the smelting furnace, or at any desired distance therefrom, not exceeding, however, 300 yards. Different modifications of furnaces were required for different forms, sizes, and qualities of manufactured material. The grinding and polishing processes also required special adaptation of machinery. He (Dr. Smith) did not re-melt slag, inasmuch as that process would not be economical; but, for certain classes of ware, he fused or cemented together broken fragments of cold slag, by means of the application thereto of hot or molten slag. Dr. Smith stated that he could also coat or enamel with fluid slag, bricks or blocks, and various other foreign substances made of clay, iron, stone, &c.

Mr. Cameron stated that he hoped they would excuse his not expressing himself in the scientific terms used by Dr. Smith, his object being simply to explain the invention, as proved by his experience of the last twelve months. When Dr. Smith came over from America, and the invention first came under his (Mr. Cameron's) notice, he felt that, if it was what was represented, it was of immense importance, and he was determined thoroughly to test it, and accordingly, through the kindness of the proprietors of the Dowlais Works, he erected an oven, and made several very beautiful samples, fully bearing out all that was represented. He afterwards erected annealing ovens, in France and elsewhere, to test the different slags, and always with the same successful results. As the experiments were more to test *the fact* of the invention, than to make perfect materials, he was quite satisfied with the results in the rough and crude way in which the testings were conducted. Mr. Cameron proceeded to explain that

the annealing ovens which he used were not retort ovens, which were absolutely necessary to produce a perfect and uniform material, and one of the consequences was that the heat playing unequally on the ware when in the oven, caused one piece to be thoroughly devitrified, while another piece, on which the heat was not so great, was in a vitrified state. He felt certain that the invention was in its childhood, but that the resources of mind and pocket of the English people would be sure, ere long, to cause it to rank amongst the most valuable inventions of modern times.

Mr. Davison being called upon by the Chairman, said, he could confirm all that had fallen from Mr. Cameron regarding the experiments which had been carried on at the Dowlais Iron Works; indeed he had stated his views on the matter in connexion with Professor Wilson's paper on the "Iron Industry of the United States," which had already appeared in the Society's Journal. He might, however, state, by way of still further confirming the comparative ease with which the operation was carried on, that upon Mr. Cameron requiring a few additional specimens after he had left the works, the same had been prepared, according to his written instructions, by one of his (Mr. Davison's) sons, a lad fifteen years of age, then present—which specimens were then before the meeting. As to the operation or process itself, he might repeat that the slag, as it ran from the mouth of the furnace, was simply poured into rings, or moulds, of any form (the rings being placed on a heated iron plate), and when the slag so run was so far "set" as to admit of its removal from the ring, it was immediately transferred to the annealing-oven, where, after two or three hours' regulation of the heat (for everything depended on that), every aperture was then closed, and the oven, with its contents, allowed to cool down till the same had arrived at the temperature of the surrounding atmosphere, or thereabouts, when the oven could be discharged with impunity. In reference to the slag itself, as it now ran from the furnace, it was not only *useless*, but cost the iron-masters nine-pence to a shilling per ton, and often much more, in removing it from the works, besides the loss, not unfrequently, of valuable space; hence, it was not too much to say, that £150,000 or more was annually thrown away, besides the material itself, throughout the works of Great Britain. He had little doubt but common paving tiles, and the like, made of annealed slag, of one inch to an inch-and-half in thickness (without going into the matter of profit), might be delivered in London at a sum varying from 1½d. to 2½d. per superficial foot; but with regard to the polished article, it was difficult to say what it would fetch, as some of it was so beautiful as to excel the finest marble. He had only further to say, that he formed a high opinion of the subject some six or eight months since, when the experiments were going on at Dowlais, and that high opinion had continued—unabated—up to the present time.

Mr. Nesbit said, there could be but one opinion among those who had heard the paper as to its importance, when the very large amount of slag produced from the iron furnaces of England was considered. He had listened to the paper with great interest, but he thought it was not quite so new a subject as appeared to be supposed by the author of the paper, inasmuch as in 1846 or 1847, he (Mr. Nesbit) was called in professionally to advise upon the matter of making stone out of the slags of iron furnaces, and for that purpose he undertook a long series of experiments. He went to the South of France, and made experiments at the iron works of St. Etienne. He had also made experiments at some works in South Wales, and having erected an apparatus upon his own premises, he had operated upon slags from all parts of England and Scotland. The result of the experiments was that a patent was taken out in 1846 or 1847, by the parties for whom he acted, and he had brought with him a few of the specimens which were at that time produced. The process in the patent was very simply described; it consisted in moulding the slags on iron plates, and then annealing them. A large quantity of paving flags, amongst other things, were made, some of which were laid down in the Place de la Bourse, in Paris, and he believed remained there to the present day. A question had been raised with regard to the hardness of the material, and he had procured a report from the Prefect of the Seine, which showed the resistance of this material to crushing power. A number of small cubes (2½ inches square) of granite and other materials were submitted to pressure, together with similar cubes of this lava, and the comparative resistance to crushing power of the various materials so tested was given in kilogrammes as follows. 1. Great rock of the Plain of Paris, was crushed with a weight of 4125 kilos. 2. The Lias of Bagneux, with 7238 kilos. 3. The granite of St. Honorine, with 7498 kilos. 4. Granite of Flamainville, with 8705 kilos. 5. Black marble of Italy, with 10,696 kilos. 9. The artificial lava with 17,280 kilos, equal to 12¾ tons nearly.

Professor Wilson coincided with Mr. Nesbit as to the importance of this subject, and he had no doubt that, as a movement had been made in this direction, it would not be allowed to rest till it had been investigated more thoroughly. Probably one of the highest developments of science was its application to such practical purposes as these, and the utilisation of waste substances was one of the most important problems of the day. There were some questions which it was necessary to consider with regard to the application of these slags. He could hardly go the full length with Dr. Smith on some points. He (Professor Wilson) thought the constitution of slag was scarcely so definite as that gentleman seemed to think—that unless the several ingredients were chemically combined, and the mass was perfectly homogeneous, the material was liable to be decomposed, especially by the action of the atmosphere. This point appeared to him a matter for consideration, as the author told him that he allowed the slag, after it came from the furnace, to remain a certain time till the molten matters separated into two or three different strata, and, therefore, these strata must be differently constituted, inasmuch as they made different forms of slag when cool. It appeared to him (Prof. Wilson) somewhat difficult to draw the line where those changes commenced and where they ceased, so that, unless they could obtain a perfectly homogeneous mixture, they could not operate with any certainty upon the materials which this process was intended to utilise. He thought there was also another point which required further proof, and that was one which time could only determine. He would like to see the effect which the action of continual exposure would have upon this material, after it was furnished either in the rough or in the refined and polished form. They knew that many of the ornamental stones and marbles, which were more or less the same kind of substance manufactured by nature—were, after exposure for a certain time, affected on the surface, even though polished as fine as possible. He should like to be satisfied—which could only be done by time—as to whether this substance would not be susceptible of the same influences, as if so, a great portion of its value was lost. The enormous mass of material at hand, and the little cost at which it could be worked, deserved the attention of ironmasters and of scientific men; and he, for one, begged to thank Dr. Smith for his excellent paper on the subject, which he had no doubt would, by calling attention to it, tend materially to aid in the establishment of, what he hoped he might be able to term, a new industry.

Mr. Charles May called attention to an analagous substance manufactured by Messrs. Chance, of Birmingham, from the rowley rag or basaltic rock of Dudley, which appeared to be the same sort of thing, but possibly a little more homogeneous in its composition. From this article there had been produced castings of corbels and quoins for buildings, and various other articles, which by annealing, returned to the basaltic state, or by rolling,

remained vitreous like glass, and formed a very beautiful substance. He thought the rowley rag, being more homogeneous than the slag, would be found a better article and pretty nearly as cheap. [Specimens were exhibited.]

Mr. Beard could answer one of the matters alluded to by Professor Wilson, as to the durability of the slag in the rough. As manufactured by himself, and used for the coping of walls, and in some cases for ornamental purposes, in the town in which he resided (Taunton), it had stood for forty years, and the large pieces of coping were in as good condition as when first put up.

After a few observations from Mr. R. F. Davis,

Mr. Hugo Reid said Dr. Smith had suggested the use of slag for building purposes, as it had been found to sustain great pressure. He thought it would have added to the interest of the subject if they had been informed what was the specific gravity of slag. Dr. Smith had referred to the igneous rocks as analogous in composition to slag. He might say that, for building purposes, igneous rocks had never been employed to any great extent in this country, and it would be interesting to know whether, in the United States, they had been employed to a greater extent than here. For his own part, he did not know of any town in England which was principally built of igneous rock, but he knew one or two towns in Scotland which were chiefly built of that material. Aberdeen was built principally of granite, and the little town of Galashiels, he believed, of black basalt. When they saw the small use to which igneous rock was applied in this country, it would be interesting to know whether in the United States it had been used to any great extent for building purposes.

Dr. Noad wished to observe, in reference to what had fallen from Professor Wilson, that he had found, from numerous analyses, that the cinder from the blast furnace was very uniform in composition, however greatly the burden of the furnace might differ. When allowed to cool gradually and in large masses, fine crystals were found lining cavities in the interior of the blocks; these crystals had a composition which placed them among the auzite or pyroxene class of minerals. When the furnace was making gray iron, the composition of the slag was somewhat different; it was, however, still uniform in chemical composition and crystalline. When cooled rapidly the surface of the cinder became vitreous and extremely brittle, but when this glassy surface had cracked off, the slag underneath was as hard and as firm as a native rock; and that it would stand the weather, was proved by the fact that walls were built of it which had remained sound and firm for very many years. The uniformity of the chemical composition of the cinder, under burdens differing so widely from each other, was a striking circumstance, and greatly in favour of Dr. Smith's proposed utilization of these products. Dr. Noad wished to ask Dr. Smith for some further explanation regarding the advantage to be derived from what he termed the *subsidence* of the slag, as he had found the composition to be perfectly uniform at all times of the day.

Mr. Austin, in reference to the specimens introduced by Mr. May, as the manufacture of Messrs. Chance, said it was a production from the basaltic strata, which principally abounded in the neighbourhood of those gentlemen's manufactory, and it was also found in Scotland. The disadvantage was, that it had to be dug from the earth and then conveyed to the place of manufacture, and he thought it would be too expensive to successfully compete with the production direct from the slag. He was convinced, from the valuable articles he had seen produced under a new patent, by Mr. Elliott, that slag would supersede any material which was attended with the cost and labour of digging from the earth, because the slag could be obtained at no cost at all. He had known some iron masters pay as much as 3s. 6d. per ton for conveying the slag away, which increased the price of iron. This would not be the case if the slag were convertible to useful purposes, and he was convinced that it only required the spirit and energy which Englishmen possessed, to carry it out to a very profitable result.

Dr. Smith, in reply to the remarks of Mr. Nesbit, begged leave to state that he did not by any means wish to convey the idea that there was anything novel in the working of slag, by simply running it from the smelting furnace in its crude state, as mixed mechanically with debris, &c. That had been done in different countries for centuries past. The novelty which he referred to, consisted in the adaptation of slag, by refining it, &c., to the production of articles of commercial value. Unless refined and carefully separated from all foreign ingredients or debris, slag could not be properly annealed or profitably manufactured. And he, Dr. Smith, believed slag had not been thus utilized, either in France or any other country, excepting in accordance with the novel process which he had secured in Great Britain, France, Belgium, America, Sweden, Austria, and other countries, by several patents, comprised in specifications and claims which were too numerous to be here repeated. In reply to Professor Wilson he would simply state, that if the professor carefully examined the consecutive and continuous operations carried on in the smelting process, he would become fully satisfied that the definite union in fixed chemical proportions, would be found the only possible condition under which mineral products could be fused together. Dr. Smith further stated, in answer to the inquiries made by Dr. Noad, that the subsidization and refinement of the slag, subsequently to its withdrawal from the smelting furnace, materially affected the quality of the liquid material, inasmuch as the merely mechanical mixtures could thus be separated from those purely chemical. Dr. Smith added, in reply to the inquiries made relative to his visit to certain furnaces in Wales, that he had been kindly favoured with permission to make some samples from the slag of the Dowlais and Ebbw-vale Iron Works. These samples were now before the meeting, in the form of table-tops, &c., and showed that those furnaces yielded slag of a very superior quality, as to liquidity, colour, &c.

The Chairman was sure he was only expressing the wishes of the meeting when he said they were desirous of thanking the author for the interesting paper he had read. Many remarks had been made upon previous attempts to utilise this substance, but it might be said " he invents who perfects," and if Dr. Smith did that he would confer a great benefit upon the country.

The Secretary announced that the Paper to be read at the next Meeting, on Wednesday evening, the 4th of April, was, "The Diseases of Miners." By Mr. Herbert Mackworth, M. Inst., C.E.

## COTTAGER'S STOVES.

By Lady Bentham.

The cookery of English housewives is notoriously inferior to that of their continental neighbours, a difference which probably originated in the kind of fuel employed in this country viz., coal, to keep up an equable small fire with which requires almost constant attention. The French woman, on the contrary, with her wood fire, can collect its embers, draw them round her soup pot or stew, leave her provisions to simmer gently without attendance, whilst she occupies herself in other business. The first step, therefore, to the improvement of English cookery should be the contrivance of a stove which, when burning coals, would enable the housewife to attend to other concerns than keeping up a cooking fire.

Many fire-places are in the market, under the name of Cottager's Stoves, several of them possessing good properties, but no one all that are desirable for even English cooking, still less for the confection of food in the palat-

able, economical manner customary in France and in other continental states; the following hints may possibly tend to the contrivance of a stove suitable for the working classes and for small economical families.

The first desideratum is, that such a stove could be manufactured at a low price.

A second desirable quality is, that it should be a bad conductor of heat in all parts surrounding the fire, excepting where its heat is required for warming an apartment, or occasionally for cooking. This property is easily attainable by forming the fire-place of fire-bricks or lumps instead of metal, as is now practised in many grates and stoves.

The next consideration would be the several services required from a cottager's stove. The principal ones appear to be the following: To heat the cottage or kitchen in cold weather; to furnish a sufficient supply of boiling water at short notice, and of tepid water at all times; to boil quickly such meats as require to be so cooked; to broil; to fry; to bake; to stew, and to make soups; to dry shoes and other apparel, without annoyance to the inmates of the cottage or kitchen; to dry linen after washing; to heat smoothing irons; to ventilate the cottage or kitchen.

Heating the apartment sufficiently may be attained by any stove constructed on the principle of an Arnott's stove, and which principle forms the basis of the subsequent suggestions.—The construction of a stove surrounded with non-conductors of heat, excepting in such parts as are required to give it off, and that with more or less rapidity; also the providing means for regulating the admission of air to the fuel, so that it may burn away with more or less rapidity, according to the degree of heat required. This is effected, as is well known, by a regulator in the furnace door, and the stove itself is rendered a slow conductor of heat, by surrounding it with a casing of sand. In like manner a cooking stove, the fire-place being of fire brick, might have an outer shell of sand enclosed in any suitable material. The English working classes being accustomed to see and to enjoy an open fire, it might be expedient to continue this indulgence by constructing a grate in front of the fire, but closable with a door at pleasure. At St. Petersburg stove doors are habitually made double, having, perhaps, an inch of air between the inner and the outer doors, and—I forget how—the two folds are so contrived as that, by simple mechanism, they close air-tight. The front grate in *Nicholson's* stove is exceedingly convenient—it lets down so as to drop out the coals on extinguishing the fire, the back of the fire-box being a curve towards the front. Servants and cottagers, on raking out a fire, poke and beat it, smashing the coals and cinders to ashes. The coal-box recently advocated by Dr. Arnott might with great advantage be applied to feed the fire in a cottager's stove. In hot weather an outer casing of sand might be added to the sides of a stove, but evidently at an additional expense.

The exterior of stoves in this country have hitherto been of metal; but, independently of non-conducting property, on account of cleanliness glazed earthenware is far preferable. In Denmark, Sweden, and Russia, the stoves for heating apartments, at least, are universally of glazed pottery, and doubtless they are so in German states that I have not seen. So in France, the largest and the smallest stoves are of white glazed earthenware. I purchased one for 20 francs, (about 16s. English) in a provincial town in the south of that country. This stove had an iron oven in it, the heat of which was sufficient for cooking, though it was not used for more than toasting bread. There was a neat door for the oven, another for the fuel, and two or three iron bands around the body of the stove. It cannot be conceived that English potters should fail of accomplishing what in France is so generally effected; not that any stove for coals could be furnished for sixteen shillings, as a grate would be necessary, besides other conveniences that seem desirable.

Housewives are likely to exclaim loudly against me, when I condemn the usual *boiler* connected now-a-days with all kinds of cooking grates and stoves. But such boilers are, in fact, extremely wasteful of fuel; I am well convinced of their convenience, though the old-fashioned boiler slung upon its crane, always gives an ample supply of hot water, and at a boiling point when necessary. The *fixed* boiler works whether hot water be wanted or not; when boiling water is not required, it goes up the chimney in the form of steam, and it is well known that many times the heat necessary to make water boil, are absorbed in its conversion into steam. The loss of heat consequent on the attachment of a boiler to the fire-place is not known, but it must be considerable, for with fewer and much smaller fires, the same quantity of coals has been consumed since a fixed boiler was obtained with a new kitchen range, upon approved principles, and of a description in very general use. Boiling water being wanted by the cottager for tea and other purposes, an aperture should be formed over the fire large enough to admit a tea kettle; the kettle itself, though having a bottom so far flat as to ensure steadiness when set down, might have its sides flaring outwards for two or three inches, whereby the aperture in the stove would be well closed. The kettles made for a cottager's stove do indeed cover such an aperture, but they being at some distance from the fire, are long in boiling, whereas a conical kettle might be inserted enough for it to nearly touch the fire. The same aperture would serve for plain boiling of meat or vegetables, the boiling vessel being also conical at its lower part. For a constant supply of tepid water, a flat-bottomed kettle might be kept on the top of the stove. The same aperture would afford an open fire for broiling and for frying. Should a roast be required, it might be done at the open front of the fire, should that be preferred to using the oven for this purpose.

The oven would be a most essential part of the stove. The oven should be capable of being heated to the degree necessary for baking bread and pies, and also susceptible of being kept at a lower degree of heat. The oven should have a very small pipe from it opening to the chimney, this being for the purpose of carrying off steam and disagreable odours; there should also be means of conducting air to the oven in Count Rumford's way, as he found that want of air caused the inferiority of baked to roasted joints; both the pipe to the chimney and the air opening should be closeable at pleasure, by means of the ordinary rose-closure, which also enables the opening to be regulated according to need. Soups and stews of all kinds would be best cooked in the oven; they might be left therein to simmer gently for several hours without the least attendance; a piece of beef, with a seasoning of salt and spices, remained in my oven for five hours to-day, and proved excellent; many a French cook would have placed the stew-pot and its contents on the embers of a wood fire overnight, the tenderness of the meat depending on its being very gently simmered, never boiled. Professed cooks are aware of this, but the generality of English housewives fancy that a fierce fire is essential to good cookery. It is the same with soups; soup meat is tough, hard, and tasteless when it is kept boiling, but, on the contrary, the *bouilli* from which soups are made in France, is always tender and well flavoured, for it is never allowed to boil after the first skimming of the pot. These are homely matters to descant upon, but if Viscount Ebrington deems it worthy of the Society of Arts to improve the habits of the working classes, surely it is not beneath them to point out the means by which ordinary diet may be amended.

Many a cold, a fever, or a consumptive malady, originates in the sitting in wet apparel, or in exposure to the vapor in drying it, of fresh-washed linen. To obviate such mischief a drying-chamber might be formed, at little cost, in an ordinary fireplace; for this purpose a part of the chimney might be enclosed, so as to be somewhat heated by the stove, the chimney shaft, or a part of

it, being left open for the escape of moisture. Count Rumford, more than half a century ago, fitted up a drying closet in his house in Parliament-street, in which closet bed-linen and blankets were daily hung. That closet furnished the idea of the enclosure now proposed, and, by opening the door of it, a draught of air up the chimney would ventilate the cottage or kitchen more or less at pleasure.

The heating of smoothing-irons remains to be provided for. In the generality of stoves, their tops being hot plates, the irons are placed upon them; but for this purpose a great fire is necessary, otherwise the irons are not hot enough for large linen. In Mr. Strutt's laundry, at Belper, the irons sunk into a bed of sand on a hot plate, were speedily heated at a small expense of fuel, and a slight shake threw off the sand on taking them for use. In the same way a box of sand might be placed over the aperture on the top of a cottager's stove, or, where box-irons might be preferred to flat ones, the heaters might be placed between the bars of the grate when open, or otherwise put into the fire from the aperture above it.

No cottager's stove hitherto in the market is provided with means of applying fire-heat to that particular part where wanted at the moment, but this might be easily effected by a better arrangement of the flues, and by dampers upon them, to cut off the heat from parts not wanted.

Amongst the best of the present stoves is that called the Cottager's, and it is sold in many of the London warehouses; but it has the great inconvenience of being laid and lighted from an opening in the top, thus rendering it impossible to rake out cinders, or to lay the fire, without soiling the arm; were the front bars to let down this would be avoided. It is also necessary in this stove to heat the oven, although a kettle of hot water were all that was required, and the top plate is rarely hot enough for smoothing irons. Soyer's stove has the advantage of a small projection above the fire as a security against smoke from the fire-plaee. Nicholson's stove seems to be the best of existing ones, but it requires setting by the bricklayer. Having determined to have one of Nicholson's in my kitchen, I sent for the best builder of the place, informed him that such stoves might be seen in constant use in the Model Lodging Houses in Streatham-street, and authorised him to order *himself* such a stove for my use, that he might not lose the profit allowed by manufacturers; but no, nothing, he said, would suit me but the usual range, with its boiler and oven. I jogged on with such a one for another twelvemonth before a Cottager's stove was procured for the kitchen in question. This is mentioned as showing the desirability of contriving a stove complete in itself, without requiring any setting.

Nicholson's stove is said to have been improved upon in London, but like many other so-called improvements, for the worse, and so as to render it more costly.

There are times of the year when fire is wanted merely to boil water for tea; for this purpose, and a few others, there is already an excellent apparatus called the Batchelor's Kettle, with which a single round of the patent wood "four fires for a penny" boils a pint of water. It is sold by Spiller, 98, Holborn-hill.

Amongst the best of the present stoves, is the "Anglo-German warming and cooking stove," of Pierce, 5 Jermyn-street.

As there is some difficulty in firing large masses of pottery, especially glazed ware, and as lime cements are destroyed by great heat, it would seem expedient to compose an earthen cooking stove of separate pieces, connected with one another by clay instead of mortar. At St. Petersburgh, we had a dressing-room divided from the bed chamber by a wall of white glazed tiles; this wall containing horizontal flues its whole height; during its construction, I noticed the operations of the stovebuilders, especially whilst preparing the clay as a cement; they kneaded it for some hours with their feet, carefully picking out even the smallest pebble, which, if neglected, they said, would seriously injure the intended structure; the tiles, of perhaps 18 inches square, had been moulded with a few holes in their sides, less than the eighth of an inch diameter, for the reception of iron steady-pins, to keep the work in its place for a few days; the wall being finished, the builders gave instructions to allow a current of air to pass through it for some days, but not to make a fire in the stove till the clay should be nearly dry, then to burn it into brick by making a hot fire in the stove. It would seem that around many of our fire-places, clay would form a more durable cement than mortar, yet the builders here are averse to the substitution of clay.

For cooking in an oven, culinary vessels of pottery are preferable to any metal. Formerly the kind of pottery called "Hempel's ware," bore excessive heat without a fracture; a sort of ware much resembling it is now common, and is used as potting pans. The shapes of these are not convenient, as they are contracted at the top as well as bottom. Hempel's vessels had usually a rim at their tops to support a lid. Formerly earthern pipkins were used in every kitchen, but with their abandonment habitual use of crockery has been lost. This is much to be regretted, as carelessness of brittle things is one great source of that wastefulness in the working classes which Lord Ebrington remarked in his address of the 15th November. French women and Russians are said to be rough, but in both nations brittle earthenware is the common material of culinary vessels, which are in those countries seldom broken. I heard a French housewife sorely lament a crack in her soup-pot, which had cost 8 sous, and had "lasted so *many* years." Let not, then, the unnecessary breakage of earthenware be an objection to its use for culinary purposes; it is cheaper, and more easily cleaned when soiled than any other material; it is not susceptible of sudden change of temperatures, it is of little cost, it keeps its contents long hot; indeed, on this account a soup or stew may be served at table in the same clean vessel in which it had been cooked on a hot plate, or in an oven.

## PARIS EXHIBITION.

Concurrently with the Exhibition at the Palais d'Industrie, a general exhibition of agricultural produce, to which all countries are invited, will take place in Paris from the 1st to the 9th of June next, under the auspices of the Minister of Agriculture and Commerce. A show of this kind is, it is believed, the first that has occurred in France. England will of course be expected to take a considerable part in it. A special section is destined for animals, male and female, of foreign breed, which may be brought expressly for the Exhibition, or which have already been imported into France, whether they be the property of Frenchmen or of foreigners. Cattle, sheep, pigs of all breeds and kinds, will be admitted. Fowls, turkeys, ducks, pigeons,—in a word, all the best specimens of animals of every description comprised in the term of agricultural produce, will have their places. The French Government not only invites all friendly nations to participate in this show, but will also share in paying the expenses of transport; and from the French frontier the stock of the kind mentioned coming from abroad will be brought to Paris at the expense of the State, as specified in the 16th article of the Ministerial order to that effect. It has been also decided that the expense of feeding shall be defrayed by the Government during the period of the Exhibition. Independently of a sum of about £1,000 sterling which will be expended in prizes to the successful competitors, sales, either by auction or by private arrangement, of the stock, or any portion of it, may take place, so that not only will the exhibitors enjoy the advantage of free transport and of gratuitous feeding for the cattle and other animals, but they will be enabled to effect sales on the spot, and under circumstances of the most favourable kind, when the largest proprietors and farmers are met together.

A bill has been presented to the Corps Legislatif for modifying the French patent laws with a view to the Universal Exhibition. Any exhibitor who may desire to reserve his right in his invention will be allowed to apply to the directors of the Exhibition for a certificate, instead of at once taking out his patent, and paying the first instalment of 100fr. required by the present law. This certificate will protect him for a year from the day of the deposit of the article with the committee; after that period a patent must be taken in the usual form. The bill will be applicable to foreigners as well as Frenchmen, and to articles not strictly patentable, which, under the name of *dessins de fabrique*, are regulated by a special law.

## THE PATENT OFFICE.

A Free Library and Reading-room, in connection with the Office of the Commissioners of Patents, was opened to the public on Monday, March 5. The hours of attendance are from 10 till 4 o'clock.

The library includes a printed collection of all specifications filed since October 1, 1852, as well as a considerable number of those recorded under the old law.

# Home Correspondence.

## DECIMALISATION OF COINS AND ACCOUNTS.

SIR,—There has been pointed out to me, in a lette from Mr. Theodore Rathbone, contained in your *Journa* of the 16th inst., the following passage:—

"Between the 69·43 grains of silver constituting the franc and the 67·27 grains the English tenpence, there is, of course, literally only about two grains of difference, with a corresponding degree of difference in the dollar, &c.; and so far from there being any approach to accuracy in Mr. Miller's extravagantly wild assertions that by the proposed adjustment, I mean 'that England should abandon every one of her present measures of value, &c.,' it is not even proposed that she should abandon any one of them whatever."

"Extravagantly wild assertions," or "assertions without any approach to accuracy," would be unpardonable upon a subject where all the facts lie before us.

The passage of Mr. Rathbone's upon which my remarks were made was the following:—

"When Great Britain has everywhere adopted the *tenpence, or twenty fourth part of her pound sterling* as the principal denomination in all her accounts, can it be doubted that the very slight adjustment required to render *this coin* the true European franc or French tenpence, would very soon follow?"

There can be no question here, as there usually is, about Mr. Rathbone's meaning. He says, "this coin, *the twenty-fourth part of a pound sterling*," and he contemplates the changing it into a franc by a slight adjustment. Now this slight adjustment is in £1,000 upwards of £48, or nearly a shilling in the pound; and such, or, indeed, any alteration in the value of our great unit and standard of value, would necessarily leave us without one single element wherewith to connect the money of the past with the money of the future. My remarks, therefore, were neither extravagant nor incorrect, as Mr. Rathbone supposes, but plain facts, fairly and logically stated.

Mr. Rathbone now changes his ground, and states that he means by the "slight adjustment," the small amount of silver required to make an English tenpenny token equal in weight to a franc. We will grant him, for the instant, that they contain an equal quantity of fine silver. Now, what has he gained by it? He has simply—very simply—altered, not the measure, but the symbol or token for the measure, made it more costly, and thinks that he has made a universal thing; and thereupon mounts up into the seventh heaven of self-glorification, singing, as he rises—"How vast the gain to mankind of a strictly uniform and *interchangeable* silver coinage!"

Did it never occur to him, before he left the earth, to try its interchangeability? Perhaps he may be acquainted with "an order of mortals on the earth" who would exchange tenpennies, 24 to the pound sterling, for francs 25 and near ¼, to the pound; but I hope and believe that even in Liverpool such an order of simple ones is not an extensive order.

The great delusion upon this point is, that it would be any advantage to the nations of the earth that their coins should be interchangeable.

One of the great advantages of our currency is, that our silver coins remain at home. That advantage results from their being merely the legal tokens for the values they represent, and the values themselves. The United States have just now adopted our plan, and doubtless all Europe will be driven to do the same.

There would, really, be some statistical advantages in a universal money of account, but without that, a similarity of coins could be no advantage whatever. The fairest arrangement undoubtedly is, that each nation should pay for the fabrication of the money it uses, as it does at present.

I warn Mr. Rathbone off this ground. He has to learn yet the first principles of monetary science. Let him take up the cry of the "Poor Man's Penny;" it is a safer string for him to harp upon.

Mr. Rathbone further states that I am a party to a proposition to alter the value of the gold sovereign; such is not the fact.

Yours, &c.,
W. MILLER.

Bank of England,
March, 1855.

SIR,—In a former number of the *Journal* I pointed out the origin of the pound-and-mil-scheme of decimal coinage. The following extract from the *Times* will show that the penny scheme is no new proposal, and that the *Times* is perfectly consistent in now advocating that measure.

In the leading article of the *Times* for the 14th June, 1816, occurs the following paragraph:—

"Since the revolution, a simple system has been adopted in France, and the coins, both of gold and silver, have been, in comparison with our own currency, perfection itself. The integral unit in this system is a piece of silver instrinsically worth about 9½d. or 9¾d. of our legal money. If, therefore, our government would coin shillings of the same intrinsic value, (that is to say, containing 69½ grains of pure silver, besides the alloy), and would make these shillings current for *tenpence*, we should have the elements of a decimal system of calculation, with little derangement of our existing accounts, inasmuch as it would only be necessary to enact, that wherever pounds sterling have been mentioned in any existing contracts, the term should be taken to mean 240 pence, or 24 shillings, of tenpence each."

This is only one of numerous articles on this subject, both before and after that date, in that paper, and many pamphlets were published on the plan in that year, but all these were overlooked by the late Parliamentary Committee. Even the desire to introduce the French system entire was advocated at the same time. In the leader for the *Times* of 31st May, 1816, the following paragraph is to be found:

"Why not at once adopt the French integer, which they call the franc, and which we may call what we please! Vast would be the benefit to commerce—vast, indeed, the convenience to individuals, if the same money substantially circulated in the two countries."

During the discussion on the new coinage in 1816, all the advocates of a decimal coinage in the House of Commons and the press, were in favour of a *tenpenny* coin. Though "Mercator" had published the pound-and-mil

scheme recommended by the late Parliamentary Committee, I do not find it recommended by a single person at that time. It was evidently considered too theoretical, and not sufficiently practical or accurate for general use. There was every probability of the *tenpenny* being adopted by the government, but a discussion arose about the gold coin, if it should be a guinea or a sovereign; and nothing further was said about the decimal coinage, and perhaps the government were annoyed at Mr. H. Goodwyn's claim for a compensation for the scheme.

Yours very truly,
JOHN EDWARD GRAY.

British Museum, 19th March, 1855.

## Proceedings of Institutions.

WARE.—On Friday evening, February 9th, a lecture on Fire-Arms, was delivered at the Town Hall, to the members and friends of the Institute, on the subject of "Military and Sporting Arms," by Mr. D. B. Harvey. The lecture was well attended, and the chair was occupied by Mr. Gisby. The lecturer gave an interesting and lucid sketch of the history of fire-arms, pointing out the peculiarities of construction, with their advantages and disadvantages, of the different kinds of muskets, rifles, and pistols, which have from time to time been invented. Having briefly noticed the earlier improvements which took place in the manufacture of fire-arms, particularly the flint lock and the percussion cap, the former a French and the latter an English invention, he dwelt at greater length on the various improvements of more modern times. He fully explained the construction and mode of action of the needle gun, the Minie rifle, breech-loading guns, revolving and repeating pistols, air guns, india-rubber guns, and bulleted-cap guns; and illustrated his remarks with specimens of each kind. The needle gun which is of Prussian origin, but has been improved by English manufacturers, had not, he said, had a fair trial in this country, and it should not be taken for granted that it was inferior to the Minie rifle; in fact, in some respects the needle gun was superior to the Minie. Many of the Russians were armed with the Prussian needle gun, and used it very effectively, for with this gun they had picked off single men walking along the banks of the Danube, at a distance of 1500 yards. The needle gun was in great favour in Prussia, 50,000 having been issued to the Prussian army, who, armed with this weapon, were very formidable opponents. The lecturer remarked that in this country the proof of gun barrels was very lax, for after a barrel came from the proof-house it was often filed down to fit the stock; but in France and other countries it was required that the gun should be nearly completed before it was sent to the proof-house, and consequently greater security was obtained, from the barrel not being afterwards tampered with. The public, however, might know whether a gun barrel had been filed down after it left the proof-house by the distinctness or indistinctness of the stamp. The lecturer concluded by stating some interesting facts respecting the immense quantities of gunpowder consumed in a given time at various battles and sieges, and by alluding to certain experiments which had been made relative to the advantages of gun cotton.

## To Correspondents.

ERRATA IN MR. LAWES' PAPER.—Page 271, on the eighth line of figures from the bottom, for 48·10 read 45·62; for 3·083 read 2·737; for ·556 read ·581; for ·410 read ·456; and on the last line of figures, for ·157 read ·057.

In the discussion on the Sewage of London, Mr. Higgs referred (page 324, col. 2, line 34) to works about to be opened at *Tottenham, Middlesex*, instead of at *Nottingham*, as reported.

At page 325, 2nd line of the last paragraph of Mr. Morton's letter on Italian Ryegrass, for *soil* read *evil*.

## MEETINGS FOR THE ENSUING WEEK.

MON. Royal Inst., 3. General Monthly Meeting.
Architects, 8.
Entomological, 8.

TUES. Horticultural, 3.
Civil Engineers, 8. Renewed Discussion upon Mr. Robinson's Paper "On the Application of the Screw Propeller to the larger class of Sailing Vessels."
Linnæan, 8.
Pathological, 8.

WED. Society of Arts, 8. Mr. Herbert Mackworth, "The Diseases and Accidents of Miners."
Geological, 8. Sir. R. I. Murchison, "On the Comparative Geology of the Paleozoic Rocks of the Hartz, the Thuringerwald, and other parts of Europe.
Pharmaceutical, 8½.

THURS. Photographic, 8.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

Par. No.

*Delivered on 20th of March*, 1855.

110. Local Acts (8, Somerset Central Railway; 9, Dundalk Harbour and Port; 10, Sunderland Dock; 11, East Kent Railway; 12, East of Fife Railway; 13, Stokes Bay and Isle of Wight Railway, &c., &c.; 14, Fergus Estuary Reclamation; 15, Dagenham Docks;)—Reports from the Admiralty.
113. Linseed, &c.—Return.
Arctic Expeditions—Further papers.

*Delivered on 22nd March*, 1855.

61. Works and Public Buildings—Abstract Accounts.
62. Woods, Forests, and Land Revenues—Abstract Accounts.
120. Sugar—Return.
122. Army (Officers Promoted)—Return.
125. Metropolitan Water Companies—Further Reports.
36. Statute Law Commission—Return.
Prisons (Scotland)—16th Report of the General Board of Health.

*Delivered on 23rd March*, 1855.

124. Court of Chancery—Return.
59. Bills—Education (No. 2.)
60. Bills—Metropolis Local Management.
62. Bills—Newspaper Stamp Duties.
Church Estate Commissioners—4th General Report.
Ecclesiastical Commissioners for England—7th General Report.

*Delivered on 24th and 26th March*, 1855.

126. Military Medical Officers (Turkey)—Return.
128. Guano—Return.
130. Promotions (Marine)—Copy of a Royal Warrant.
131. Railway and Canal Bills Committee—2nd Report.

## PATENT LAW AMENDMENT ACT, 1852.

### APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, March 23rd*, 1855.]

*Dated 17th February*, 1855.

358. H. P. Haughton, Bethnal-green—Wearing apparel for the ankles.

*Dated 20th February*, 1855.

374. F. B. E. Beaumont, Upper Woodhall, Barnsley, Yorkshire—Revolvers.

*Dated 1st March*, 1855.

451. J. Ramsbottom, Accrington, Lancashire—Steam-engines and motive power.

*Dated 5th March*, 1855.

482. J. Gledhill, Congleton, Cheshire, and R. Gledhill, Halifax—Preparation of Silk, Flax, and other fibrous substances, and in the machinery employed therein.
484. W. Johnson, 47, Lincoln's-inn-fields, and Glasgow—Coating iron and steel wire with other metals or alloys. (A communication.)
486. A. Hotchkiss, New York, U.S.—Projectiles.
488. Arsène Louis Garnier, Guernsey—Photography, denominated Système Garnier de Photocherographie coloriée.
490. R. Van Valkenburgh de Guinon, Brooklyn, State of New York, U.S.—Anchors.
492. J. Wood, 30, Barbican—Ornamenting woven fabrics for bookbinders and others.

*Dated 6th March*, 1855.

494. W. Hyde, Spring-hill, Ohio, U.S., 17, Cornhill—Marine life-preserving apparatus.
498. J. Player and L. D. Jackson, 2, Winchester-buildings—Furnaces for the prevention of smoke.
500. T. Lawson and M. Thompson, Gateshead-on-Tyne—Consumption or prevention of smoke.

*Dated 7th March*, 1855.

502. J. Kennedy, Liverpool—Manufacture of boots and shoes.
503. J. Higgins and T. S. Whitworth, Salford—Small arms, hardening articles of metal.
504. J. Cooper, Birmingham—Joiners' braces and bits.
505. W. Weild, Manchester—Looms for weaving pile fabrics.
507. J. W. Sloughgrove and J. H. Wheatly, Windsor-street, Islington—Smoke consuming furnaces.
508. J. M. Napier, York-road, Lambeth—Machinery for manufacturing balls for small arms.

510. J. Wilson, Hurlet, county of Renfrew, and J. Horsley, Cheltenham—Manufacture of iodine and iodides, and of a pigment or pigments therefrom.

*Dated 8th March*, 1855.

511. B. L. F. X. Flechelle, Paris—Porte-monnaies.
512. L. E. Bataille, of Paris—Looms for weaving pile-fabrics.
513. G. C. Reitheimer, Holyhead, Anglesea—Means of loading or discharging fire-arms.
514. T. Walker, Birmingham—Rotary engines by steam or other fluid.
515. A. F. J. Claudet, Regent-street, Westminister—Stereoscopes.
516. G. Hazeldine, Lant-street, Southwark—Wheel carriages and wheels.
517. A. Krupp, Essen, Prussia—Construction of railway wheels.
518. J. Brooks, Bury, Lancashire, and Walter William Stephen—Looms for weaving.
519. J. Taylor, Spring-grove, Isleworth—Packing and preserving eggs and other articles of food.
520. H. Gilbert, Kensington—Hurdles.
521. J. and S. Aitken, and J. Haslam, Bacup, Lancashire—Machines for preparing, spinning, and doubling cotton, wool, flax, silk, &c.
522. J. Norton, Dublin—Fire-arms and ammunition.
523. W. Foster, Black Dike Mills, Bradford — Machinery for drying wool, &c.
524. W. Foster, Black Dike Mills, Bradford—Machinery or apparatus for cleansing wool, &c.
525. J. Bernard, Club Chambers, Regent-street—Manufacture of boots and shoes, and machinery for same.
526. J. Gerard, Guernsey—Portable floating pier, &c.

*Dated 9th March*, 1855.

527. G. White, 5, Laurence Pountney-lane, Cannon-street — Treatment of horn, &c. (A communication.)
528. P. Dall, Woolwich—Self-acting indicating and recording mechanism for steam-engines.
529. J. Bullough, Accrington—Looms and apparatus for weaving.
530. J. Murdoch, 7, Staple-inn, Holborn—Shade or reflector for lamps. (A communication.)
531. J. Murdoch, 7, Staple-inn, Holborn—Method of enlarging or reducing designs, maps, &c., and machinery for same. (A communication.)
532. F. A. Barnet, Nelson-street, Bristol—Manufacture of metallic bedsteads and couches for the use of invalids, &c.
533. T. Hill, the Birches, Stanton Lacey, Shropshire—Machinery for the manufacture of bricks, drain-pipes, tiles, &c.
534. S. Lister, Manningham, Bradford—Treating and preparing the fibres of flax, hemp, &c., for spinning.
535. G. Bousfield, Sussex-place, Loughborough-road, Brixton — Preparing wool, &c., for spinning. (A communication.)
536. S. C. Lister, Manningham, Bradford—Combing the noil of silk waste.
538. S. C. Lister, Manningham, Bradford—Machinery for combing wool and other fibres.

*Dated 10th March*, 1855.

540. W. Mickle, Willington, Durham—Smelting or production of iron from its ore in blast furnaces.
542. J. Sunderland, Marsden, near Burnley—Self-acting apparatus for regulating the flow of liquids from casks.
546. R. Brisco, Low Mill House, St. Bees, Cumberland, and S. Horseman, St. John's Beckermet—Preparation of flax.

*Dated 12th March*, 1855.

548. D. H. Brandon, 11, Beaufort-buildings, Strand—Machinery for cutting fustians, &c. (A communication.)
550. J. Hulls, Plaistow, Essex, and J. Lowe, Lambeth-road — Coating iron and other metals with lead.
552. J. Gilbert, Engine Works, Boston-street, Hackney—Pump or pumping apparatus.
554. W. Score, Bristol—Bleaching oils, fats, and resin.

*Dated 13th March*, 1855.

556. D. Macaire, Paris—Casks and taps.
560. S. Swingle, Aston-juxta-Birmingham—Metallic spoons, forks, and ladles.
562. A. V. Newton, 66, Chancery-lane—Engine to be actuated by the expansive force of explosive mixtures. (A communication.)

## WEEKLY LIST OF PATENTS SEALED.

*Sealed March 23rd*, 1855.

2066. Louis Cornides, 4, Trafalgar-square, Middlesex—A new mode of manufacturing a transparent medium, plain, printed, and coloured, of gelatine in combination with other substances.
2075. Charles Barraclough, Halifax, Yorkshire—Improvements in machinery or apparatus for the manufacture of clog soles and patten soles by power.
2085. William Hutchinson and William Barlow, Salford—Improvements in steam boilers.
2087. George Crux, Manchester—Improvements in the production of bonnets, children's hats, and similar coverings for the head.
2115. Christopher Hill, Chippenham, Wiltshire—Improvements in the manufacture of pulp.
2133. Aimé Antoine Joseph Legentil, Arras, France—Certain improvements in pumps or machinery for raising and forcing water and other fluids.
2155. George Thomas Selby, Smethwick, Staffordshire—An improvement in furnaces.
171. Peter Arkell, Stockwell, Surrey—An improved mode of purifying whale and seal oils.

*Sealed March 27th*, 1855.

2086. William Beckett Johnson, Manchester—Improvements in lamps and other apparatus used for illumination.
2094. Walter Sneath, Derby-road, Nottingham—An improvement in sewing machines.
2100. Gémis Filhon, Paris—Improvements in glass chimneys for gas burners or lamps.
2101. Thomas Collins, Gayton, Northamptonshire—Improvements in manufacturing bricks and tiles.
2108. William Woods Cook, Rumforth, near Bolton, Lancashire—An improved method of weaving or manufacturing woven fabrics suitable for petticoating or similar purposes, where thick and thin parts of the same fabric are required.
2118. William Tatham, Rochdale—Improvements in machinery or apparatus for preparing, spinning, doubling, twisting, and winding cotton, wool, flax, silk, and other fibrous substances.
2120. John Jeyes, Northampton—An improvement in the manufacture of paper, threads, and yarns.
2131. William Peel Gaulton, Cray Works, near Macclesfield—Improvements in breaks applicable to railway carriages and other vehicles.
2135. Thomas Prosser, New York, U.S.—Improvements in the manufacture of certain hollow closed vessels, and in the machinery or apparatus employed therein; parts of which improvements are also applicable when preparing for and fastening tubes into steam-boilers, or other vessels requiring tubes to be fixed therein.
2145. Thomas Bennett, Woodbridge-street, Clerkenwell—Improvements in the apparatus employed in the manufacture of gold, silver, and metal leaf.
2148. François Durand, Paris, and 4, South-street, Finsbury—Certain improvements in circular looms.
2154. Robert Way Uren, Fogginton, Devonshire—Improvements in machinery for the manufacture of bricks and tiles.
2166. Samuel Hancock, Woolaton-street, Nottingham—Improvements in the manufacture of looped fabrics.
2210. Etienne Bernot, Paris, and 4, South-street, Finsbury—A new machine for cutting files, which he calls "Bernot's file-cutting machine."
2239. Thomas Biggart and Allan Laudon, Dalry, country of Ayr, N.B.—Improvements in regulating motive-power engines.
2315. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in lithographic printing presses. (A communication.)
2366. Charles William Siemens, John-street, Adelphi—Improvements in electric telegraphs.
3399. Peter Armand le Compte de Fontaine Moreau, 4, South street, Finsbury, and 39, Rue de l'Echiquier, Paris—Improvements in fire engines.
2759. George Edward Dering, Lockleys, Hertfordshire—Improvements in obtaining motive power when using electric currents.
11. George Peacock, Gracechurch-street, London—Improvements in constructing propellers for ships and other vessels.
66. Henry Bessemer, Queen-street-place, New-Cannon-street—Improvements in the manufacture of iron and steel.
73. Edward Hall, Dartford, Kent—Improvements in the manufacture of gunpowder.
75. Elmer Townsend, Massachusetts, U.S.—New and useful improvements in machinery for sewing cloth, leather, or other material. (A communication.)
146. John Irwin Clarke, Windsor-court, Monkwell-street—Improvements in applying colour to the edges of leather gloves. (A communication.)
155. William Douglas and John Carswell, of Manchester—Improvements in dyeing woven fabrics.
201. William T. Vose, Massachusetts, U.S.—New and useful improvements in pumps for elevating fluids.
202. Isaac Atkin and Marmaduke Miller, Nottingham—Improvements in apparatus for measuring the supply of water and regulating the supply of fluids.
220. Arthur Collinge, 65, Bridge-road, Lambeth—Improvements in spring hinges.
223. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the generation of steam. (A communication.)

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3699 | March 23. | Wheatman's Mill Saw Key Tiller ......... | Wheatman and Smith ...... | Sheffield. |
| 3700 | ,, 24. | Hospital Stove................................... | Price's Patent Candle Co.... | Belmont, Vauxhall. |

Journal of the Society of Arts.

*FRIDAY, APRIL* 6, 1855.

## CONVERSAZIONE.

On Saturday Evening the Society's Seventh Exhibition of Inventions was opened with a Conversazione, which was numerously attended by the members and their friends. About one thousand persons were present. Viscount Ebrington, M.P., Chairman of the Council, received the Company.

The Exhibition of Inventions is now open daily from ten till four. Admission free to members and their friends; to others on payment of 6d. each.

## INTERNATIONAL COMMERCIAL LAW.

A deputation from the joint committee of the Society for the Encouragement of Arts, Manufactures, and Commerce, and of the Law Amendment Society, had an interview with Lord Stanley (of Alderley) on Friday last, at the Board of Trade, to present a memorial praying Her Majesty's Government to make known to the Imperial Government of France the interest with which a congress at Paris, to promote an approximation to an international system of commercial law, is viewed by the commercial public of Great Britain. The deputation consisted of Mr. W. Ewart, M.P., Colonel Sykes, F.R.S., Mr. W. Hawes, Dr. Waddilove, Mr. T. Winkworth, Mr. Leone Levi, and Mr. Le Neve Foster (Secretary.)

Lord Stanley (of Alderley) expressed himself as fully impressed with the importance of the subject brought to his notice by the Deputation, and assured them that he would not fail to confer with the Earl of Clarendon and the other members of Her Majesty's Government, as to how far assistance could be given to bring the subject to the favourable notice of the Imperial Government of France.

## SIXTEENTH ORDINARY MEETING.

### Wednesday, April 4, 1855.

The Sixteenth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 4th inst., Dr. T. K. Chambers, Chairman of the Industrial Pathology Committee presided.

The following Candidates were balloted for, and duly elected Ordinary Members :—

| | |
|---|---|
| Cape, George Augustus, jun. | Merrifield, Chas. Watkins |
| Clarke, Hyde, D.C.L. | Ottley, George |
| Denton, J. Bailey | Wilson, Samuel King |
| Fowler, John, jun. | |

The Paper read was

## ON THE DISEASES OF MINERS.

By Herbert Mackworth.

In taking up this important branch of the pathological investigations set in motion by the Society of Arts, and in giving a sketch of the condition of those whose toil is in the hidden places of the earth, a tribute is due to the encouragement afforded by the Society at all periods since its formation, to improvements directed to the amelioration of the physical condition of the miner.

I may especially refer to the premium given in 1816, to Mr. John Taylor, for an improved ventilating machine, which may be said to have been the basis of the mechanical ventilation now so largely applied in Belgian mines, and to the liberal premium to Mr. John Ryan, for improvements in ventilation, the principle of which, though little applied in England, has since, in a modified form, been incorporated into the mining laws of the principal continental mining states.

No one who has associated much with miners, or employed, as I have, considerable numbers of the various classes under which they fall, coal, iron, copper, tin, and lead miners, can fail to be struck with their appearance and general physical characteristics, as different from those of other classes of workmen inhabiting the same localities. It is remarkable that this large population, numbering by the last census, 296,461, following a peculiar and interesting occupation, has not attracted, by any means, to the same degree as on the Continent, the attention of medical writers, and that if we except the able reports of Dr. Barham, Dr. Mitchell, &c., to the Children's Employment Commission, we are actually without any comprehensive physiological treatise, such as those of Hanot, Vandenbroeck, Brockmann, and others; and it may be asserted that little more is known of the deplorable evils under which this class of workmen labours, than is given in the reports made in 1842, to which I have alluded.

The various committees of Parliament which have instituted inquiries since that time, have been satisfied to direct their labours towards a fraction only of these mines, and of these evils; either omitting altogether, or briefly referring to the enormous number of non-fatal accidents, the excessive proportion of sickness which falls to the lot of the miner, and the peculiar diseases and influences which prey on a miner's strength, and bow him down to the grave at an age when other labourers are in the vigour of life and strength.

The serious waste of our mining population from these causes, and the consequent drain on other classes, the rate of wages; the cost of mining; the demand for minerals of all kinds; apart even from motives of humanity, render the subject of mitigating or averting accident and disease from miners, one of national importance.

It is not by visiting the large mines, or by reading the evidence given by their managers, that a correct appreciation can be obtained of the hardships of a miner's life; it can only be obtained by those who have visited that greatly preponderating class, which the proprietors never visit, where no medical man enters, and where foremen and workmen are, in the face of dangers and difficulties, left in that untutored state which we see on the surface in populous towns, constantly converting a perhaps naturally healthy site to a sink of impurity and disease.

In attempting a feeble pourtrayal of a subject embracing so many topics as the pathology of miners, my remarks must necessarily be more superficial and general than I could desire, but I trust never to lose sight of the practical bearings of each question, and of the economic value to the masters as to the men, of remedial measures. As the various kinds of mines will require, in some points, separate treatment, their relative importance may be classed according to the numbers employed in 1851 :

| | | Production in 1852 about |
|---|---|---|
| Coal Miners ......216,366 | ... | 52,000,000 tons. |
| Iron Miners......... 27,098 | ... | 2,250,000 tons. |
| Lead Miners ...... 21,617 | ... | 65,000 tons. |
| Copper Miners ... 18,468 | ... | 11,000 tons. |
| Tin Miners......... 12,912 | ... | 9,000 tons of ore. |

Minerals lie in beds, lodes, or veins. Coal mines are worked almost entirely in beds, lying generally rather horizontal, but in other cases at every conceivable angle. A lode may for the present be taken as a bed lying at a steep angle. Veins, strictly speaking, are threads of mineral matter, which the miner follows until they enlarge into bunches, rooms, &c.

Copper and tin lie chiefly in lodes; iron and lead in beds and veins; but as the object is to get out a certain quantity of minerals with the least labour, many coal, iron, copper, and tin mines are worked on a similar plan; the chief differences being that a coal mine generally consists of two shafts, sunk down on to a bed, whilst in copper and tin mines the lode is turned on end, so that the numerous openings from the surface are in the lode itself. In coal mines large quantities have to be brought out rapidly from great distances underground. It is evident, therefore, that coal miners are further removed from the surface atmosphere than most other miners, and that consequently the ventilation of their working places is more difficult, if difficult it may be called.

The conditions which pervade all mines are, that a miner excavates a tunnel or space before him sufficiently wide to allow him to work and progress in the cheapest manner. This excavation serves for the extraction of the materials by means of boxes or trams, for carrying off the springs of water met with, and for bringing in to him a supply of atmospheric air sufficient to keep his light burning. As he penetrates deep into the earth's crust, the minerals are brought in a horizontal direction to the bottom of a highly inclined or vertical shaft, through which they are raised to the surface.

Hence, there are three distinct portions of a mine, the shafts, the underground roads or ways, and the variety of working places at their extremities, which have to be considered in relation to the occupation followed in them. All of them are distinguished from other workshops by the peculiarities of the temperature, pressure, moisture, and composition of the air, of the gases, and miasmata which exist in them; by the absence of sunlight, and by the mode of lighting, quite as much as the motions and working positions are different from those belonging to any other occupation. In the deeper parts of his operations, the miner is liable to be stopped or overwhelmed by water or carbonic acid; in the higher parts he may be suffocated or destroyed by irrespirable and explosive gases; and if he enters but a very short distance beyond the supplying current of atmospheric air, the oxygen rapidly falls below the proportion necessary to support life.

In the coal, and in some of the ironstone mines in England, it is the custom for the workmen to ascend and descend the shafts by ropes and chains. In the other mines the miner has access to his working place by ladders. The effect on the health and lives of miners, by having to ascend many 100 yards of almost perpendicular ladders at the end of a day's work, appears to be very serious from the able investigation of members of the Royal Cornwall Polytechnic Society,—Dr. Carlyon, Dr. Barham, Messrs. Lanyon, Blee, and others.

The muscles usually in full action in breathing, being tensely contracted, and the compression of the air in the lungs forming a fulcrum for the development of the force necessary to draw up the body, the minute air vessels of the lungs are very subject to injury during so prolonged an exertion, following on the completion of the daily task. The mischief done to the principal vital functions is still further aggravated by the want of ventilation in many ladder shafts, and in others by their serving as upcast shafts, that is, to bring the air out of the mine loaded with all the impurities collected in its course. I can speak from experience in the deep coal mines of Belgium, and the North of France, and in Saxony, as well as in this country. It is the opinion of the chief medical authorities, that climbing ladders in these shafts strike the first death-blow to the constitution of a large class of miners. The more enlightened managers of mines are aware both of the sacrifice of life and health, and the sacrifice of a considerable portion of the labour, enhancing the cost of working deep mines either by an actual payment for each transit, or a diminution of the daily task. This loss I have heard variously estimated at from ⅓th to ⅙th of the ordinary labour. Converting the ladder shaft into a downcast instead of an upcast; placing open timber sollers or landings, so as not to check the ventilation; or, as is done in Belgium, constructing them of iron bars, shortening the length of each ladder to 20 or 30 feet; making the rounds 8 or 10 inches apart, in lieu of 12 or 14; and inclining the ladders at an angle not exceeding 85°, are the praiseworthy means adopted by some proprietors to diminish this evil.

But the merit of the introduction of the fahrkunst o the Hartz mines, or man machine, as it is called in Cornwall, by which 100 men can at one time ascend without exertion and with great safety from their work, is due to Sir Charles Lemon and the members of the Cornwall Polytechnic Society. Three of these man-engines are now at work, at the United Mines, Tresavean, and Fowey Consols.

At the first of these mines Captain Francis showed, in a Report of 1845, that, deducting the cost of working the engine from the half hour per day saved to 450 men and 50 boys, there was a clear saving of £800 per annum, which would, in 3 years, pay the cost of the machine, without reckoning the saving in labour. "The relief afforded to the miners by this machinery can scarcely be estimated, and can only be fully appreciated by those who, after having nearly their whole strength and spirits exhausted by working for 8 hours, and even longer in some instances, in an atmosphere varying in temperature from 95° to 105° Fahrenheit, had formerly to climb to the surface by ladders. The amount of physical suffering which it alleviates is almost incalculable, and this benefit would, of itself, be full compensation for the outlay incurred in its erection, but the advantages, in a pecuniary point of view, which it affords, are equally striking."

The single acting man-machine consists of a strong rod of wood or iron, extending the whole depth of the shaft, to which are fixed platforms, about 4 feet by 2½ feet, at intervals of 10 feet. There are corresponding platforms fixed at the same distances to the sides of the shaft. The rod has a reciprocating motion up and down of 10 feet, communicated to it by the crank of a water wheel or steam engine. Now, a person stepping on the rod when it is about to go up, and off it on to the side platform when it is about to go down, and repeating the operation at every stroke of the rod, would arrive without effort at the top. One man can be on each platform at a time. In the double machine there are 2 rods, which move up and down alternately, and, therefore, double the speed of the ascent.

At Mariemont, in Belgium, the best example of a man-machine is to be found, but in many parts of France, Belgium, Westphalia, and Saxony, these machines are coming into general use, where the mines are deep and the number of miners who have to ascend considerable. At Mariemont, several mines communicate underground, for the purpose of getting access to the man machine. It has also been shown in Westphalia that a considerable saving may be effected by the employment of a man-machine, instead of raising and lowering the miners by ropes. It is therefore evident that it is in the power of proprietors of mines, by a remunerative outlay of capital, to preserve the workmen from what has been expressively termed "the miner's anticipatory tomb."

The roads by which the minerals are brought from the working parts to the shafts, vary in dimensions according to the inclination or thickness of the bed of rock. 4ft. 6in. is a common height for the branch road in driving through barren ground in metallic mines. In Cornwall, the levels vary generally from 5 ft. high, and 2 ft. wide, to 6 ft. high, and 4 ft. 6 in. wide. But the roads are seldom made so low in the above mines as in many of the ironstone and in some of the coal mines, where the height of the road is made to depend on the height of the seam. There are coal mines in Yorkshire, near Bristol, and in many other parts of England, where the whole thickness of ground taken out for the man to work in, is 15 inches. In this height the miner has to work with his pick in "holing" under the coal,—the technical expression for picking out a thin wedge of ground from under the seam, so that the coal, by its own weight, or by driving wedges in to the upper part, will become detached. In this height of 15 inches, it has to be piled into small boxes on sledges, and drawn or pushed by boys down a slope to the level, which is rather higher. The position of the boys in this "hurrying," "pulling," or "carting" (for every mining district has its own term,) is almost horizontal; the work that falls to their share is exceedingly laborious, and disproportioned to their age and strength. The height through which the "hurriers" have to push the trams, frequently does not exceed 30 inches. Here they harness themselves in front of the train by a leathern belt on the hips, and a chain between the legs, or push behind, assisting, when the top is low, by resting the head against the end of the tram. The mines in which this system is carried on are generally in the most neglected state: neither proprietors nor any person of superior intelligence enters the mine, and I generally find the drainage and ventilation in a deplorable state. Conceive the effect of the constrained attitude, laborious exertion in so contracted a space, half a mile away from the atmosphere, and the faces of these boys between 10 and 15 years of age, within a few inches of pools of mud and water, in which are worked up the putrefactions and nuisances of years. This is generally acknowledged to be the most costly method of working a colliery, the price of hauling being even 18d. per ton more than in other mines. I have met with instances where 75 men were ordinarily employed in the extraction of 30 tons of coal per day. Improvements in mining, slowly as they are imitated, are somewhat reducing the proportionate number of these mines. I have never met with any seam of coal in which the cost of cutting out the roadway to a height of 40 or 42 inches, and employing small ponies for the heaviest portion of the work, of which there are large numbers in the North of England mines, would not amply repay an expense often more imaginary than real.

Dr. Copland states: "Working in constrained positions shows its effect most decidedly in miners and colliers, who labour chiefly in the sitting or kneeling posture, frequently with the body bent in the greatest degree, in an unnatural atmosphere, often containing carburetted hydrogen and carbonic acid gases, and with artificial light. They are, moreover, exposed to changes of air, and occasionally work with their feet in water. They are generally spare men, with slightly curved spine and bow legs. When the dirt with which their skin is usually loaded is removed, the complexion seems sallow and unhealthy. Their complaints are asthma, rheumatism, disorders of the head, intolerance of light, &c., evidently resulting from the circumstances just stated connected with their employment, and their exclusion from the beneficial influence of sunshine, light, and air. They are not generally very intemperate, and yet they seldom live beyond fifty."

In the thin seams, the body of the collier is usually bent up, so that the elbow may rest either on his knee or thigh, to prevent the abrasion of the joint which would occur if rested on the ground whilst he is working with his pick. His candle he places rather behind him; occasionally he sticks it in his cap. A Cornishman can drive a gallery in rock, 2 feet high, by 2 feet 6 inches wide. Cornish miners are more accustomed than others to work over their heads, in driving upwards the small underground shaft, or in bringing down the ore; and for this reason, chiefly, they present much muscular development about the shoulders. All these are positions in which breathing is accompanied with increased effort, even in a pure atmosphere, and yet they occur in places where, without constant attention, pure air will not penetrate. The "hurriers" are in one respect fortunate that their journey to and fro bring them into the current of air, where some renewal, at least, is going on.

The degree to which physical defects prevail amongst young colliers of 18 years of age, may be illustrated by the fact that, in the neighbourhood of Liège, out of every 100 colliers drawn for the militia, 42·5 were rejected for physical reasons; of 100 nailers, 36; of printers, 22; of weavers, 21;—the rejected out of the whole district averaging 26 per cent.

Although man can bear for a short time, without serious inconvenience, temperatures varying from 50° to 300° Fahrenheit, and pressures of three or four atmospheres, as in a diving bell, or of only ½ an atmosphere as on the summit of Mont Blanc; we perceive by the physical differences of races inhabiting the temperate and torrid zones, mountainous districts, or flat countries nearly level with the sea, how large an effect on the human frame comparatively small atmospheric differences may produce. We may go further, and venture to infer from the beautiful foresight with which nature has hedged round the composition of the atmosphere (on mountain or in valley, at the equator or the pole, invariably the same) that very minute differences of the oxygen it contains, or accessions of foreign constituents may be expected to produce a powerful effect on all the animal organisations which are linked with the operation of breathing.

The temperature of the rocks which the miner has to penetrate increase in depth according to a somewhat uniform ratio, but varying according to the description of rock passed through. The extensive experiments of Mr. Henwood, conducted in the Cornish mines, are summed up in the following table, which exhibits the difference between the temperatures of granite and slate rocks:—

| Depth in fathoms of place of observation. | TEMPERATURE. In Slate. ° Fahr. | In Granite. ° Fahr. |
|---|---|---|
| Surface to 50 | 57 | 51·6 |
| 50 to 100 | 61·3 | 55·8 |
| 100 to 150 | 68 | 65·5 |
| 150 to 200 | 78 | — |
| 200 and upwards | 85·6 | 81·3 |

The temperature of the water issuing from the artesian well of Grenelle, 600 yards in depth, is 820°, being an increase of 1° per 59 feet in depth. The result of a series of experiments at the Dukinfield deep pit, in Lancashire, gives 1° per 51 feet as the increment of temperature. A shaft, 126 yards deep, in Siberia, gave 1° degree for every 30 feet. The experiments on the rock in coal mines have not generally been conducted with that extreme care necessary to ensure accuracy.

The effect of this temperature on the working places of the miners is much modified by the water flowing in, and varying in temperature from about 46° when it comes direct from the surface, up to 106°, as was observed at a depth of 500 yards in the United Mines, Gwennap. 94 gallons of water per minute, poured in from this spring, whilst at a distance of only 3½ feet, another spring from the other side of the lode discharged water at a temperature of 98° to the amount of 30 gallons per minute. The temperature of the air in the working places of mines I find to be exceedingly variable, but frequently very much higher in the metallic mines than in the coal mines, although M. Von Dechen finds the increase of the temperature of the rock in the Rhenish coal mines more rapid than in metalliferous ones. The temperature of working places has seldom been observed so high as in

the United Mines. The labour of working in this place was so great that the men had to be changed every five minutes, and they threw themselves six or eight times a day into cold water to refresh their exhausted frames. The cost of driving the level under these circumstances, as was afterwards shown, was actually trebled. In the Consolidated Mines the air has been observed at a temperature of 98° at a depth of 630 yards, and in the Tresavean Mine, of 95° at 640 yards. The remarks in a short paper of mine, read before this Society on the 11th of August last year will have shown that the excess of temperature beyond 75° in these extreme cases, in any working place, is due solely to the ignorance or neglect of the simplest rules of ventilation. The temperature of the "ends" of metalliferous mines is generally between 75° and 90°, which is due to the air being so long stagnant that the combustion of the lights and the heat given off from the bodies of the workmen (assumed to be at the normal temperature of 98°), is able to raise its temperature from 15° to 30°, notwithstanding the cooling influences of the surfaces of rock. From a number of observations I have found that no part of a well-ventilated mine in the summer time exceeds 68° at a depth of 300 yards. The return air of such coal mines about, and exceeding, that depth, varies from 62° to 68°. In coal mines which are not well ventilated the temperature of the ends is frequently between 70° and 80°, although the thermometer at the surface may be at the freezing point.

By a judicious use of the thermometer, and observing its gradual rise in walking from the downcast shafts to the working places, the localities of defective ventilation may be detected, as well as leakages of impure air which might otherwise escape observation.

In districts where ventilation is not understood, it is commonly asserted by miners and others that the deeper the mine the more difficult the ventilation, when, as will presently be shown, the contrary is the case. Many parts of the deep metalliferous mines are worked at a loss, or altogether abandoned in consequence of the poor air and high temperature. That this is not due to the heat communicated by the rock, however deep the shaft, or to the thousands of yards which it may be indispensable for the air to travel before it reaches the miners, may be illustrated by an experiment at the Seaton Colliery, made by Mr. Nicholas Wood, the air at the surface being 44°.

The shaft was 520 yards deep, and 14 feet in diameter, divided by an air-tight brattice, or division. The length of the air-course underground was 1,012 yards, and the area of the passage 24 square feet. The surface of the air-course exposed to the air was 60,720 square feet, at a temperature probably of 80°. 7,002 cubic feet of air per minute passed through the air-course, and although it took 20 minutes to travel from shaft to shaft, its temperature was only raised from 49½° to 52½°, that is, by three degrees. The air gained 5½° in descending, according to the usual rule of 1° increase in temperature for every 300 feet of descent, due to the increased pressure of the air, but which it again lost on returning to the surface, where it exhibited a temperature of 46°.

In the ends, where miners work, there is often a difference of 3° or 4° between the warmth of the air at their feet and at their heads, where the function of respiration is going on; one example of the imperfect diffusion of gases which takes place, but a means of assisting the circulation of the air, provided the main current were brought close to the workman.

In hot mines the men are more subject to take cold, either from passing to and fro into the cooler incoming air, or in standing about the top of the shaft previously to going home. The boys between 10 and 15, who bring out the coal from the working places, are in a perpetual change of temperature, often of 30° every few minutes, and consequently suffer in a high degree from pulmonary complaints. I have said enough to convince the manager of a mine of the loss of work caused by an increase of a few degrees of temperature, I will only add the opinion of Monsieur Coulomb:—"I have caused," he says, "extensive works to be executed by the troops at Martinico, where the thermometer is seldom lower than 77° of Fahrenheit. I have executed works of the same kind by the troops in France, and I can affirm, that under the 14th degree of latitude, where men are almost always covered with perspiration, they are not capable of doing half the work they could perform in our climate."

Numerous observations with the hygrometer in Belgium and England, exhibit the fact that the current of air, however dry it may have entered, after it has passed through the workings, is nearly at the point of saturation. The worse the ventilation, the greater the amount of moisture.

A working man exhales and throws off in perspiration from 6 to 8lbs. of water per day. Horses perspire more profusely than other animals. To be added to this is the moisture acquired by the air in descending or traversing wet shafts and airways, or derived from the combustion of the lights and gunpowder.

Dr. Hanot remarks, "This condition of the atmosphere is one of the most hurtful to the animal economy; the various functions languish, the tissues become relaxed, the fluids of the human body tend to escape in consequence of the accumulation of caloric, and soon the perspiration which the air, already charged with humidity, is unable to carry off, streams down the bodies of those working under these influences." A remark confirmed by the experiments of Bertolet and Laroche.

It is well-known that high temperatures accompanied with moisture, especially rapid changes of them, are extremely productive of disease amongst artisans. Moisture is the very common vehicle in which other agents of disease are dissolved, and brought into action with greater intensity. These facts have an important bearing, when we consider the amount of malaria now pervading the air of mines. It is sufficiently evident that to obtain the greatest amount of work from a man in a given time, it is necessary to supply air, not only cool, but tolerably dry. This can be effected in almost every mine by a moderate amount of ventilation when properly distributed.

The action of breathing has been called the ventilation of the blood. The expansion of the chest caused by the powerful muscles, which belong to the action of the lungs, produces a partial vacuum sufficient to draw in a proportion equal to about $\frac{1}{6}$th of the air already contained in the chest. By a rapid diffusion of the gases, the oxygen is brought into contact with those delicate labyrinthine tissues, (the surface of which is variously estimated at from 15 to 400 square feet,) where the oxidation of the particles in the blood is effected.

The average of a number of experiments (by Vierordt, Liebig, Lehmann, &c.) gives 320 cubic inches as the quantity of air inhaled per minute, of which 10 per cent., consisting of oxygen, is consumed by the lungs, and from 7·7 to 8·5 parts of carbonic acid gas are expired.

The oxygen inhaled produces a slow combustion, and, the oxidation in the process of breathing causes a mild and genial warmth throughout the frame. All vital activity, according to Liebig, is derived from the mutual action of the oxygen and food. The 14 oz. of carbon which are burnt into carbonic acid daily, must be taken in food. A horse burns 97 oz. daily, consuming for this purpose 13 lb. 3 oz. of oxygen. The food, therefore, should be in direct ratio with the supply of oxygen. These conditions, joined with a due proportion of sleep, enable a man to perform a daily task equivalent to carrying 30 lbs. a distance of 72,000 feet. Any causes which disturb this balance produce a diminution in the average amount of work performed.

According to the experiments of Dr. Wehrle, the oxygen consumed by a candle per minute amounts to 16·6 cubic inches, and the carbonic acid formed, to 4·2.

When the quantity of oxygen is reduced from 21 per cent. to 18 or 16, an ordinary miner's light is extinguished; an Argand lamp will burn until the proportion is reduced to 14 per cent.

According to the analysis, by Professor Hunt, of air from the Consolidated Mines, the amounts of oxygen were respectively 16·25, 17, 17·50, 19·15, 18, and 17·75 per cent. The average of 18 samples of air taken from different mines in Cornwall was

| | |
|---|---|
| Oxygen | 17·067 per cent. |
| Nitrogen | 82·848 „ |
| Carbonic acid | ·085 „ |

Of six others—

| | |
|---|---|
| Oxygen | 19·34 per cent. |
| Nitrogen | 78·75 „ |
| Carbonic acid | 1·90 „ |

It is suggested that the quantities of carbonic acid in these cases may have been actually larger, being partly absorbed during the experiments. Traces of sulphuretted hydrogen, and sulphurous acid were also found.

In the mines of the Hartz, the following are the results of accurate analysis:—

| | | | | | |
|---|---|---|---|---|---|
| 1st place | —1·86 | per cent. oxygen | × | 1·8 | per cent. carbonic acid gas. |
| 2nd | 1·94 | „ | × | 1·77 | „ |
| 3rd | 0·73 | „ | × | 1·04 | „ |
| 4th | 2·29 | „ | × | 2·38 | „ |
| 5th | 0·29 | „ | × | 0·65 | „ |
| 6th | 0.21 | „ | × | 0·72 | „ |

In all of these cases candles would burn, and Nos. 3 and 5 were considered samples of tolerable ventilation.

It has been approximately determined that a deficiency of oxygen of 10 per cent., or an excess of carbonic acid gas amounting to 8 per cent., will quickly produce stupor, and eventually death. I have frequently met with instances in mines where the men were obliged to work in the dark from want of ventilation, some being pointed out to me who were particularly good hands at it, and I have had occasionally to spend the night in parts of mines where the candles will only keep alight by being tied two or three together and held horizontally. A few months ago, the manager of a colliery was killed by remaining ten minutes in a place where the men had at last refused to work. Defects in the atmosphere of smaller amount the miners do not feel, except in the sensation of lassitude, and difficulty of prolonged exertion.

Their exclusive attention is directed to keep the candles burning, a very necessary caution, for in passing slowly through the air in the roadways, my candle has sometimes gone out ten or twenty times, and I have seldom visited mines not containing explosive gases where there was sufficient oxygen to keep a light burning throughout the parts in work. These, then, are the ordinary limits within which a miner has not only to live, but to carry on a laborious occupation. The ordinary practice is to drive on a gallery or opening as far from the current of air as the condition of light will permit, varying from 20 to 100 yards, as it is termed, "in advance of the air." I have contrived a portable spirit lamp, by which the air in each working place can be at once analysed, or rather the point reached by the miners between perfect combustion and the extinction of the light can be determined. It consists simply in providing an airtight cover to the glass cylinder, capable of being shut instantaneously. The time in seconds is noted which the lamp takes to go out, first, in pure air at the bottom of the pit, and afterwards in the working places. The lamp having been ascertained endiometrically to go out with a certain deficiency of oxygen, and excess of carbonic acid, these will be in proportion to the difference of the squares of the times registered.

It is very certain that the deficiency of oxygen acts injuriously on the miner before he is able to appreciate with his eye the diminished intensity of the light of the candle. According to Dr. Bird, a deficiency of 2 per cent. has in some cases been known to be destructive to animal life. M. Gonot and other engineers have remarked that the diffusion of gases does not proceed so rapidly underground as on the surface. I have certainly met with many instances where a light will burn at the feet, and go out if raised up to the head, or it will go out only in the highest parts of the works. In other instances carbonic acid gas, air, and fire-damp may be found in successive strata at the same spot. It must be recollected that a miner works in the lowest possible room, in such conditions as would be felt by a person confined in the upper part of a close room in which many persons were congregated, except that in the former case he is a long way from the atmosphere.

The story of the 56 monkeys dying in the Zoological Gardens in a large domed roof, ventilated only along the floor, will be familiar to many, and illustrates the effect on animals of living in a stagnant atmosphere, such as that to which a miner is unnecessarily condemned. One remark, made I believe universally during the cholera epidemic, pointed to the want of through ventilation in houses, as the distinguishing mark of those visited with its severest attacks. The opinions as to a large amount of disease being caused amongst miners by the deficiency of the vital element, have been so universally expressed by medical men, mining engineers, and others who have carefully investigated the subject, that I need only refer to the commission of 1842, the numerous papers read before the scientific societies in Cornwall, and indeed all medical treatises on miners. One observation of Dr. Hanot is worth recording: "Placed in favourable circumstances for observing two kinds of working miners in two distinct kinds of coal mines, the colliers of Dur, where the ventilation is good, and those of Flenu, where it is slow, and often neglected, I have arrived at the conviction that there existed among them an external physical difference readily appreciated by the eye, to such a degree that I could point by the finger when surrounded by workmen to those who work at one, or at the other description of mine."

The dust which floats in the air, more particularly of some colleries, is often referred to as productive of permanent injury; but more accurate observations have determined that melanosis, and other affections which may result from it, are also produced in other mines, and are attributable rather to the carbon arising from the imperfect combustion of tallow or oil of bad quality. This disease seldom, if ever, occurs amongst men working in coal dust on the surface. The disease to which I have alluded has been often described, although it has not been thoroughly understood. It prevents the free access of oxygen to act on the blood, and it appears, after a time, as if carbon was actually formed in the lungs. I have known instances of a cloud of dust alone having produced suffocation. In one instance the person inhaled unconsciously the dust brought by a rapid current of air from the upsetting of a tram; in another, two men were found dead in a ladder shaft, with their candles still alight, but covered with dust thrown up by an explosion of fire-damp. It is, in my opinion, to the hot fiery dust which accompanies such explosions that the number of deaths from suffocation, amounting often to seventy per cent. of the whole number of killed, is chiefly to be attributed. Whilst investigating the circumstances attending a large number of explosions, I have found several instances of men who had placed a wetted cap or handkerchief to the face, having come out from the extremities of the mine, passing over the dead bodies of their companions. On the other hand, I have not met with any instance of men having been found dead who have adopted this simple means of safety.

Deprived, as a miner is, of the beneficial rays of sunlight for six days out of seven, at least in the winter months, we cannot altogether reject the idea that he permanently suffers from this cause, although it is one difficult to estimate. The shady side of a street, under some circumstances, is more unhealthy than the other, and individuals labouring under asthmatic complaints are very sensitive

to the action of light, but much, no doubt, is due to the heating rays.

This has been used as an argument, and with some justice, for working two shifts or changes of men underground, the first from 4 a.m. until 12, and the second from 12 till 8 p.m. The mining engineers in Belgium are, however, mostly of opinion that the night-work in their mines is preferable to the day-work, and does not present serious inconveniences to the young miners. One of the arguments used, being that from the atmosphere being cooler the ventilation is better by night than by day.

In considering the absorption of oxygen by the various chemical changes which go on in mines, whether by breathing, combustion, or by the decomposition of vegetable and mineral matters, it must be noticed that a double deterioration is caused, increasing the proportion of nitrogen, in addition to that of carbonic acid or other gases of a poisonous nature. The action of nitrogen on the human frame admits of more close investigation than it has hitherto received. It appears sometimes to be absorbed by the lungs in small quantities; at other times given off. Its excess in any atmosphere is not believed to be actively injurious to the vital functions. On the other hand an excess of carbonic acid above $\frac{1}{500}$ in the surface atmosphere begins to exercise an injurious effect, and the presence of 1 per cent. indicates a very unhealthy atmosphere. What, then, must be the effect in those mines where I frequently find openings left from the old workings into the downcast shaft, or the commencement of the air course for the free percolation of carbonic acid gas (variously termed choke-damp, black-damp, stythe, or sulphur) into the incoming vital current in sufficient quantity to extinguish a candle at the part where it enters? These old workings, technically called goafs, or deads, are vast laboratories for the decomposition of minerals, timber, and animal remains their principal products are carbonic acid gas, sulphuretted hydrogen, and mineral salts. Lead mines, especially those in the carboniferous limestones, seem to give off considerable quantities of carbonic acid gas, but the most remarkable mine probably in this respect is the Pontgibaud, in the Puy de Dome, where on the first starting of the pumps, the pressure of the gas was sufficient to raise the water in a fountain five or six yards in height.

Men are occasionally suffocated by carburetted hydrogen in entering goaves. Where this gas exists, it is essential that the higher side of the goaf especially should be swept by a current of air. No old working should be entered in which a light will not burn. Explosive gases sometimes exist unsuspected in these places, and the examinations should, therefore, be made by the safety lamp. If it will not burn, an endeavour should be made to ventilate the place. If this happen to be a shaft or well, the most immediate means are to throw down repeatedly water, or a bundle of straw fastened to a rope.

The next most important gas met with is sulphuretted hydrogen. It proceeds from some mineral combinations, and the crementitious matters which necessarily accumulate in the neighbourhood of working roads or places inhabited for many years continuously. It exercises an extremely deleterious action on the respiratory functions; it is the most active of the gaseous poisons. It seems to act upon the blood in depriving it of some of the elements necessary for proper respiration. It is lighter than air, $\frac{1}{15000}$th is supposed to act injuriously on the constitution; $\frac{1}{250}$th has been known to kill a horse; $\frac{1}{1500}$th a bird. It exists in some proportion in the air of very many mines, and is commonly termed White Damp. It explodes at a lower temperature than fire-damp, and the ordinary Davy lamp is, therefore, not a sufficient protection. Occasionally it commits great ravages on the health of the workmen. A medical record exists of its effects some years ago, at the mines of Anzin, at No. 4, Vanneaux, Wasmes, Turlupu, and Jemmapes. At Vanneaux, the water dropping from the roof of the mine raised blisters on the skin.

Blasting with gunpowder consumes oxygen, and gives off a variety of gases. According to one estimate, two miners working an eight-hours' shift or change (Germanicè *schicht*), give off:—

| | | |
|---|---|---|
| By breathing.......... | 1·53 lbs. | carbonic acid gas. |
| From oil lamps...... | 1·03 ,, | ,, ,, |
| From blasting ...... | ·56 ,, | ,, ,, |

In addition to the gases already enumerated, carbonic oxide and compounds of hydrogen are produced by blasting. The solid particles of combinations of potassium float in the air and cause the smoke, which, under a system of ventilation having economy for its object, should be at once removed.

I need not enter at length into the variety of exhalations and miasmata proceeding from the putrid fermentations of animal and vegetable matters underground, as they are well known upon the surface; but in these confined channels the accumulation is heaped up at every step, and the warm moist atmosphere gives every facility to them to produce their direst effect. However careful each man may be in covering the deposit (46 lbs. of solid excrement per man per year), from 300 or 400 men in and around the working-places, and in the dead ends which the current of air passes, it cannot but supply a fertile source of miasmata. In some populous mining villages, there are from 20 to 50 houses to one privy, which unmistakeably adds to the nuisances underground. If there is a stable and accumulated dungheap, it is almost certain to be placed close to the incoming air, in which also the horses stand, or are constantly working to and fro. A forest almost of timber, used for supporting the roof and sides, is undergoing dry rot, which, under bad ventilation, consumes it in two years. The existence of these nuisances is not so appreciable to the smell as it would be on the surface, even on entering the receptacles themselves, a peculiarity arising from the solvent power of the moist air; but their effect may best be understood by imagining a town supplied with air by a culvert, which passed through most of the streets in succession, but leaving each house to be ventilated solely by a diffusion of gases very slow in action, and the only escape from nuisances being to cover them. Add to this the other noxious gases which I have named, and a conclusion may be drawn as to the condition of mines, and its destructive consequences to economy of labour as well as health, when they belong to proprietors who never go into them, and are left to the charge of managers who know or "care for none of these things."

I shall hereafter show the requirements necessary for mitigating these evils to the greatest possible amount. I will only now refer to two sanitary rules. The stables should be kept clean and whitewashed, and be ventilated by a separate current, technically, split of air, passing on to the return air-course without supplying the miners. I have known nearly the whole of the horses in a mine die from the stables being allowed to accumulate filth. The horses in mines generally thrive well, as they work almost entirely in the purest of the air before it has reached the men. A remedy for another nuisance is to supply iron trams, with two iron lids on hinges, to each range of work, and place them in the return air after it had left the men. They were generally used in the Standedge Tunnel, of which I was the engineer, and were brought out and emptied once a week. I have never yet met with such a contrivance in any mine, and yet it is evident it would in a short time repay its cost. In estimating the effect of all that I have described in producing disease, it must be recollected that the adult workmen are seldom exposed to their action in the working-places where the concentration is greatest for more than eight hours continuously. Many of them pass occasionally in and out of the working-place at meals and other times, and many of the lads are as much in the air-current (whatever that may be) as in the unventilated ends.

Mr. Ratcliffe's tables give the duration of life of miners at not much under the average of England and Wales, but appended to it is this remark :—

"This class of lives shows a very large amount of average sickness at every period, and increased sickness with advance of years. From the very nature of the employment this must have been anticipated, but not to such an extent as appears from these results. At age 20 miners experience an average sickness of 46 per cent. more than the general class; at age 30 they have 70 per cent.; at 40 years, 78 per cent.; at 50 years, 76 per cent. and at 60 years, 53 per cent. more average sickness than the general class of lives. The aggregate amount of sickness experienced by miners for the period of life, 20—60, is 95 weeks, showing an excess of about 67 per cent. more than the general results. Had these lives, which form 4.93 per cent. of the general class, been first extracted therefrom (and which should have been the case), it would have shown a less amount of average sickness experienced by the general class, and consequently would have proved that miners are subject to more average sickness per annum in excess of the general class than appears to exist."

But these tables do not include lives under eighteen, before which time it will be shown that not only disease, but an excessive mortality occurs.

In Cornwall it has been ascertained that 61 per cent. of the miners die from diseases of the chest—31 per cent. only of the rest of the population.

In the Report on Mines, 1842, it is remarked "the ironstone pits are in general less perfectly ventilated and drained than the coal mines, and are, therefore, still more unhealthy, producing the same physical deterioration, and the same diseases, but in a more intense degree. The ultimate effect of the disadvantageous circumstances under which the miner in tin, copper, lead, and zinc mines is obliged to pursue his laborious occupation, is the production of certain diseases (seated chiefly in the organs of respiration), by which he is rendered incapable of following his work, and by which his existence is terminated at an earlier period than is common in other branches of industry, not excepting even that of the collier. The primary and ever active agent which principally produces this result, is the noxious air of the places in which the work is carried on." A surgeon writes, "In reality what is this number of violent deaths (and I appeal to my fellow-practitioners at collieries) compared with those thousands of persons who advance day by day bowed down to a premature death arising from their occupation, and which brings on an old age, overwhelmed with infirmity, at a period when other men still enjoy the plenitude of their strength?"

It is very much to be desired that tables of mortality should be constructed based upon the numbers given in the last census, which would express in exact figures, not only the comparative unhealthiness of each class of mines, but the mortality caused in each mining locality by the neglect or improper methods of ventilation. In the following table will be found the relative numbers employed at each age, of miners, agricultural labourers, and labourers, in town and country.

| OCCUPATION. | All ages. | 5 to 10. | 10 to 15. | 15 to 20. | 20 to 25. | 25 to 30. | 30 to 35. | 35 to 40. | 40 to 45. | 45 to 50. | 50 to 55. | 55 to 60. | 60 to 65. | 65 to 70. | 70 to 75. | 75 to 80. | 80 and upwards. | Average age of living. | Age of commencing work. | Age of leaving off work. | Number of years of labour. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coal miners | 1000 | 5 | 124 | 171 | 169 | 130 | 100 | 94 | 62 | 48 | 36 | 21 | 18 | 10 | 6 | 2 | 1 | 26·1 | 11·2 | 39·7 | 28·5 |
| Iron miners | 1000 | 5 | 97 | 147 | 194 | 160 | 122 | 92 | 64 | 45 | 31 | 19 | 13 | 7 | 3 | 1 | — | 26·8 | 13·4 | 38·8 | 25·4 |
| Lead miners | 1000 | 3 | 79 | 147 | 167 | 143 | 112 | 94 | 75 | 60 | 46 | 31 | 23 | 12 | 4 | 3 | 1 | 28·9 | 12·9 | 42·5 | 29·6 |
| Copper miners | 1000 | 10 | 116 | 183 | 156 | 127 | 100 | 82 | 65 | 57 | 43 | 27 | 17 | 10 | 4 | 2 | 1 | 26·4 | 11·6 | 38·9 | 27·3 |
| Tin miners | 1000 | 12 | 143 | 178 | 150 | 116 | 89 | 79 | 63 | 56 | 41 | 30 | 20 | 11 | 7 | 4 | 1 | 25·7 | 10·6 | 38·2 | 27·6 |
| Agricultural labourers | 1000 | 6 | 75 | 115 | 113 | 108 | 98 | 88 | 80 | 72 | 67 | 51 | 47 | 32 | 24 | 14 | 10 | 34·2 | 11·3 | 53·6 | 42·3 |
| Labourers' class undefined | 1000 | 2 | 39 | 108 | 137 | 124 | 113 | 94 | 90 | 69 | 66 | 44 | 43 | 28 | 22 | 12 | 9 | 34 | 14·6 | 50·6 | 36 |

I have taken these classes for comparison, inasmuch as mining is usually carried on in agricultural districts, and the wasting ranks of the miners are supplied chiefly from these classes, and I shall hereafter show that the occupation of the miner is not necessarily much more unhealthy. In the four last columns of the table, I have endeavoured, as well as the materials and nature of such a calculation would allow, to present the average ages of the whole of the persons following these occupations in 1851, as well as the age of commencing work, and the average number of years of work done by each class. The differences will be rendered more apparent to the eye, by the diagram on the wall, in which the base line represents years, divided by vertical lines into periods of 5. The heights of the intersection of the curved lines with each vertical line, represent the numbers out of each 1000 workmen at work at those respective ages.

Hence it appears that the average age of miners living, varies from 25·7 years in the case of tin miners, to 28·9 amongst lead miners, being a difference of about 3 years, but this is accounted for by the tin miners commencing work at 10½ years of age, the lead miners not till above 13 years, on the average. These are the extremes of age, within which, on an average, each of the five classes of miners begin work.

The result bears out my previous quotation as to iron mines being the unhealthiest of all, for notwithstanding that the men do not commence work until 13 or 14 years of age, their span of labour only reaches 25·4 years, which is 2¼ years below the average time in which a miner wears out. The miners last but 27·7 years, whilst 42·3 years are got out of the agricultural labourer. In other words, the lives of the miners, in addition to excessive sickness and diminished strength, are shortened by an amount equivalent to more than half their working life.

These tables are to a great degree confirmed by limited observations in particular mining districts. Mr. Robert Blee, in 1847, comparing the agricultural and mining population in Cornwall, gives 52½ as the average age of the former, 42 of the latter; in neither case including any below 10 years of age. Again, of the total number of males dying in ten years, there died per cent. between the ages of

| District. | Gross Male Population. | — to 10. | 10 to 20. | 20 to 30. | 30 to 40. | 40 to 50. | 50 to 60. | 60 to 70. | 70 to 80. | 80 to 90. |
|---|---|---|---|---|---|---|---|---|---|---|
| Not Mining. | 10322 | 42·4 | 4·6 | 6·9 | 6·6 | 6 | 7·2 | 9 | 10·9 | 6 |
| Mining. | 10869 | 42.8 | 7 | 8·4 | 7·9 | 9·4 | 10·6 | 7 | 4·7 | 2·7 |

Dr. Barham states, "On the whole it may, perhaps, be a fairer deduction from the data hitherto collected as to the comparative longevity of miners, and other labourers, in nearly similar general circumstances in this county (Cornwall), that ten, rather than twenty years,

approximate to the period by which the average life of the miner is shortened by his occupation."

It results from the particulars which I have given that 117 agricultural labourers do as much work in their lives as 174 colliers, as 194 iron miners, 168 lead miners, 183 copper miners, 179 tin miners, or as 137 labourers of the general class.

In tracing out the remedies to be applied to render the cell of the miners a fit place for human beings to pass a large portion of their lives, it is necessary for me to point out that it requires no other remedy, except in a higher degree, than we are now adopting on the surface. The same rules of ventilation, the same habits of cleanliness, will suffice. They have reached their present condition just in the same manner as a portion of any town inhabited by the poor, unvisited by intelligent or professional men, uncared for and never entered by the owners of the property, would infallibly become the stronghold of disease.

Many of the proprietors and managers, I find, have never realised the fact of their workmen being short-lived, and are equally unconscious or forgetful of three-quarters of the accidents which occur in their mines. There are exceptions, and examples every way worthy of imitation, to which I shall hereafter allude, but truth compels me to state that, in the vast majority of mines in this country, such is the want of education amongst the class from which the managers are chosen, that persuasion, backed by the strongest facts, is of no avail in inducing them to adopt inexpensive measures to improve the sanitary condition of their mines, or to prevent accidents in them. Any one who has been engaged in the removal of nuisances will readily appreciate the difficulty in influencing the despots who rule an unknown land. In my endeavours towards this object, I have always done, as I shall do in this paper: I have scrupulously avoided any recommendation attended with a considerable outlay, or in which the care and expense would not be amply repaid. I have invariably found that those mines which were worked most economically, and with a large production, were the most healthy and the safest. The same intelligence which effects the one, carries out the other as an inseparable condition. In fire-damp mines, the ventilation is generally better than in others, and several persons are employed in attending to the airways and ventilation. On dividing the quantity of coal brought out, by the whole number of men employed in a large number of fire-damp mines, including those employed in ventilation, and also in a large number of those not containing fire-damp, I found in the former that each man did considerably more work. Miners themselves, until the candles burn dimly, are so little conscious of the effects of imperfect ventilation, that they commonly object to improvement, and yet they have admitted to me, after it had had a sufficient trial, that they could do one-fourth more work. There are many mines, or parts of mines, which can hardly be worked in the summer, because candles will not burn. The ventilation entirely stagnates in the act of reversing. The powder-smoke hangs in the face so as to cause a delay of half an hour after each shot is fired, and the workman will have to stop after every dozen strokes with his pick to trim his light. Such are a few of the conditions which, occurring frequently amongst a large number of men in mines where no artificial means of ventilation are employed, produce losses on a large scale, but which, as they are customary, are seldom appreciated by the proprietors. In suggesting these things to them, before entering a mine, although it may be difficult for them to tell me which way the air goes in, I am met with a blank denial; and yet, on entering, the state of the extremities they are obliged to admit, and is exactly as any experienced man would have foretold. It has been remarked that evidence has been given at every inquest, on the most serious explosions of fire-damp, that the ventilation of the mine was good. In metalliferous mines, the good ventilation I found sometimes to be, in the adit or water level, most ignorantly left open, which effectually cuts off the ventilation from the lower parts of the mine.

I have already shown that one-third of the value of the miner was cut off by the hand of death; but the causes which have brought him to the tomb must have necessarily diminished the amount of work he is able to perform, even in the best years of life; and during $\frac{1}{15}$th of his working-life he depends on the sick-club or parish for support. He has good grounds, therefore, for receiving a high rate of wages, and he is especially in need of the assistance of benefit societies to help him in this period of trial.

"As an evidence of the good economy of spending money to lessen these terrible effects of the miners' occupation," Mr. Blee states, "that, from a return made by the relieving officer of Gwennap to the Redruth Board of Guardians, he has ascertained that of 240 families receiving parochial relief in Gwennap, in one quarter of last year, upwards of 200 were miners' families; and that, of the fathers of those families, fifteen had been killed in the mines; forty had been blinded, maimed, or so injured otherwise by mine accidents, as to be unable longer to earn a livelihood, many of the injuries, at different distances of time, having terminated fatally, while sixty-five have died, and fifteen others, who had among them eighty children, were dying more or less slowly of miners' consumption." I might add many facts to illustrate how important it is to the pockets of mine-owners to keep their miners in at least as good condition as their horses, and to exercise that degree of superintendence over them in the regions of darkness, which it would be considered ruinous to neglect if the same men were working at the surface. The benefit and check of piece-work underground is very often lost.

The age fixed by the legislature, as the earliest at which boys may be employed underground is often evaded, as the census returns show. It is not always the fault of the manager that they are brought in, as the parents sometimes represent them to be older then they are. A register of birth should be required with each. From the numbers which I have given in a previous table, it may readily be shown that but a small number of boys enter the mines between 10 and 12 years of age, (in some lead mines of Cumberland they are not taken under 18,) and, therefore, that there would be a small apparent sacrifice if the proprietors were to yield to the petition of the coal miners of the north of England, that no boy should enter the mines until 12 years of age, in order that he may have time for education. The proportion of the boys so excluded, who would go off into other employments, would be insignificant, and the gain, intelligence, and strength of constitution of the others would doubtless amply compensate it. One of the most important duties in fire-damp mines, is entrusted often to the youngest of the boys, that of opening the ventilating doors to allow trams to pass. Who has not heard of and sympathised with these children, taken from their amusements and the education of daylight and confined in darkness and solitude; and yet, often in their forgetfulness, the door is left open, a number of men are deprived of the proper amount of oxygen, and in fire-damp mines where locked safety-lamps are not used, a few minutes may suffice for an explosion, which indeed has been too often the result. The doors should be always so hung as to close to of their own accord, after a tram has passed.

In entering upon the all-important subject of ventilation, I have little fear but that most mining engineers will subscribe with me to the correctness of the report of 1842, "That a mine when properly ventilated and drained, and when both the main and the side passages are of tolerable height, is not only not unhealthy, but the temperature being moderate and very uniform it is considered, as a place of work, more salubrious and even agreeable than that in which many kinds of labour are carried on above ground."

To effect this, requires one simple regulation to be unremittingly carried out, namely—that no man shall work in a stagnant atmosphere, that the working places as now existing, the reservoirs of all the deleterious gases brought along by the air current, shall have a current sent through them into every part in sufficient quantity to dilute all the deleterious gases and deprive them of their power, or, in the words of the resolution passed by a meeting of deputies from the coal-mining interests of the kingdom, in May, 1854—"That adequate artificial means of ventilation be provided at all collieries, and that there shall be at all times a sufficient current of pure air through the workings to dilute and render innocuous all noxious and deleterious gases." Mr. Richardson estimates that the quantity of air required for vital chemical purposes should be per hour—

| | | |
|---|---|---|
| For breathing ............... | 14·0 | cub. ft. per man per hour. |
| For displacing carbonic acid | 62·8 | do. |
| For diluting nitrogen ...... | 258·4 | do. |
| For displacing perspiration | 97·0 | do. |
| | 432·2 | |
| For the combustion of one light ........................ | 59·3 | cubic feet. |
| For one-fifth of that needed for a horse.................. | 517·0 | |
| | 1008·5 | |

This agrees nearly with the estimate of Dr. Hutchinson, but it does not quite provide for diluting the gases to a point where they would be no longer injurious, nor for removing the air after it has been breathed, especially when a number of men are working at a continuous face of rock. The slow diffusion of the gases must also be considered, and the variety of impurities, and that hard work is going on in a room of the lowest possible height.

Mr. T. J. Taylor, in answer to Question 6019, before the Committee of the House of Lords on Local Mines—"What would be the least amount of current with which you would be satisfied in any of those pits which you have under your management?"—"That would depend on the requirements of the mine; for example, in a mine which yields no fire-damp, with 120 or 130 persons employed in it, I should say that a current of 20,000 to 30,000 cubic feet per minute might be a fair quantity, being properly conveyed up to the face of the workings, and made to sweep those districts where the people are employed; but in a fiery mine I should require very much more than the quantity named."

After having examined and measured the ventilation in a great number of mines I have found the simple rule hold good, that where there was no escape of fire-damp, and little of any other mineral gas, that 100 cubic feet of air per man or boy per minute, was the minimum quantity of air essential for sanitary purposes alone.

This quantity of air it is quite impossible to introduce with air pipes in the manner recommended by many benevolent persons not practically acquainted with mines, but it can be introduced and passed round by means of the opening which the miner is obliged to make to work forward himself and extract his minerals. The employment of small faces and narrow air tubes, or of the waterfalls used in the Cornish winzes, are radical errors; they are contrivances for enabling a man to breathe over and over again the same air, and to accumulate nuisances, and they cannot be too soon discarded.

The miner is now obliged to bring the current of air perhaps several miles, to within 20 or 100 yards, in order to keep his candle burning; this, then, is the only further distance that the air has to be carried. It can be carried by the same means by which it has already travelled so far, viz., by a double air course, one serving for the incoming air, the other for the outgoing, with communications from one to the other at intervals. Temporary brattices or partitions are needed, of the kinds shown in the drawing on the wall, to complete these communications. The means already exist at every mine for the purpose, except a few planks or tarred canvass sheets to form the moveable brattice.

The main current of air can be increased to the required amount, if tolerable attention be paid to the airways, to keep those well open which have been constructed, and a simple artificial means of ventilation be applied at the shafts.

Judicious splitting or dividing the currents of air will bring almost any quantity of air through the mine. It is the same thing as having a number of pipes to take water from one reservoir to another in lieu of one. In the Hetton colliery, such is the skilful management of these splits, that by means of natural temperature alone, on a winter's day, it has been found that as much air goes through the workings, (100,000 cubic feet per minute) as can be obtained at some other large mines by the use of immense furnaces.

By having a separate split, or current of air to ventilate each range of workings, the air will be brought much cooler and purer to the miners;—it is the great modern improvement in the ventilation of mines. The cost of the ventilating power in the most difficult mines, and where there is the largest escape of gas, does not exceed a penny per man per day; in mines where there is little or no escape of inflammable gas, the expense would not be half so great. This is the cost when a furnace is used at the bottom of the up-cast shaft to rarify the air. Few persons who have tried the experiment will deny that in previously badly-ventilated mines, the consumption of one ton of coal per day, at the bottom of an up-cast shaft, with proper attention to the airways, will enable each collier to cut one ton of coals more per day with the same amount of exertion. In well-constructed furnaces, a consumption of one ton of coal per day will raise 60,000 cubic feet of air per minute 30° in temperature, a temperature amply sufficient to produce the motive power necessary for ventilation, at the worst periods of the year, in all mines not containing fire-damp. It has been shown in Belgium, where about 200 of the most dangerous mines are provided with ventilating machines, that they produce the largest amount of air required in those difficult mines with about half as great a consumption of fuel as the furnace previously employed. Models of some of the best of these ventilators are on the table. The fan of Mr. Lloyd, of Great Guildford-street, described in the Jury Report of the Great Exhibition of 1851, gives the best effect of the quick-motion machines, but when the drag of a mine, or resistance to the passage of air exceeds half an inch of water, the machines of Mr. Struvé, Mr. George Jones, of Birmingham, of Messrs. Fabry and Lemielle, give a much more economical result. Ventilating by a furnace is most suitable to coal mines, where the fuel is close at hand, but even in these, when the upcast shafts are shallow, or contracted, divided by brattices, used for pumping, or are very wet, or not walled, the superiority of ventilators is still more striking than I have named. The sweeping objections made to all mechanical contrivances for this purpose, on the ground that they are liable to break down inside, by those who think that only the system they have seen carried out is the best, are inconsistent with the practical experience of nearly twenty years in Belgium. My limits will not allow me to enter on an investigation of the principles of ventilation, but it will be useful to point out some of the errors to which deficient ventilation in mining are attributable.

One almost universal neglect in such cases is allowing the air to leak from the in-coming air-current into the out-going; thus, a crack, one-eighth of an inch wide, on each side of a brattice in a shaft 200 yards deep, will cut off most of the air. Air always tends to take the shortest course. The channel leading the air from the surface to the miners should be made as air-tight as possible. I have known men unable to enter parts of a mine for

weeks, in consequence of the state of the ventilation, until some one suggested that the stoppings should be looked to and made tight. After the air has passed the men and become rarified, it cannot be taken downwards without a loss of power.

In deep metalliferous mines, a natural ventilating power, equivalent to nearly fifteen horses, is sometimes entirely sacrificed. The air-ways should be as nearly of the same size as possible; and common sense ought to show that the largeness of the air-way is useless if obstructions are allowed to exist. Yet it is to these very obstructions that I am sometimes taken by miners, to show me what a good ventilation there must be when the air will nearly blow out a candle in going through a small hole.

The following are the simplified results which I have deduced from a large number of experiments in every kind of mine:—

1. The quantity of air which passes through air-ways of equal length is in proportion to their areas multipled by the square root of their respective diameters.

2. When the areas are similar, and the lengths unequal, but great in proportion to the depth of the shaft, the quantities of air are inversely as the square roots of the lengths of the air-ways.

3. The quantities of air passing through mines are in proportion (other conditions being similar) to the square root of the depth of the shaft, or of the height of the column of air rarified by natural or artificial causes.

4. The amount of ventilation passing through a mine is in proportion to the square root of the difference of the temperatures of the downcast and upcast shafts.

5. The resistance to the passage of the air through the mine or any air-way increases as the square of the velocity.

6. The power required to ventilate a mine increases in a higher ratio than the cube of the amount of ventilation, *i.e.*, to double the ventilation requires at least eight times the power, but if two currents of air are made in the mine instead of one, the power required is little more than double. This demonstrates the economy of "splitting."

7. Air should, as a rule, not travel underground at a greater velocity than five lineal feet in a second. The most fiery mines in England have not an average of three feet per second sweeping the working faces. If the velocity in the airways exceeds five feet, the loss by leakage, and the power expended in ventilation, increase in a high ratio.

8. Air should never flow in any part of any mine at a less rate than half a foot in a second. This is not sufficient to deflect perceptibly the flame of a candle.

9. No single current of air should ever supply more than 50 men and 5 horses.

10. No airway of a mine should be so small that a man cannot walk easily through and bring in a tram to repair it.

11. In furnace ventilation, one square foot of area in a deep upcast shaft should be allowed for every 1,000 cubic feet of ventilation per minute. For mechanical ventilation a less area will suffice, although it increases the power required.

12. To ascertain the minimum amount of ventilation required for sanitary purposes in any mine which contains no explosive gas, and little mineral gas, multiply the number of men and boys employed underground by 100, the number of horses by 500, and the product will be the number of cubic feet of air per minute.

From the evidence given by Mr. Woodhouse, of Overseal, mining overseer of the Moira Collieries, who has had great experience in the scientific ventilation of coal mines, it appears that a large saving of expense is invariably realised in practice from the adoption of the improved modes of ventilation, because the constant introduction of fresh currents of atmospheric air into the pits, tends in a remarkable degree to protect the wood work of the mine, and to keep the roadways dry and in good order. After speaking of the drawbacks from the profits of collieries arising from an imperfect system of ventilation—imperfect as regards the whole quantity of air passed through the workings, but still more imperfect in its distribution, he says,—"The improved system adopted in the collieries on the Tyne and the Wear, of dividing the workings into districts, and so obtaining a current of fresh air in every division, may in many cases be adopted at a trifling expense in these counties; and although the extent of the workings in general bears no porportion to those in the collieries in the north, the principle remains the same, and the result would be favourable in a corresponding degree. It may be urged that the immense quantity of gas given out of the coal in the north has called for the improved system there, which is probably the fact; but there are many advantages to be derived from good ventilation beyond the mere prevention of explosion. In pits with a rapid circulation, the men respire more freely, the road ways are kept dry and repaired at less expense, and the timber lasts longer *by years*, and, therefore, it is a matter of strict economy to ensure a good ventilation. The men suffer most materially from working in an impure atmosphere. In some mines the air can scarcely be perceived to move at all, a thick mist or fog pervading the whole pit; which is caused partly by fermentation in the wastes and old works, partly by the lights, and partly by the heat and effluvia from the horses and men. This, with a large proportion of carbonic acid gas, forms an atmosphere that none but colliers who are accustomed to it could endure, but which has the effect of shortening their days."

The saving of timber from improved ventilation is estimated even as high as 80 per cent. The proprietor of a colliery informs me that he has just reduced the expense of timber in the first year of trial from 6d. to 4½d. on the ton of coal extracted.

One of the consequences of bad ventilation is, that it induces the inclination to indulge in strong drinks after coming out of the mine. Some medical men have even asserted that a small quantity of spirits was beneficial; but there is no doubt that in a few of the mining districts of England, it prevails to a great extent, causing a considerable loss of time after each payment of wages, and rendering accidents more frequent on the first day after commencing work. Considering all the circumstances of the life of the miner, his arduous struggle for life, his early death, his privation from the lessons of nature and of surface life, he seems in a peculiar degree entitled to the sympathies and philanthropic exertions, if not duties, of his employer. This feeling is becoming more awakened, and very much is due to the exertions of Mr. Tremenheere, but it is lamentable to think how small is the number in whom even the necessaries or the education of the miner excite a more than passing care. I regret often to observe more care exhibited to provide for the health or the safety of the horses. It is looked upon as an extraordinary example of generosity to insure the lives of some of the miners for £10 a-head. Of the condition of miners at the surface, and the state of their dwellings, it will not be necessary for me to treat in these illustrations of under-ground life. In these respects, however, as well as in most others which relate to the well-being of the miner, I cannot but cite as examples of excellence the works of Anzin, Grand Hornu, Mariemont, and others, in the coalfield stretching from Valenciennes to Aix-la-Chapelle; and I hope that proprietors of mines in this country may be tempted to go and see, with their own eyes, how much is done by every mining proprietor, and the largest mining companies, of their own free-will. Some particulars are given in the Report of Mr. Tremenheere.

Mines in this neighbourhood are remarked at a distance by enormous buildings, which enclose the machinery and the top of the pit, and the persons at work on the surface. In it are rooms for dressing and undressing, washing drying clothes, as well as the necessary offices. The can be no question of the influence which those habits

cleanliness, and a change of clothes to walk home in, have on the health of the miner.

As long back as 1826, the Anzin Company erected bathing halls for the miners, supplied with waste hot water from the pumping engines. The system is one which could be adopted at a small outlay at every mine where a pumping engine is in use, and convert to a philanthropic and remunerative use, heat which is now run to waste. Mr. Lanyon says, "A well constructed changing house, containing a warm bath, should be deemed indispensable at every mine." Lady Bassett's philanthropic exertions in Cornwall in effecting these objects deserve especial mention.

At several mines on the Continent, I found barracks fitted up for those men who came from a distance, and who only returned home once a week, thereby avoiding the risk of cold from the chill which ensues after leaving a deep unventilated mine on a cold day.

Another regulation, very common at continental mines, is the providing an accident room, in which are kept the most necessary remedies for sudden cases of illness or accidents, and simple couches, stretchers, or apparatus for producing artificial respiration. The list of apparatus and remedies necessary, can be easily supplied by the surgeon connected with the works who should be required to visit this room at least once a week. It is intended that whenever a casualty occurs he should be immediately sent for, but that in the meantime the managers of the work should apply, as far as their printed directions extend, the preliminary measures for alleviating or restoring the sufferers. I have no doubt that many lives might be saved after explosions of fire-damp in England, if such a system were pursued. Fractures are often rendered more serious from the distance the men have to be carried, the want of a proper stretcher, and the ignorance of those removing the patient. A model on the table, one of several which I have been preparing for the Pathological Exhibition of the Society, represents a mattrass, or thick coverlid, of water-proof material, mounted on a plank or light frame, which may be kept in the bottom of the mine. The patient being placed in an easy posture and tied in with straw or hay as packing, if any is at hand, is brought out without having to alter his position, and he may be raised up the shaft in a vertical position, the limb remaining in the best position for subsequent surgical operations. Vandenbroeck states that after the battle of Waterloo a large number of the wounded presented themselves with well-executed arterial compressions, to which they owed their lives. They assured him that in each of their companies some of their fellow soldiers had learned this easy operation.

Very much may be done in this and similar directions which will suggest themselves to the medical attendant at each colliery, and as they are very generally paid 1d. or 2d. a week by each man, there seems no difficulty, beyond that of inducing some one to set the example, why a practice so general and highly spoken of by colliery practitioners on the continent, should not become general in this country.

Humboldt, in a work published in 1798, describes some ingenious lamps, supplied with common air, which would burn for some time without the contained supply being replenished. As the light burnt dimly, the air was let in from the reservoir.

It cannot be denied that the production of coal and minerals in this country is far greater than that of any other continental country. In the former mineral, it is threefold as much as that of the three next largest coal-producing countries of the Continent united. We have mines carried on on a scale with which none on the Continent can compare: and it would be difficult, in the present state of our knowledge, to point out how the ventilation of some of our great northern mines could be in principle improved; but unfortunately there results from this, and the very excess of one of our Anglo-Saxon qualities, that we are too apt to think ourselves in every way superior, and that we have nothing to learn. In nothing are we more behind them than in the pathology of miners. It does actually happen that in proportion to the resources of the raw material, coal, we produce less than France and Belgium in the proportion to one acre of surface of somewhere about 10, 17½, and 15 tons. This has an important bearing on the difficulty of working mines, and the position of the collier. Already, with the large portion of the population devoted to mining, the rapidity with which they die out, the increase of demand for minerals, and the difficulty of finding workmen, the question is beginning to press—from whence are the labourers to come? A migrating tide of colliers in pursuit of higher wages is flowing from west to east in the coalfields of South Wales. The accumulation of colliery population to certain centres increases the difficulty of finding recruits; and whether the nation at large or our manufac, turers are to pay a higher price for our minerals or not the pathology of miners will assume every day a position of more vital importance to the owners of mining property.

The Cornwall Polytechnic Society, whose members are to a great extent connected with mines, have paid constant attention to these questions, and spent large sums in premiums for improvements in the condition of the miner. They have just issued an announcement of premiums of £40 and £20 for the two best ventilated mines, and of £10 and £5 for the best model and plan of ventilating ends.

To sum up my recommendation for the sanitary improvements of mines, they are—

1. That an artificial power and other means of ventilation, under the constant superintendence of appointed persons, should be employed at every mine, so as to produce at all times a regular current of pure air into and throughout the whole of the working places and parts of a mine past every workman, and so as to dilute and render imperceptible and harmless all noxious gases at the points where they are given off. That the velocity and abundance of the current of air, which must be easily accessible for examination and repairs at all points, should be regulated to the extent of the works, the number of workmen, and the escape or formation of gases and other nuisances.

2. That dung-heaps, putrescent timber, and similar nuisances should be removed from the mine at least once a month, and the exhalations at all times carefully prevented from mixing with the incoming air.

3. That a medical officer should examine the sanitary state of the mine at least twice a year, and report thereon to the owners and to the government.

4. That there should be an accident-room at every work, provided with necessaries, and inspected once a week by the medical officer.

5. That a benefit society should be established at every mine, at the joint expense, and under the joint management of the proprietors and workmen, to provide medical attendance for the workmen and their families, to support them when sick or wounded, and to pension them off when too old or maimed to gain a livelihood.

I was, I confess, once sanguine enough to suppose that persuasion and argument would be sufficient to induce most persons to adopt plans which, in other places, had been found, under similar circumstances, remunerative. My present conviction is, that however indefatigably such exertions may be pursued, if we trust to those alone, the present race of miners will be swept from the earth before any one of these recommendations is adopted in one-quarter of the mines of this country. The loss of life which I have pointed out, no one can say is attributable to the recklessness of the miners; in their petitions they show a just appreciation of the incubus which rests upon their progress.

These vital improvements and the power of saving life to an extent not difficult to calculate, rest upon the masters, and on them alone. I think I have shown satisfactorily, by the proofs of some amongst them, and of other persons rather than my own, that it is not against their interests,

moral or pecuniary, to set about the work. If the necessity of some sanitary measure is the first step to legislation, then certainly the mines are the first places where it should begin. It is painful to be compelled to form so low an estimate of this division of pathological progress, or to give the palm in any respect to other nations, but we have to perform a duty to future generations as well as to our own, and we shall do more good and show more true love to our country by looking into our deficiencies than counting up our triumphs.

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DISCUSSION.

The CHAIRMAN said, according to the usual practice, they would now enter into a discussion upon Mr. Mackworth's paper. He would remark that it went straight to the point which the Industrial Pathology Committee appointed by the Council of the Society of Arts had made the chief question of their investigation, which was this:—Was it necessary that certain positions of the human body, known to be prejudicial to health, in various departments of mechanical labour, should be continued to be practised, or was it not? and was it possible that, in a great labouring country like England, people should work and not be deteriorated in their physical condition by that work, or was it not possible? As far as the investigations of the Committee had as yet gone, the evidence tended to show that it was not impossible; and that the great evils, in almost all industrial occupations, arose from defective ventilation—from a culpable disregard of established principles with regard to the health and comfort of the operatives—from insufficient drainage, and—from awkward positions in the performance of the manual operations. The inference drawn by the Committee up to the present time, was, that most occupations might be rendered more healthy by an avoidance of these evils. Mr. Mackworth's paper went very far to confirm this view, and that gentleman stated, as the result of considerable experience on the subject, that the diseases incidental to miners arose, in a great degree, from ignorance of proper methods of ventilation and mismanagement, which might be remedied at a cost which would not interfere with the profits of the coal-owner. That was a point which was deserving of investigation, and it was upon that he hoped to hear some remarks in the course of this discussion. It was unnecessary to say how very important this subject was, affecting, as it did, more than 300,000 of the population. These men were working, like moles, in the earth, and they became mole-like in their habits and manners. He remembered being very much struck by what he once heard from a coal-owner in Yorkshire. From some cause or other the coal-owner had been obliged to bring some of his men before the magistrates, by whom they were sentenced to a term of imprisonment in Wakefield gaol, with hard labour. The complaint of the men was, not that they had to work, but that they were compelled to keep themselves in the ordinary posture of rational creatures.

Mr. CHADWICK begged leave to express his satisfaction with the paper which had been just read, and at the course of investigation adopted by the Society into what had been called Industrial Pathology, or, in the vernacular, health of manufacturing processes, of which investigations this paper might serve as an example. The course of investigation into the health of manufactures might be undertaken legitimately, simply and solely for the improvement of art, because, according to his observation, there was scarcely any sanitary evil arising in the conduct of arts or manufactures which did not, on examination, appear to arise from some rude and imperfect condition or process, capable of removal by some corresponding and substantial improvement in art; and there was rarely any substantial improvement in art or manufactures which was not attended by an economy, or an improvement in the object of the pursuit—the pecuniary result. So commonly had this been the case as to warrant the declaration, that they might, for the purposes of such investigations, relieve their minds from the immediate or passing consideration of the excessive sickness, the mutilations, the horrible deaths, the orphanage and widowhood, the premature and wretched disability, and keep their own and manufacturers' views in eventual "paying" results. Early in his sanitary investigations, an instance had been brought under his notice of this kind, in the conduct of the mining art. The late Lady Basset was the benevolent owner of the Dolcoath mine, at Camborne, in Cornwall. She felt for the sufferings of the miners, for their exhausting labour in ascending and descending the pits, the bad condition of the atmosphere in which they worked, and their sufferings under the severity of the change of condition when they came out of the mines in winter, exposed to wet and cold, engendering rheumatic pains. For their relief she consulted an enlightened physician—Dr. Carlyon—enlightened in prevention. The pains and exhaustion of the ascent and descent were relieved by machinery, ventilating appliances abated the evils of the atmosphere in the mine, and when the men ascended in the afternoon, instead of issuing on the blank hill side and receiving beer in a cold shed, they issued from their underground labour into a warm room, where well-dried clothes were ready for them, and warm water and baths (from the waste water of the steam furnace); and instead of beer a provision of good soup was made for them. It was proved to him (Mr. Chadwick) in a report from Dr. Barham, that by a combination of well devised benevolent arrangements, the health of that mining population was brought up to the health of the adjacent agricultural labourers working on the surface. But it appeared that Dr. Carlyon might have been consulted not as a physician, but as a mining manager. It turned out that steam power was far cheaper than the human power heretofore exhausted in the deep descent and in the ascent. With the saved strength the men did more work in the relieved atmosphere beneath; the skilled and mature workmen were not so frequently swept away by permature disablement or mortality; they were, from less discomfort, less untrustworthy, and they worked more steadily. The principle adverted to was vindicated, and it was proved that good sanitary provisions were sound economical provisions; and that benevolent works paid as investments of capital. Such examples it would be the duty of a zealous and competent inspection on behalf of the public to propagate. But it was proper to state that, under existing circumstances, much of the interest in improvements, or in acting on proved suggestions, was frequently shifted and dissipated and lost. Adventurers opened mines in rural parishes; they subjected the districts to nuisances created by rude and imperfect processes, as from smoke, by the wasteful consumption of fuel; by ignorant processes and the reckless direction of labour, they wasted valuable life, and shifted from themselves on to the poor-rates, and on the surrounding ratepayers, the pecuniary consequences of disablement and widowhood, which consequence the adventurers had, and the ratepayers had not, the means of preventing. When serving on the Central Commission for Enquiring into the Labour in Factories, great numbers of dreadful accidents and mutilations, the consequences of rude processes, were brought before them. The first question raised upon them was, whether they should recommend government inspectors to be armed with arbitrary powers of ordering the adoption of works and means of prevention. To himself and his colleagues, it appeared to be the most expedient to have recourse to the principle of concentrating responsibility where there was the best means of prevention,—namely, in the owner or the user of the machinery. But the adoption of this principle of unity of responsibility, was prevented by the adverse interests to the public, which were wont to influence the House of Commons on such questions. It was alleged that the prevention of such accidents was impossible. Adopting this declaration, assuming that the processes were the perfection of art, and the casualties en-

tirely blameless, why should the necessary and proper consequences of these processes be borne by ratepayers and others, (at all events in such excess) where they had nothing to do with them, and derived no benefit from them? He still contended that those full and assumed unavoidable consequences should be imposed on the processes themselves, as an insurance charge. As an insurance charge—supposing the imposition general, as it should be—it would be properly borne by the consumer, and he who derived the benefit from the process would pay for it, as he ought to do, in an increase of price compensating for the whole expense of the commodity. But this imposition of the insurance charge upon the consumer would have the benefit, in creating a proportionate bounty on improvements to the adventurers or directors of the art processes, in all the savings effected by them. Under such a bounty, inventions, and the adoption of inventions, would receive a high stimulus, reaching the rudest minds. Instead of a deaf ear being turned to such official scouts for consequences as the author of the paper read before them, he would be frequently received as the welcome harbinger of profit. Luckily for the public who travelled by railways the principle in question had been partially adopted in Lord Campbell's Act, which rendered the users of machinery responsible for the pecuniary consequences of the loss of life, as well as of limb, inflicted from *culpable* remissness. The interposition of the element and question of culpability was a large legislative and economical error. It should be assumed that the accidents were all unavoidable, and the charge of the whole consequences should be imposed simply as an insurance charge. Luckily for the public and the future improvements in arts, and the future saving of the pain which money could not compensate, there was rarely any serious accidents where some gross and culpable mismanagement, some rudeness or imperfection capable of future prevention could not be maintained in evidence. When heavy cases of compensation did occur, if they watched their operation in the minds of railway directors, they would see the becoming concern with which the accidents were regarded, and not summarily dismissed, but looked to with solicitude, with the view to the competency for the agency for future prevention. Though the principle in question was as yet but partially applied, and admitted of much improvement, when examined it would be found to have greatly diminished the hazards of those tremendously dangerous machines, the locomotives, and increased the safety of railway travelling. But in France the principle of concentrated responsibility contended for had been adopted. The code rendered all users of machinery or processes liable in civil damages for the consequences of whatever accidents or injuries resulted from their use. The French code was in operation in Belgium. In the superior intelligence of the direction of the mining labour in France and Belgium, in the more ready adoption of improvements, in the greater productiveness of the working of the mines—to which the most important portions of the paper read that evening testified, might be seen the probably unconscious operation of the principles of the concentration of responsibility where there was the best means of preventing them. Neither he nor his colleagues had ever conceived that the principle could or ought to supersede official inspection. Much as his manufacturing friends had grumbled at that inspection, as an imposition and a tyranny, the most candid of the cotton manufacturers at the least, who remembered the general state of the manufactures twenty years ago, when at the recommendation of the central board of engineers, it was imposed, and what was the state of the manufactures now, where there was at least twenty model mills for one that had existed formerly; and that in all these instances, the relation of labourer and employer had improved, and the violent risks of manufactures had diminished, acknowledged the improvement effected by keeping attention sustained to the whole condition of the labourer, and therewith to the processes and the art. It was incredible almost to find in the isolated conduct of manufacturers, in what ignorance the directors were of improvements in labour in successful operation elsewhere, whilst a concentrated responsibility from the imposition of the consequences of accidents or defaults would augment the interest in all improvements in the arts by which they were to be prevented. The duty of inspection, if competently and zealously performed, as it appeared to be in the present instance, might be made the means of at once communicating and explaining to all, the results of whatever new processes were tried.

Mr. Conybeare said, although he had for a long time been a member of this Society, yet he had as yet never attended the meetings, or taken any part in the discussions, but from the interest which he had felt in this subject he had determined upon hearing this paper. He regretted that, in consequence of his late arrival, he had not heard the early portion of the paper, which probably might have dwelt more on Cornish mines, as the latter portion of the paper did on collieries. He should have felt particularly interested in that part of it, if any, which alluded to the diseases incidental to the operatives in the Cornish mines, as distinguished from collieries. He agreed with the author in his general remarks with regard to the collieries, but as to the special diseases of copper miners, he thought they were to be attributed very much to other causes than insufficiency of ventilation. As to ventilation he was struck with the remark of the author as to the desirability of preventing any intercommunications between the outgoing and incoming currents of air; that was opposed to the law of ventilation in the human frame—and as the allowing of those channels of air to come in communication with each other, in consequence of congenital disease, was the cause of the disease called the *blue* disease, so intercommunication, by winzes or otherwise, between the incoming and outgoing channels of air, produced as surely, though not as palpably, a speedy and very similar disease among underground miners. In either case the blood was not sufficiently oxygenated. In the one case, that of the baby, because nature forgot at birth to stop up the antenatal passages connecting the pulmonary artery with the aorta, and the communication between the two auricles; in the other, that of the miner, because, owing to bad engineering, the oxygen of the air in the working parts of the mines became comparatively exhausted, and fresh air, with its fresh supplies of oxygen, was allowed to leak back into the *back* channels without ever reaching the ends, and restoring that due per centage of oxygen to the air inspired by the miner, which was accurately fixed in nature, and necessary for health. But the difficulty of working copper, tin, and lead mines without injury to the health of the miner arose from the fact that the mineral they wanted to work did not lie, as in coal mines, in horizontal strata, but in vertical *lodes*. It was, therefore, much more difficult to define at what exact spots the shafts should be sunk to meet the productive ground, and they had to go to an enormous depth—in some instances 340 fathoms—following the mineral when they had once got at it. He believed it was a false notion of economy with regard to the Cornish mines, in compelling the miners to traverse those enormous depths by means of ladders. No human being could perform such an operation without great injury to health. They would often see the strongest and most robust men, if *not used to such work*, break out into a profuse perspiration from the great physical exertion required in ascending. It was this terrific exertion, equal to walking to the top of Caeder Idris every morning before commencing work, which, in his opinion caused the fatal disease known in Cornwall as the "miner's consumption," which, though the name might lead to a different opinion, was a complaint not of the lungs, but of the heart — the organ overworked in those ladder ascents. He protested against the remark that such questions were

to be dealt with as questions of pounds, shillings and pence, for he contended that it ought to be dealt with on far higher grounds.

Mr. Chadwick—I said I think it would set us right in these cases.

Mr. Conybeare thought not. Look at the like case of the owner of a young horse; many people acted upon the notion that they got more profit out of a horse by beginning to work it at two or three years old, before the back of the animal was properly set for labour; for his own part he believed the average period of hard-working equine life would be 17 or 18 years instead of 9 or 10 years, if they were not put to work at so early an age, before the frame of the animal was set, so as to enable it to endure severe labour. Something of this sort applied to mining labour. They were told that miners in general lived only about half the average of human life, but that was a matter that did not give much concern to the mine owner, inasmuch as when one set of workmen died off, there was a fresh supply of labour to meet the case. Hence the great anxiety observable among Cornish miners to marry early, and have families of boys. Although labour might be regarded as the capital of the labourer, it was a capital he threw away recklessly. It was a question, therefore, for the legislature to look into as regarded the pounds, shillings, and pence part of the case, for such waste of life and sickness was a loss and charge to the country at large, although not to the individual employers of mining labour. There were some things in which they ought not to allow life to be improperly sacrificed. He looked upon it as a moral question, and the great ultimate remedy for the evils complained of would be found in the proper education of the men; meanwhile he would not allow any miner to be worked below a certain depth without man engines to lower and raise the men. The pounds, shillings, and pence view of the question might be true, if they took the community at large, he repeated, but not as applied to the individual employers. There were some descriptions of trade in which it paid the masters to employ workmen at high rates of wages, with a perfect recklessness of the consequences to the life and health of the labourers—for instance, in the phosphorous match business, they sometimes, he believed, employed girls of tender age, and the nature of the occupation was such, that it destroyed health and engendered the most fearful diseases throughout a miserable though shortened existence, without any pecuniary loss accruing to the individual who employed them with an utter recklessness of the consequences to human life and health. With regard to the remark of the Chairman as to the complaint of certain miners that they were compelled, while in jail, to maintain an erect position, the blame was not with the men themselves, that they had a distaste to what had been termed the *distinctive* attitude of human beings. We should say that it was the necessary consequence of the standing muscles not having been properly developed by exercise, and we had no right to blame the miner for not wishing to stand up right, when from the nature of his occupation, he was compelled to adapt himself to unnatural and distorted postures of the body. It was very remarkable that with the generally intelligent and frequently fairly educated class of men composing the body of the Cornish miners, more attention had not been awakened upon these matters which affect their comfort and well-being in life. It was strange that they (who could so well calculate their chances on a "tribute pitch,") should not also calculate their chances of life in their occupations. With respect to Lord Campbell's Act that did not apply to the chief evils among miners. It gave a remedy in cases of *accidents*, but not in cases of loss of health and *chronic diseases*. He believed the great ultimate remedy of the existing evils in the mining occupation would be found in the proper education of the miners; so that they might be brought to regard their true interests as human beings, and to stand upright socially and morally, even while they might be physically incapacitated from retaining that position without great fatigue; the fact being, that standing upright was not, as commonly supposed, a state of rest, but required the combined action of various muscles; and if those were allowed to relax, the upright position would not be for a moment retained, and could only be retained with *great fatigue* by men who, from working chiefly in recumbent attitudes, had not got the muscles of standing in such vigour as would suit a peripatetic philosopher.

Sir John Rennie said it was a question with him whether governmental interference would work out a remedy for the evils complained of with regard to operations in mines. He thought Government interference would effect very little good in the matter, and he should prefer that the owners of mines should be led to carry out improvements that were brought before their notice, from a conviction of their desirableness and utility, rather than by any strong legislative enactments.

Mr. Tennant considered it would be an advantage to all parties concerned in mining operations, for the Government to enforce those rules and regulations somewhat similar to other European countries, where they had not even a third of the capital, or number of workmen, employed that we had in Great Britain. In all cases where it could be shown to be an advantage to preserve human life, it ought to be the duty of the legislature to see it carried out. In other countries there was a much larger number of inspectors in proportion to the mines and people employed. It was well known that from accidents in mines from various causes, the loss exceeded 1,500 per annum. If any improvement which would reduce this by one-fifth—and more than this, from the evidence on the continent, was practicable—it would be a great benefit, not only to the working man and his family, but to the relief of the poor's rate, which persons who were not immediately connected with the mines had to pay.

Mr. J. Arthur Phillips did not agree with the author of the paper that the mines of Great Britain were worse ventilated and less skilfully worked than those on the continent of Europe. He would instance the tin, copper, and lead mines of Devon and Cornwall as examples of well-ventilated and carefully worked mines, and was confident, from his own experience, that they would compare favourably with those of France, Germany, or any other country. It was true that in some instances inconvenience was experienced from want of proper ventilation, but this generally occurred in ends, or fire-breasts, where, until a communication could be effected with the other parts of the workings, a stagnation of air was liable to take place. Those in charge of the mines were, however, as a general rule, quite conversant with the principles on which a good supply of air depends, and were fully alive to the advantages to be derived from good ventilation, and where this could not be effected by the establishment of a natural draught, mechanical means were adopted. He was also of opinion that the health of the miner suffered as much from the sudden changes of temperature to which he was constantly subjected as from a want of ventilation in the mines. It was true that in certain exceptional cases, where carbonic acid gas was given off, the ventilation of metal-producing mines became deficient, and necessitated peculiar precaution. As an illustration of this fact he would state, that when the Pranal pumps at the Pontgibaud Mines, were first set in motion, after a stoppage of some years, the water issuing from the shaft was so impregnated with carbonic acid gas as to effervesce with great violence on reaching the surface, and on flowing into the river caused the death of multitudes of small fish from the same cause.

Mr. Hall begged, on the part of an important class of operatives in this country, to express his thanks to Dr. Chambers for the prominent part he had taken in the question of Industrial Pathology, and for the able manner in which he had brought forward the importance of maintaining, as far as possible, an upright posture of the body in all manual operations. He was happy to

say that in the branch of trade (shoemaking) with which he was connected, the suggestions had been carried out, to a great extent, and with the most beneficial results to the workmen, by whom the system was very highly appreciated, as they could do more work, and with greater ease to themselves, than under the old system of a cramped position whilst at work.

Mr. J. A. Phillips said, that with regard to the progressive increase of temperature in mines as we went further from the surface, he did not consider this phenomenon to be wholly dependent on their depths. It was well-known that tin and lead mines of a given depth were never so bad as copper mines of the same depth, and he believed this difference of temperature depended entirely on chemical influences. He had always observed that the warmest places in mines were invariably in the vicinity of large quantities of either iron pyrites or copper pyrites in a state of rapid decomposition. By this decomposition the sulphates of these metals were produced, whilst a considerable elevation of temperature was the result of the chemical action.

Mr. Conybeare fully agreed with Mr. Phillips, and it was the case with all precipitate works. With regard to copper mines, by the pumping operation, great quantities of water were washed out. The copper was precipitated, and the sulphide destroyed by the chemical action. With regard to the Cornish mines, he believed they were well worked in respect of ventilation, but the present means of ascending and descending the mines were fraught with the greatest danger to the miners. In one or two instances man-lifts were employed, but, generally speaking, miners were a class of men who did not like anything new, and would prefer climbing up and down the enormous depths they did, to being hauled up by means of a good steam apparatus. In some of the mines the labour of ascending and descending was equivalent to a man walking fifteen miles a-day to his work, and if the talented author of the paper could suggest a simple and economical means of obviating that amount of physical labour, he would confer a great benefit upon the mining community.

The Chairman said they must not lose sight of the obligations they were under to Mr. Mackworth, and he begged to move a vote of thanks to that gentleman for the valuable and important paper which he had brought before them that evening. He hoped it would lead to the subject being followed up by others, if not with equal ability, at least in a way to be of great value and importance.

Mr. Mackworth said, in replying to the remarks which had been made in the discussion, he must express his satisfaction that so many gentlemen had taken it up, as he was persuaded that very much good would be effected by, as the phrase went, "ventilating" the subject of the diseases of miners. He had alluded in his paper to the ventilation of Cornish mines, and by that (after having been down many Cornish mines) he was prepared to take his stand. The chief defect in their ventilation was the communication left between a number of shafts, which cut it off. He did not agree with Mr. Conybeare, that the ventilation had little to do with the short lives of the Cornish miners as compared with the ladders. There was so small a difference in the lives of miners in different parts of England, that we must look for some general cause pervading all mines as the cause of mortality, and that was working in advance of the air. He quite agreed with the remark as to Government interference being undesirable; but when a man was needlessly injured, whether it be by the fault of his employer, ensuing in his death or in crippling him for life, it was surely just as much deserving of the interference of the law as reckless trading, or cruelty to animals. By the same rule of passive inspection only, all the powers of sanitary laws should be abolished. In mines the men were peculiarly in the power of the manager, and yet it had been shown, in the experience of the last four years, during which nearly 4,000 lives had been sacrificed in coal-mines, not to speak of the 40,000 other serious accidents, that, as regarded the condition of the miner, criminal and civil laws were almost completely inoperative. They would not go under ground In no instance in England, he believed, had the charge of manslaughter been sustained against a manager, nor had the widows or children of the men killed been able to recover any damages. Hardly ever was any effort made to compensate them in their distress. The managers of mines enjoyed practically a perfect immunity from all legal responsibility. He intended to have omitted accidents altogether from consideration, but he might state that, from published Government Returns, the mortality from accidents was, in the coal-mines of

| | Killed. | Persons. | | |
|---|---|---|---|---|
| Prussia | 1·89 | per 1,000 | per ann. | |
| Belgium | 2·8 | ,, | ,, | ,, |
| England | 4·5 | ,, | ,, | ,, |
| Staffordshire | 7·3 | ,, | ,, | ,, |

He had spoken decidedly as to the difficulty of persuading persons to adopt sanitary measures, as he found it next to impossible to induce proprietors of mines to adopt remedies for the most obvious dangers, and afterr epeated accidents had occurred from the want of them. The Inspectors of local mines had been engaged on persuasion on a great scale, and the result was, that the number of accidents, though not the number of deaths, was increasing Government interference could not be said to have prejudicially affected Belgium, for the production of coal was half as much again as in England per acre of the coal-field, and the production was still increasing at about 10 per cent. per annum, whereas, in England, the highest estimate was 5 per cent. Experience had shown that the cotton manufacture and railways, contrary to most sage predictions of utter ruin, had increased much more since Government interference commenced. As to the benefit, let the operatives and the travelling public speak. Commercial transactions were hedged round by every possible sort of legislation, because the persons affected were on an equality. But a miner could not obtain any protection whatsoever for his life or his health, except by leaving his employment; and this was lauded as a free use of the capital of labour. It would be equally satisfactory to tell a person travelling by railway that, as he was not satisfied with the safety of the line, he must travel by another. All sanitary measures had passed over the mines as if 300,000 of the most valuable part of our population were to be forgotten. The education of the mining population was of the highest importance. They had begun to understand the causes which had weighed them down. They ought to have a voice, and certainly the chief one, in any legislative measures. It was *their* property in their labour which had been curtailed, although their want of information might not have taught them that care on the part of the managers would have prolonged their lives. In conclusion, he believed he had advanced no statements but such as could be amply substantiated, and made no proposal which would increase the cost of mining, or check its development, but the contrary. The subject was one still more important, from the magnitude of the evil, than the accidents in mines. It could not be in better hands than the Society of Arts.

The Secretary announced that the paper to be read at the meeting of Wednesday next, the **11th** inst., was on "The Mineral Industries of the United Kingdom," by Mr. Robert Hunt, F.R.S.

## To Correspondents.

**V. B. is informed that the circumstance alluded to in his note has never come within the knowledge of the Secretary.**

## MEETINGS FOR THE ENSUING WEEK.

TUES. Syro-Egyptian, 7½. 1. Mr. Bonomi, "On the Assyrian Deity Nisroch." 2. Dr. Benisch, "On the Cuthite Idol Nergal."
Med. and Chirurg., 8½.
Zoological, 9.
WED. Literary Fund, 3.
Society of Arts, 8. Mr. Robert Hunt, F.R.S., "The Mineral Industries of the United Kingdom."
Graphic, 8.
Ethnological, 8½.
FRI. Astronomical, 8.
Botanical, 8.
Philological, 8.
SAT. Royal Botanic, 3¾.
Medical, 8.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 24th and 26th March, 1855.*

132. Committee of Selection—6th Report.
135. Publication of Intelligence (Crimea)—Copy of Letter.
61. Bill—Criminal Justice.
Epidemic Cholera (General Board of Health)—Report on the results of the different methods of treatment.
Australian Colonies (Alterations in the Constitutions)—Further Papers.

*Delivered on 27th of March, 1853.*
Session 1854.

524. Chapels, &c., Abroad—Return.

*Delivered on 28th of March, 1855.*

119. Clergy Reserves (Canada)—Copy of Act.
110. Local Acts (16, Hoarwithy Bridge; 17, South Wales Railway 18, Maryport and Carlisle Railway; 19, Newcastle upon Tyne, New Streets and Improvements; 20, Gateshead Quays and Improvements;)—Reports from the Admiralty.
Turnpike Trusts—1st Report by the Secretary of State, with Abstract of Accounts.

*Delivered on 29th of March, 1855.*

98. (1). Staff Officers—Supplemental Return.
129. Bankruptcy—Abstract of Return.
136. Regimental Commissions—Return.
139. Committees of Selection—Seventh Report.
141. Mr. Kennedy—Return.
75. Wrecks—Return.
65. Bills—Registration of Births, &c. (Scotland).
66. Bills—Affirmations (Scotland).
68. Bills—Convention with Sardinia.
Public General Acts—Caps. 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10.

*Delivered on 30th March, 1855.*

89. Coroners' Inquests—Abstract Return.
134. Jurors—Abstract of Returns.
142. Public Debt—Account.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, March 30th, 1855.*]

*Dated 18th December, 1854.*

2661. W. Gilpin, 2, Moorgate-street, and A. Bowen, Stafford-stree Peckham—Prevention of smoke.

*Dated 17th January, 1855.*

126. J. Slack, Manchester—Woven fabrics.

*Dated 16th February, 1855.*

351. R. A. Brooman, 166, Fleet-street—Preparing certain fibres for manufacturing purposes. (A communication.)

*Dated 28th February, 1855.*

432. T. Helliwell and J. Barker, Todmorden—Preserving pickers and picker-sticks, and preventing cops being knocked off in weaving.

*Dated 10th March, 1855.*

541. A Clark, Gate-street, Lincoln's-inn—Globes.
543. J. Hughes, Newport, Monmouthshire—Bushing touch-holes of cannon.
544. C. Heaven, Hull—Machinery for embroidering fabrics.
545. A. E. L. Bellford, 32, Essex-street, Strand—Machinery for making butt-engines at one operation. (A communication.)

*Dated 12th March, 1855.*

547. J. Malcomson and R. Shaw, Portlaw, and W. Horn, Mark-lane—Expansion valves.
549. J. Brookes, Birmingham—Waistcoat.
551. G. Mosley, Southwark—Buttons.
553. W. P. Stanley—Peterborough—Clod crushers.
555. J. M. Napier, York-road—Furnaces used in the manufacture of soda or alkali.

*Dated 13th March, 1855.*

559. T. W. Willett, 25, Belsize-road, St. John's wood—Swimming belts.
561. J. Gracie, Stanley-terrace, Rotherhithe—Wood-planing machines.
563. C. Iliffe, Birmingham—Manufacture of metallic rods, bars, and tubes.

*Dated 14th March, 1855.*

564. R. C. G. Cooke, New Swindon—Cloaks.
565. G. Riley, 12, Porland-place North, Clapham-road—Starch or grape sugar.
566. H. Gray, 60, Clement's-lane, Strand—Substitute for flock.
567. B. Goodfellow, Hyde—Regulating the power for driving pumps of hydraulic presses.
568. R. Neale, Cincinnati, U.S.—Copper-plate printing.
569. J. Kidder, Plaistow—Castors.
570. W. and J. Galloway, Manchester—Regulating the pressure on slide valves of steam-engines.
571. J. Marland, Walsden — Rollers for spinning and other machinery.
573. W. Soelman, 3, Bennett-street, Fitzroy-square—Propellers.
574. E. J. Mitchell, Bradford—Rollers in washing wool and linen.
575. J. Turner, Farringdon-street - Coffin furniture.
576. J. Bernard, Club-chambers, Regent-street—Boots and shoes.
577. C. Goodyear, jun., Paris—Plates of artificial teeth.
578. R. Wright, Richmond, York—Swords.
579. A. Davis, Tottenham Court-road—Polishing powder.
580. J. Hetherington, Manchester, and A. Vickers, Bristol—Spinning machinery.
581. W. Lister, Richmond, Yorkshire—Implement for raising roots in the ground, &c.

*Dated 15th March, 1855.*

582. H. Bach, Sheffield—Sash frames.
584. R. M. Butt, Fairfield works, Bow—Night-lights.
585. E. Humphrys, Deptford—Applying heat to steam-boilers.
586. F. Loret-Vermeersch, Malines—Stopping trains on railroads.
687. W. Monday, jun., Kingston-upon-Hull—Preparing plumbago, graphite, &c., for polishing and lubricating, &c.
588. G. Grignon, 13, Sutherland-square, Walworth—Detaching boats from ships' sides.
589. H. Wickens, 4, Tokenhouse-yard—Communicating signals in railway trains.

*Dated 16th March, 1855.*

590. J. Mitchell, Sheffield—Supplying grease to engines.
591. W. Hill, Birmingham—Metallic pens and penholders.
592. M. Smith, Heywood—Looms.
593. J. W. C. Wren, Tottenham Court-road—Invalid bed.
594. T. Picton, Liverpool—Scaffoldings.
595. W. Winstanley and J. Kelly, Liverpool—Force pumps.
596. A. Mauduit and F. H. Ouin, Paris—Hydraulic machine.
597. Sir W. Burnett, Somerset house, and J. W. D. Brown, R.N., Haslar Hospital, Gosport—Constructing signal lanterns.

*Dated 17th March, 1855.*

598. T. Petitjean and — Pitre, 45, Upper John-street, Tottenham Court-road—Daguerreotype-plates. (A communication.)
599. E. Breittmayer, Paris—Mortising machine.
600. J. H. Johnson, 47, Lincoln's-inn-fields—Application of carbonic acid gas as a motive power. (A communication.)
601. J. H. Johnson, 47, Lincoln's inn-fields—Steam-engines. (A communication.)
602. J. H. Johnson, 47, Lincolns'-inn-fields—Steam pressure and other indicators. (A communication.)
603. T. G. Shaw, Old Broad-street—Facilitating the 'tilting' of casks.
604. B. Britten, Anerly—Projectiles.

*Dated 19th March, 1855.*

606. G. Lowry, Manchester—Lubrication.
608. E. R. Tayerman, 79, Pall Mall—Portfolios.
610. V. Scully and B. J. Heywood, Dublin—Regulating supply of gas to gas burners.
612. F. A. Chartraire, Paris—Fastening gloves, collers, &c.
614. L. H. Crudner and F. L. Koebrig, Tottenham Court-road—Ventilation.
616. R. E. Hodges, Southampton-row, and C. Murray, Manor-place, Walworth—Door springs.
618. W. Smith, Little Woolstone, Fenny Stratford—Ploughing.

### WEEKLY LIST OF PATENTS SEALED.

*Sealed March 30th 1855.*

2123. William M'Naught, Rochdale—Improvements in slide-valves for steam-engines.
2130. David Chalmers, Manchester—Improvements in the mode or method of working railway breaks and communicating signals.
2147. John Macmillan Dunlop, Manchester—Improvements in machinery or apparatus for preparing, spinning, and doubling cotton and other fibrous materials.
2149. Andrew Smith, Princess-street—An improved safety cage and apparatus for miners.
2168. George Wigzell Knocker, Bushy-ruff, Dover—Improvements in obtaining motive power by means of water.
2222. Jacob Dockray, Leeds, and John Dawson, Holbeck, Leeds—Improvements in machinery for raising woollen cloth.
2467. Robert Gibson, Hunslet, Leeds—Improvements in machinery for carding wool, flax, cotton, and other fibrous materials.—(A communication.)
2647. Daniel Chandler Hewitt, Richmond—Improvements in the construction of pianofortes.
2684. William Milner, Liverpool—Improvements in safes and other such depositories, and further improvements in the locks of the same.
2707. Edward Loysel, Rue de Grétry, Paris—A new game combining chance and skill, and the apparatus to be used therewith.
156. Scipion Salaville, Paris—An improved method of preserving and purifying grain and seed.
221. Thomas Binks, Wentworth—Improvements in raising and regulating the supply of water and other fluids.

Journal of the Society of Arts.

*FRIDAY, APRIL* 13, 1855.

## SEVENTEENTH ORDINARY MEETING.

Wednesday, April 11, 1855.

The Seventeenth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 11th inst., Edwin Chadwick, Esq., C.B., in the Chair.

The following Candidates were balloted for, and duly elected:—

AS ORDINARY MEMBERS.

| | |
|---|---|
| Barlow, Wm. Henry, F.R.S. | Mair, Hugh |
| Dudgeon, John William | Melrose, James |
| Enfield, Edward | Swarbrick, Samuel |
| Gill, Samuel Lawrence | Symons, Alexander |
| Green, Henry | Trevithick, Frederick Henry |
| Green, Richard | Williams, Charles C.B. |
| Johnstone, James B, M P. | Wood, Benjamin |
| Keener, John | Young, Charles D. |
| Kirtley, Matthew | Younghusband, Capt. C. W., R A. |
| Low, William | |
| Lycett, Francis | |

AS A CORRESPONDING MEMBER.

Franscini, Federal Councillor.

On the table were exhibited specimens of a Miners' Safety Lamp, recently invented by Messrs. Whitehead. It consists of a strong cylinder of iron, with on one side a bull's eye surrounded by reflecting surfaces. The light given off is thus greatly increased. It has only one loose joint. The air to support combustion passes through a number of small openings round the oil receptacle, and thence through wire gauze, such as is used in the Davy lamp. The air admitted is purposely small in quantity. Wire gauze is also introduced at the top of the chimney, so as to complete the isolation of the flame. One of the lamps exhibited was for exploring purposes, where foul gases might be collected. A gutta percha tube is attached to the lamp, and is proposed to be used to conduct the air necessary to support combustion from some part of the works where it is sufficiently pure. In the event of the pipe being suddenly detached, no accident, it is said, could result, as the light would simply go out.

The Paper read was

## ON THE MINERAL INDUSTRIES OF GREAT BRITAIN.

By Robert Hunt, F.R.S., Keeper of Mining Records.

Great Britain stands remarkable amongst the nations for the abundance and variety of her mineral productions;—and the inhabitants of those islands have through all historic times been noted for their skill in mining, and their successful prosecution of the metallurgic arts.

Long before Julius Cæsar thought of visiting those small "islands of the west," the merchants of Tyre sought for the tin which Cornwall produced. The Phœnecian mariners made regular voyages to our shores, for supplies of those metals which were employed in the manufacture of the bronzes of the Egyptians in the days of Moses, and those which decorated the palaces of the Assyrian kings in the meridian glory of that mighty empire.

The Welsh Triads tell us of the golden cars of the native princes, and of the chains of gold and silver which were used as the emblems of power—the production of the Cambrian valleys.

The Roman Emperor informs us that he was persuaded to the invasion of Britain by the reports of the wealth of the inhabitants in the useful metals, and even in the more precious ones of silver and gold.

Our kings through all the earliest periods of our history derived large portions of their revenues directly from the mining operations which they caused to be undertaken, or, such as were prosecuted by others under charters granted on conditions that large royalties should be paid to the Crown. In later days we find Prince Rupert the president of a mining company, and Oliver Cromwell an ironmaster.

Notwithstanding, however, the long and unwearying search which has been made over every part of the country for mineral treasures, we are now enabled to show that, not only are our national treasures unexhausted, but even to prove that yet larger drains may be made upon the subterranean wealth of these islands, for many years to come, without entertaining for a moment any fear of coming to the end of the "hoarded treasures."

My purpose is briefly to direct attention to the progress of our respective mineral industries; the state in which they are at the present time; and to examine, by the aids of science, with equal brevity, our future prospects. This will be most effectually done by attending to the historic relation in which the several metals stand to each other, although this cannot, in this essay, be strictly maintained in the divisions of the subject.

Tin, as already stated, was obtained at a very early period from these islands. The Cassiterides, or Tin Islands, were celebrated in ancient histories and in classic song. The Scilly Islands have frequently been considered as the Tin Islands of the ancients, although there is not the slightest evidence that tin was ever found in any quantity on them. Certainly, no tin is found at the present time in any of this interesting group of English islands. There can be but little doubt that the term Cassiterides was applied to the western promontory of this island, and if we look at Western Cornwall from the British Ocean, it assumes the appearance of a collected group of islands. Indeed, an alteration of a few feet in the levels of the land and ocean would at once give an insular character to that portion of Cornwall which lies westward of the line extending from Marazion on the south, to Hayle on the northern, sides of the county.

Regarding, after the most careful examination of all the evidences which have been brought into the discussion, St. Michael's Mount as the Ictis of Diodorus, I am disposed to believe that the tin districts westward of Helstone, and those around St. Austle, supplied the ancient world with the largest quantities of tin, which they knew so well how to use, although I cannot but think it probable that some may have been derived from the islands of the Indian Archipelago. Tin *mining*, in the strict sense of the term, was unknown before the time of the Romans. The Britons, or rather that tribe of them grouped under the general epithet of the Danmonii, who maintained themselves so long as a separate family to the west of Exeter, obtained the tin they used or sold by washing the drift deposits of the valleys; and from the evidences which have from time to time been discovered, the process of washing adopted by our ancestors was similar to that which may now be observed with the modern tin-streamer of Cornwall, or the gold-washer of Australia.

There are many evidences that the Romans made great excavations in search of tin; but subsequently the tin trade of Cornwall passed into the hands of the Jews, and the remains of Jews' workings—Jews' houses, &c., as they are called—sufficiently prove the extent of their search. They appear to have confined themselves to washing processes, or merely to have followed the veins appearing on the exposed faces of the rocks. We have no means of ascertaining the quantities of tin raised by the Jews, but it was less than half the quantity which has been produced in Cornwall during the last century. In the search of stream tin, it is curious to observe the circumscribed limits by which the streamer has been bound, the districts of St. Just, of Helstone, and St. Austle being the most marked. I do not intend to say that searches have not been made elsewhere; these, however, have been unimportant, and I feel convinced that many valleys formed by the vast granite ranges of Dartmoor, and other places, would prove remunerative to the labours of honest industry. Tin mining has been for some time carried on to a great extent, and it is considerably extending.

The total quantity of tin ore raised in Cornwall and Devonshire in 1853 was 8,866 tons, the average value of which was about £68 per ton. This black tin, or tin ore, produces on the average 65 per cent. of metallic, or white tin, as it is called. The quantity of this metal of British produce brought into the market is about 6,000 tons annually. Our annual imports of tin from Singapore, our Indian territories, from China, Peru, and Brazil, amount to 2,500 tons. Of this foreign tin there is re-exported about 1,000 tons, and of British tin rather more, annually.

The actual produce of five of the principal tin mines may be given. In 1853—

| | Tons. | | £ | s. |
|---|---|---|---|---|
| Polperro produced............ | 282 | worth | 18,998 | 12 |
| Lewis............................ | 262 | ,, | 17,816 | 16 |
| Gt. Poolgooth ............... | 260 | ,, | 17,745 | 0 |
| Boscundle ...................... | 217 | ,, | 14,507 | 0 |
| Drake Walls .................. | 203 | ,, | 15,397 | 11 |

In connection with this last-named mine it is necessary to name an improvement which has been effected in the purification of the tin ore. Much tin ore is contaminated with woolfram, which, as it cannot be removed by the ordinary processes of dressing, or cleansing, or by the operations of smelting, remains with the metal, and renders it of low value. At the Drake Walls Mine they employ a process invented and patented by Mr. Robert Oxland. This process is essentially one for effecting the combination of the tungstic acid of the woolfram with soda, by roasting and dissolving out the tungstate of soda formed, leaving the pure tin behind. Although at present there is no demand for the tungstate of soda, or for the tungstic acid, and it is allowed to run to waste, the increased value of the tin ore thus treated renders the process profitable. Mr. J. A. Phillips has also introduced a process for the purification of tin, which promises many advantages.

Attention should be directed to this curious metal—tungsten and its salts—since it appears highly probable that it may be rendered available for some important manufacturing purposes.

One of the purposes to which tin is applied is to enable the dyer and calico printer to give permanence to his reds and scarlets. For this muriate of tin is largely employed—it was expected that tungsten would have answered this end, and that thus a market might have been created for a new material. Hitherto, however, the experiments have not been successful. Mr. Young has patented a process by which stannate of soda is formed directly from the ore, and this preparation of tin is extensively employed.

It was formerly considered that tin was one of the superficial formations, and that it was useless to seek it at any great depth below the surface. A remarkable example of the incorrectness of this view exists in Dolcoath Mine, near Camborne. This mine was, more than a century since, worked as a tin mine, and proved exceedingly productive. As she increased in depth the mine became poor for tin, and exceedingly productive for copper, and as a copper mine was profitable for a long period. Eventually this mine became so poor that the water was allowed to accumulate in all the lower levels, and those near the surface alone were worked. At length a mining captain advised the removal of all the water from the mine. The recommendation was adopted, and now, at the depth of nearly 300 fathoms—far below the copper—an immense formation of tin is being worked. In 1853 there was produced from this formation 120 tons of tin ore, which was sold for £7,658 5s. 2d. Huel Basset, Huel Buller, South Huel Francis, are, strictly speaking, copper mines, producing, however, large quantities of tin at considerable depths.

All the tin raised in Cornwall is smelted in the county. The ore is easily reduced to the metallic state when combined with some chemical agent, which will, under the action of heat, abstract the oxygen or sulphur in combination.

Out of the tin produce arises another, but not very extensive, branch of mineral industry. This is the production of arsenic. Most of the tin ores which are obtained by mining contain both arsenic and sulphur. These are got rid of by exposing the powdered ores to the action of fire. They are calcined in peculiarly constructed furnaces, or roasted in places locally called *burning houses.* The sulphur and arsenic both sublime, but since they condense at temperatures slightly different, the arsenic can be separated, and it is, in its pure state, collected and sent into the market.

The quantity of arsenic produced annually has been estimated at 2,000 tons. The chief market for this is, however, now closed. The exportation of arsenic to Russia was very large, the principal portion being used in the preparation of Russian leather.

Copper for a very long period appears scarcely to have attracted attention. Tin mines were abandoned when the miner came to the *yellows*—the yellow copper pyrites. "The yellows cut out the tin" was a common complaint. About a century since attention was more particularly directed to the value of the copper ores of Cornwall, and from that time to the present the value of our copper mines has been continually increasing, until, in 1853, the copper raised in Cornwall alone was sold for £1,155,167 3s. 6d., and, in addition to this, Ireland produced 11,278 tons of copper ore; and some hundreds of tons were produced in Wales and the northern English counties. The importance of some scientific knowledge to our mining population is well exemplified by the fact that hundreds of tons of the grey sulphuret of copper have been thrown over the cliffs of the western shores into the Atlantic ocean; and hedges have been built with copper ores of twice the value of the ordinary copper pyrites. Immense masses of the black oxide of copper have from time to time been thrown aside. Eventually the miner became acquainted with the value of these ores, and they are now, of course, carefully preserved whenever they occur.

Amongst the most important of the mines yielding copper in this country are the

| | Tons. | | £ |
|---|---|---|---|
| Devon Great Consols, which produced in 1853 ............... | 24,120 | at the value of | 147,281 |
| Huel Buller ......... | 18,562 | ,, | 88,307 |
| United mines ...... | 11,764 | ,, | 62,598 |

Huel Basset, Carnbrea, West Caradon, and others.

There are in Cornwall at the present time about 100 copper mines selling copper ores by public sale, the ore which is raised giving on the average 6½ per cent. of copper. It will be well understood, that the smelting processes by which so large a quantity of matter has to be

separated, and so small a portion of valuable metal saved, involves many of the nicest chemical processes.

All the copper ore raised in Cornwall is sent to Swansea; this employs about 150 vessels and 800 seamen. The ships carry back coal to Cornwall, which is employed chiefly in the production of the mechanical force by which the water is pumped from the mines and the ores raised.

The smelting establishments of Swansea support, by their direct or indirect influence, nearly 15,000 people. Thus we have an example of the effects of a peculiar branch of industry rising up, at a distance from the locality in which the material sought for is produced. The importation of copper ores from the mines of Cuba, Chili, &c., would, it was feared, greatly reduce the value of the British ore. Now, although Cuba sends us 15,000 tons of her rich ore annually—Chili at least 18,000—and Peru, Spain, South Australia, and our other colonies about 20,000 tons more, the value of the Cornish copper ores has steadily increased, the combination of the two being necessary for the production of the best kinds of metal.

The Cornish pumping engine is, perhaps, the best example of the application of steam as a motive power which the world has yet produced. This has arisen from the necessity to which the engineers have been driven to effect a great economy of fuel in a locality so far distant from the coal fields, and again, from the circumstances that the duties of the engines are regularly reported, in what are called "Duty Papers." The sizes of these fine engines will be understood when the diameters of the cylinders of a few of them are given.

| | |
|---|---|
| At the Consolidated and United mines they are | 85 and 90 inches |
| At Poldice | 90 ,, |
| At Huel Vor | 100 ,, |

The duty of a Cornish pumping engine is estimated by the number of pounds lifted a foot high by the consumption of a bushel of coals. Taylor's engine, at the United Mines reached the high duty of lifting 110 millions of pounds. The average duty of all the engines at present at work is 51,620,000, while the average duty of the best engines amounts to 99,000,000. This enormous power, which may be estimated at equal to the power of 5500 horses, is employed to raise more than 9000 gallons of water per minute from the mines, and to lift a large portion of the ore which is raised.

The manufacture of these engines gives rise to other and important industries, each of these large engines costing from £2000 to £4000. The machinery at one of the largest mines in Cornwall has been estimated to be of the value of £75,000. These steam engines are made in Cornwall, and the foundries employed in their construction are also largely engaged in supplying the water works of the metropolis and other districts with pumping engines. From estimates which have been carefully made, it appears that last year nearly 30,000 persons were employed in and about the Cornish mines. Of these 5500 were women, and 5000 children, the women and children being employed on the surface only. In one way and another at least 100,000 persons derive their means of subsistence from the tin and copper mines of Western England.

Mr. Mackworth has spoken of the health of our mining population, and from the attention he has paid to this subject, that gentleman is well qualified to express an opinion on the subject. I am, however, disposed to believe that the short average duration of the life of a Cornish miner is more directly due to the injurious effects of climbing than Mr. Mackworth conceives. When a man is engaged for an hour, or more, as is not unfrequently the case, in lifting his own weight upon perpendicular ladders, from a depth of 1800 feet, the amount of exhaustion produced is extreme. The constant effort made by the muscles of the chest eventually produces a disease of the lungs by which the poor miner is soon compelled to cease from labour, and in a few months after the attack comes on he usually ceases to live.

By the efforts of some benevolent gentlemen—urged on by Mr. Charles Fox—in connection with the Royal Cornwall Polytechnic Society, the sum of £500 was offered as an inducement to the miners to introduce some plan by which the miner should be relieved from this distressing toil. At Tresavean mine, they resolved on the adoption of a plan, by which perpendicular rods, with platforms fixed at every ten feet, should have reciprocating parallel motions. In this way at every stroke the miner on the platform moved through ten feet of space; he then shifts his position to the other rod, and is thus carried on another ten feet. In this way, without fatigue, the Cornish miner ascends and descends with much rapidity, time is saved and health preserved. In our coal mines, we find men lowered and raised by the winding machinery—many at a time—and with considerable speed—in safety. The Cornish miner's prejudices alone prevent the introduction of a plan which might be employed, in even the smaller mines, with economy and advantage, whereas now there are but four or five mines in Cornwall in which any mechanical appliances are made to this end. The use of guides in the shafts, and the employment of wire rope, appear to be two desiderata in the practice of metalliferous mining in the west.

The small quantities of copper produced in the mines of Wales, Cumberland, and Westmorland, scarcely require any further notice than that already given. The mines of Ireland promise to be of more importance than they have yet proved to be. English capital, and above all English industry, will it is hoped soon develope the mineral wealth of the sister kingdom.

Lead is produced over a very extensive range of these islands. This will be best understood by giving a list of the quantities of lead ore and lead produced in the different localities in 1853:

| | Ore. Tons. | Metal. Tons. |
|---|---|---|
| Cornwall | 6,680 | 4,690 |
| Devonshire | 3,014 | 1,798 |
| Cumberland | 8,343 | 5,619 |
| Durham and Northumberland | 19,287 | 15,041 |
| Westmoreland | 518 | 393 |
| Derbyshire | 7,681 | 4,959 |
| Shropshire | 3,508 | 2,528 |
| Yorkshire | 10,308 | 6,868 |
| Cardiganshire | 6,552 | 4,909 |
| Carmarthenshire | 921 | 692 |
| Denbighshire | 450 | 346 |
| Flintshire | 7,609 | 5,807 |
| Montgomeryshire, &c. | 1,597 | 1,114 |
| Ireland | 3,309 | 2,452 |
| Scotland | 2,799 | 1,919 |
| Isle of Man | 2,460 | 1,829 |

If to these are added 78 tons of foreign ores sold at Swansea, producing 52 tons of lead, we have a total produce of 85,121 tons of lead ore, or, 61,021 tons of lead. Nearly all the lead ore raised in this country contains more or less silver. The ores of Derbyshire and of the northern counties containing the least, while those of Devonshire and Cornwall contain the most. The average produce of silver from the lead ores of Devonshire is 40 ounces to the ton, those of Cornwall 35 ounces, those of the Isle of Man 20 ounces, of Wales about 15 ounces, of Ireland 10 ounces, and of our northern counties about 6 or 7 ounces.

Formerly it was not profitable by the processes adopted,—the oxidation of lead,—to separate the silver when it existed in less proportions than 15 ounces to the ton. By the process of desilverisation introduced by Mr. Hugh Lee Pattinson, it is now economical to separate the silver when no more than 5 ounces exist in a ton of lead. From this process an enormous amount of wealth has been added to the natural store. We now obtain from our lead

ores at least 700,000 ounces of silver, which may be valued at £92,500. A process has lately been introduced in which zinc is employed in combination with the fused metal; by the action of affinity the silver is thus readily separated. As yet this process is not extensively employed.

Beyond the important uses to which lead is applied, we have the chemical processes of white lead manufacture, in which, by a slow and interesting process, the lead is oxidized and converted into the carbonate or white lead. There is also the less known manufacture of a new white lead, which is an oxy-chloride of lead. This is produced by treating the ore directly with muriatic acid, precipitating by lime and the action of the oxygen of the air. It appears that this variety of white lead is coming into extensive use. The great value is, that it can be manufactured without acting injuriously upon the health of those who are engaged in the operations.

At the present time we are importing large quantities of silver ores from South America. These are smelted principally at Swansea, and in the neighbourhood of Liverpool, but there is some difficulty in obtaining an exact return of the quantity.

Zinc.—The history of zinc mining is somewhat curious. By various acts of parliament before and during the reign of Queen Elizabeth the exportation of calamine was prevented. This prohibition was founded on the belief, as expressed, "That our inexhaustible supplies of calamine would occasion large quantities of copper to be brought in for the manufacture of brass and gun metal." Calamine, or carbonate of lime, is found abundantly in the neighbourhood of the Mendip Hills, and in the northern counties of England: Black Jack, or the sulphuret of zinc, is discovered in many of the Cornish mines, and elsewhere. There are but two or three establishments in this country at the present time for the smelting of any of our zinc ores, nearly the whole of our supply being derived from the Vieille Montagne. There are few metallurgical processes more crude than the operation of reducing zinc to the metallic state, and there certainly is not one in which a richer reward awaits the skilful metallurgist who shall improve the process.

The manufacture of white zinc—the oxide of zinc—is a comparatively new industry, which is not, however, as yet carried out on such an extensive scale as it was expected it might have been when attention was first directed to its use as a pigment.

The oxide of zinc, or philosophers' wool, was observed by an early German chemist, Brandt, but the beautiful white formed by the combustion of the metal was not introduced as a paint until within the last ten years. The great objection to its use was the want of opacity in the particles of oxide, which, consequently, prevented it from covering as readily as the more opaque white lead. It has been found that, by regulating the action of the fire in the process a considerable opacity can be obtained; we may hence expect eventually, profiting by the experience of manufacture on the large scale, to secure a valuable pigment, which has the great advantage of not blackening under the action of sulphuretted hydrogen gas.

Manganese.—The oxides of this metal were formerly obtained in great quantities, and of peculiarly fine quality, from the mines at Lifton, near Tavistock, and from one or two other places in England. At the present time, although an abundance exists, and it can be worked at a comparatively small cost, it does not appear that we are able to compete with the German mines. All our large supply of manganese is now derived from the continent.

Manganese is employed principally as an agent in the production of chlorine gas, for the formation of the chloride of lime, unless where the gas is used directly as a bleaching agent. The oxide of manganese is used to decompose muriatic acid, and, consequently, having done its work, it remains powerless to effect further decomposition, and is thrown to waste. Attempts are now making, with much prospect of success, to restore the waste manganese to its original condition. If this is effected economically, it will be of much value to the manufacturer, but injurious to the proprietors of deposits of manganese.

This metal is used to a small extent in the production of some of the colours used on our best varieties of earthenware and porcelain.

Antimony is a metal for which there is not a very large demand. It is employed in the manufacture of type, and for a few other purposes. Our supply is principally imported. At one period considerable quantities were raised in Cornwall, but until recently, when one of the abandoned mines has been re-worked, scarcely any has been produced. There are several districts in Cornwall and Devon in which combinations of lead and antimony—ores well known to the mineralogist — exist in great quantities. These are not worked, owing to the difficulty of separating these metals from each other. Some specimens contain as much as eleven ounces of silver to the ton, and these, it would appear, should be rendered useful and profitable by some process which should economically secure the separation of the three metals, antimony, lead, and silver.

Nickel and Cobalt.—In the manufacture of German silver there has been an increasing demand for nickel. Cobalt is very extensively used in the potteries, and in our paper manufactories. Nickel is produced in small quantities in Cornwall, and on the Duke of Argyle's property in Scotland. Our supply is, however, mainly derived from the Norwegian and the German mines. Formerly considerable quantities of cobalt ore were obtained from Huel Sparnon, near Redruth. It exists in Dolcoath Mine. The Wherry, which was worked out in the sea near Penzance, produced fine specimens, in several of the tin mines of St. Just there are good samples to be obtained, and it is occasionally met with in the mines near St. Austle. Difficulties which have surrounded the purification of nickel, and the separation of cobalt, have naturally thrown the trade in these metals into a few hands. It is natural that those who are profiting largely by the efforts of their own industry, and the employment of their capital in a special direction, should cease to be anxious for the development of any sources of supply beyond those which they already hold. This mainly has led the nickels and cobalts of this country to be neglected: I am satisfied, however, that a diligent search would be rewarded by discoveries of more or less valuable stores at home of those articles which we are now deriving from foreign sources almost exclusively.

Of the less valuable metals, bismuth, molybdenum, and the like, we have many good examples, but the consideration of these need not detain us, as they scarcely form an item in the mineral production which we are considering.

Amongst earthy minerals, strontian and barytes, both carbonate and sulphate, are found in this country, the sulphates being in greater abundance than the carbonates. These minerals are worked in tolerable abundance in Cumberland and Westmoreland, and the increasing demand for the carbonate of baryta, has led to the introduction of a process for converting the sulphate into a carbonate. Amongst other uses for which the carbonate of baryta is employed, is that of using it as a base for the reception and retention of colouring matter in the manufacture of pigments.

Our clays are in the highest degree valuable. Of the finer varieties of the Cornish china clay, and the china stone employed for glazing, there is annually raised about 100,000 tons. This gives rise to the employment of 7,200 men, women and children in its preparation for the market, and not less than £240,500 per annum have for some years past been circulated in the neighbourhood of St. Austle alone. From Dorsetshire, again, large quantities of what is locally called "blue clay" are sent to the potteries. At least from 50,000 to 70,000 tons of this clay have been

sent out of Dorsetshire annually for many years past. Our manufacture of pottery may be regarded as a mineral industry; this manufacture has curiously located itself in North Staffordshire, yet, not one of the materials employed in the manufacture exists in the neighbourhood. The clays are derived from Cornwall, Devonshire, and Dorsetshire, the felspar chiefly from South America, and the buffalo hordes of that country supply the largest quantity of the bones used. Borax is brought from Tuscany, flints from the southern and eastern countries, lead and arsenic from the mining districts. Staffordshire producing alone, marl for the formation of the *saggars*, and the coal for firing the kilns and drying the clay.

Salt is of considerable importance as a mineral product. Droitwich and Nantwich are the great centres of its manufacture. In these places are produced annually about 65,000 tons from the brine springs. In the neighbourhood of Belfast a considerable discovery of rock-salt has been made; and during the past year it appears 2,000 tons have been raised and employed for home consumption, or exported in the rough state.

The most important of our mineral industries remain for notice. To our coal and iron we owe our present position in the commercial world; and, indirectly, our exalted point on the scale of civilisation. As the object of this essay is but to give a correct view of the extent and value of our mineral produce, it is not intended to enter into any details of the methods employed in raising the coal and iron ore, or to venture on any remarks as to their modes of occurrence.

Our argillaceous iron ores are largely associated with our coal measures; indeed, the three materials, iron-ore, coal, and lime-stone, required for the production of iron, are usually found in the same locality. Our coal and iron-fields are marked on our geological maps by large dark patches. The chief of these are the Scotch coal-field, extending, with a few inconsiderable breaks, from the German Ocean, west of Edinburgh on the one side, to the Irish Sea, beyond Glasgow, on the other. The Durham and Northumberland important coal-fields, and the smaller one of Cumberland,—those of Yorkshire and Derbyshire, with the outlying patches in Leicestershire, Nottinghamshire, and Warwickshire,—the large field of Lancashire, with Cheshire and North Wales,—North and South Staffordshire,—the extensive area of South Wales, and the small district of Bristol and the Forest of Dean.

The clay ironstones are usually mixed, previously to fusion, with some hæmatite iron. This is obtained in large quantities in the neighbourhood of Whitehaven and of Ulverstone. During last year there were about 550 iron-furnaces in blast, producing each on the average 100 tons of pig iron weekly, or, allowing for accidental interruptions, 2,500,000 tons. The Scotch iron is manufactured principally from the black band ironstone, to which attention was first directed by Mr. Mushet. The difficulties of obtaining the black band are constantly increasing, and the expense of working as uniformly becoming greater,—these are the difficulties which the Scotch ironmasters have to contend with.

The discovery of the ironstone formations at Cleveland had given a remarkable start to the iron-making of the Tees and Tyne district. The ore obtained is, when compared with many of our formations, poor; and the quality of the iron has, it appears, yet to be improved. The Yorkshire iron is well known, that of Low Moor and Bowling being the most celebrated. The Cleator iron-works produce an iron made exclusively from the hæmatites; and near Ulverstone, at three furnaces, which are, however, worked only for four months each, the iron is made from the hæmatite smelted with charcoal. This is the only charcoal-iron now made in this country. In South Wales iron is made from the clay iron-stones, chiefly mixed with the ores obtained from Devonshire and Cornwall. In one district it is smelted with the bituminous coal; in the other, with the anthracite.

In Northamptonshire, large deposits of iron ore have been discovered; and very valuable iron formations have been traced, extending over Devonshire, from its northern to its southern shores.

The manufacture of iron is confined to the districts producing coal; for, although at one period all British iron was made with charcoal, now there is but one Iron Company employing wood.

Previously to, and during the reign of Elizabeth, there existed many iron-works in the counties of Surrey, Kent, and Sussex; and in Elizabeth's reign there was an Act passed prohibiting the erection of any new iron-works in these counties; and it was ordered that no timber, of the size of one foot square at the stub, should be used for fuel at any iron-work. This iron was made from the green sand formations of these counties, and it is not improbable, as Mr. Samuel Blackwell suggests, that Sussex may, by means of rail-roads, at no distant period, furnish the iron-trade with additional supplies of this important ore. As an example of the complete departure of a staple trade from a locality, the town of Thaxted, in Essex, may be cited. This was once the seat of our steel-manufacture, and was inhabited by wealthy merchant-cutlers. The failure of wood, and the use of coal in the manufacture of steel, transferred the trade to Sheffield; and Thaxted is now only remarkable for its beautiful church, and for being a comparatively large town, without any communication, direct or indirect, with a rail-road.

Time will not admit of any further examination of the curious and interesting subject of the progress of our iron manufacture. It appears that, in 1740, there were in England and Wales but 59 blast furnaces, making altogether 17,350 tons of iron; after 100 years we find the quantity produced amounting to nearly 3,000,000 tons; and, seeing the infinite variety of applications to which iron is now put, we cannot but think that still larger demands must be made upon the ferruginous stores which are spread over the whole island, from the older rocks of Cornwall and Wales to the recent geological formations of the eastern counties.

The situation of our principal coal deposits has been already described. These coal formations have been estimated as extending over nearly 10,000 square miles, while the coal-fields of Belgium do not extend over 600, and the fields of France occupy only about 1,719 square miles. Such is the relative value of our own and these European coal-fields. As nearly as they can be estimated, it would appear that the areas of the coal-fields of

| | |
|---|---|
| England are ............... | 3,150 square miles. |
| Wales ........................ | 2,160 ,, |
| Scotland ..................... | 2,000 ,, |
| Ireland ........................ | 2,300 ,, |
| | 9,610 |

The area of the coal-fields of the British Isles has been often estimated at 12,000 square miles, but this, I believe, is far above the truth. Considerable difficulty has arisen in ascertaining the exact quantity of coal produced in the United Kingdom. This arises, in part, from the dislike of a number of the coal proprietors to allow the annual produce of the pits to be known. Various causes are assigned as an excuse for this, but from a visit paid to the various coal-fields I have been satisfied that all feeling of doubt and jealousy is rapidly dying out. Again, a very large quantity of coal is raised and used directly on the mines, which is never estimated, and in a very large number of the small collieries supplying the towns in their immediate vicinities no account is kept.

Data have been obtained for estimating our coal produce with a greater degree of exactness than has ever yet been reached. The computation will, however, occupy some considerable time, but in the meantime the estimates of Mr. Thos. Young Hall and Mr. Dickinson may be given, as showing a close agreement, although these estimates

are above those made by Mr. Thomas John Taylor. Mr. Taylor's estimate is—

| | Tons. |
|---|---|
| For household purposes, about | 19,000,000 |
| For iron works | 13,000,000 |
| For steam, gas, and coking coal | 9,000,000 |
| Export | 4,000,000 |
| | 45,000,000 |
| Scotland has been estimated as producing ... | 7,000,000 |
| | 52,000,000 |

Mr. Young Hall's estimate is as follows:—

| | |
|---|---|
| Northumberland and Durham | 13,300,000 |
| Cumberland | 1,000,000 |
| Lancashire and North Wales | 10,000,000 |
| Staffordshire, Shropshire, and Worcestershire | 8,000,000 |
| Yorkshire, Derbyshire, Nottinghamshire, Leicestershire, and Warwickshire | 7,000,000 |
| South Wales, Monmouthshire, Dean Forest, and Bristol Fields | 10,000,000 |
| Scotland | 7,250,000 |
| Total quantity of coal raised per annum | 56,550,000 |

Mr. Dickinson's estimate is:—

| | |
|---|---|
| Northumberland, Durham, and Cumberland. | 11,000,000 |
| Lancashire, Cheshire, and North Wales | 10,000,000 |
| Staffordshire, Shropshire, and Worcestershire | 8,000,000 |
| Yorkshire, Derbyshire, &c. | 7,500,000 |
| South Wales, Monmouthshire, Gloucestershire, &c. | 10,000,000 |
| Scotland | 7,500,000 |
| Total quantity of coal raised per annum... | 54,000,000 |

In producing this quantity of coal, we have about 233,650 workmen employed underground, and at least 50,000 on the surface.

Mr. Hall has been at considerable trouble to estimate the quantity of coal remaining in the Northumberland and Durham coal fields, and this he considers to be equal to 1,251,232,504 Newcastle chaldrons of 53 cwt. each.

By this estimate, at the present rate of demand, these coal-fields will be exhausted in 331 years.

I give Mr. Thomas Young Hall's estimate exactly as I find it, since I am not able to offer even an opinion on its correctness.

At the pit's mouth the value of the coal raised has been under-estimated as £9,000,000; it is certainly nearer £11,000,000; and at the place of consumption, £18,000,000; and £10,000,000 has been considered as the capital employed in the operation of mining our fossil fuel.

It is melancholy to find that, according to the very careful examination by Mr. Dickenson, 985 lives are annually lost in the collieries of this country.

The coal-fields of Ireland may be distinguished as the Leinster coal-field, which produces 120,000 tons per annum; the Tipperary coal-field, the produce of which has been estimated at 50,000 tons a year; the Munster coal-field, producing about the same quantity—but information on this is uncertain. These are anthracite coals.

Bituminous coal is worked in Tyrone, but the quantity is very small. The Connaught coal-field is more important, from which it appears 30,000,000 of tons may yet be raised. It has been estimated that the Mounterkenny part of this coal-field produces annually of

| | |
|---|---|
| House coal | 667,897 tons. |
| Slaty coal | 400,820 ,, |

The southern portion producing—

| | |
|---|---|
| House coal | 345,369 tons. |
| Slaty coal | 237,564 ,, |

Making a total of 1,622,150 tons.

In the Lough Allen district about 3,000 tons are annually raised. There are other districts in which, according to Sir Robert Kane, valuable deposits of anthracite and bituminous coal occur. These are, however, very inefficiently worked, and the quantity, which is small, produced, I am not enabled to ascertain.

The iron ores of Ireland possess many valuable properties in recommendation, but, like the mineral treasures of the Sister Island generally, they require further development. Of iron pyrites Wicklow furnishes annually nearly 100,000 tons, nearly the whole of which is sent to Liverpool, and employed in our sulphuric acid and soda manufactures.

The raw material of our several mineral industries may be approximatively estimated thus:—

| | |
|---|---|
| Coal at the pit's mouth | £11,000,000 |
| Iron | 10,000,000 |
| Copper | 1,500,000 |
| Lead | 1,000,000 |
| Tin. | 400,000 |
| Silver | 210,000 |
| Zinc | 10,000 |
| Salt and other minerals | 400,000 |
| | £24,520,000 |

In this estimate, it must be remembered, neither clays nor lime are included—and there is yet the valuable produce of our quarries to be considered. The raw materials, therefore, which may be grouped under the present head, represent, at least, an annual increase of our wealth to the extent of £30,000,000. Notwithstanding the vast interest which is staked on the development of our mineral treasures, and the far larger interest which is vested in rendering this available for purposes of use or ornament, there has not been, up to the present time, anything like a system of education especially directed to these great industries.

Experience has done nearly everything for those engaged, and science but little. The work of science should be to carefully observe and record all the conditions under which our metalliferous ores occur. Nature ever works by fixed rules, there is no uncertainty in her operations, and the vast speculation which is so injurious to legitimate mining, the child of ignorance or fraud, is the direct consequence of the want of that exact observation and system of record, which would sooner or later establish some constants by which mining industry might be guided. Again, in our coal mines, there is much to be effected to enable the proprietor to work to greater depths than he has yet reached, that he may meet the demand increasing with an increasing population. At present the annual consumption of coal in the metropolis is one ton a year for every man, woman, and child, and in our manufacturing districts this is raised to three tons for each head.

Again, humanity demands that no effort should be spared to lessen the frightful loss of life which the operations of coal-mining produces. That nearly 1,000 men should be annually sacrificed by causes within the limits of remedy, for the purpose of giving us domestic fires and of feeding our manufacturing furnaces, is a sad reflection upon a community proud of its high estate, and anxious to maintain its position in the front ranks of civilisation, and in the great labours of Christianity.

## DISCUSSION.

Professor Tennant would offer a few remarks upon the very interesting paper which they had heard read, as it was upon a subject in which he felt deeply interested, and he had recently been through the statistical part of it for the purpose of giving a lecture in St. Martin's Hall, on the occasion of the Educational Exhibition, which was reported in the *Journal of the Society*, No. 92, Vol. II., p. 680. On that occasion his object was to collect, as it were, the statistics, for the purpose of bringing together the different mineral products of the country, and he had

embraced in those statistics some productions which were not alluded to in the paper now before them, such as granite, limestone, and a number of others, of interest to this as a commercial country. He held in his hand a most valuable report, published by the government, bearing date 1839,* and he hoped Mr. Hunt, as he had ample means, would, by the aid of Government, be enabled to bring up the statistics of those minerals to the present time. He was confident that a great many varieties of limestone were lying dormant, which might be brought into practical use, of superior quality to those now used; and that with the present facilities of transport they might be employed for many purposes, beyond those to which they were at present applied and at a lower cost, whilst at the same time limestone was a material that was highly remunerative to the producer. He could mention an instance in which he had been called upon to give an opinion some little time ago, in which a landed proprietor, having sold only the surface soil for the purpose of constructing a portion of a railway, came upon a bed of limestone, which produced him a much larger amount of income than the rent of the whole property yielded. A railway had been brought into the vicinity, and they carried away the limestone, which was used for a variety of purposes, producing, as he had said, more income than the rent of the surface soil of the whole property. He would say a word or two with regard to limestone for building purposes. This was a most important subject, and one that might be carried to a considerable length. The report to which he had alluded, and which he was in some means instrumental in getting up, was brought forward at the instance of a petition to the House of Commons presented by Mr. Wise, member for Waterford, at the time when, the Houses of Parliament having being burnt down, it was thought a favourable opportunity for introducing a notice of British materials for building purposes. The report in question was laid before Lord John Russell, from whom it received a very favourable consideration, and who endeavoured to carry its suggestions into practice, and by means of the railways so extensively introduced throughout the country, they were enabled to bring up the material at a much lower cost than was formerly the case. Sand is not mentioned; this is used in the manufacture of glass; flints, used for macadamising the roads; slates, which were used very extensively, and gave employment to thousands of people in Bangor and other places. Sulphate of lime was another production of importance, being used in the manufacture of Plaster of Paris, in scagliola, and other things. There were some very interesting old monuments of this material in the Temple Church, in the Church of the Savoy in the Strand, also in Westminster Abbey, and more particularly in the churches in the Midland counties; and this material was now being used for a variety of manufacturing purposes. As a further illustration of the purposes to which it was applied, he need only refer to St. George's Hall in Liverpool, in which this material had been used very largely. Serpentine was another material to which he might refer. This was capable of being produced in very large quantities, not only in Cornwall, but also in Galway, where there was an inexhaustible supply of it, and of a quality superior to that of Cornwall, that from Galway being of a more compact consistency, and containing a less quantity of iron pyrites, steatite, and asbestos. Plumbago was another mineral production of considerable value. It had been reported in certain papers that ores of mercury had been found, but he had never seen any specimen of that production, and therefore perhaps it was only a report which sometimes got into papers, and it was necessary in discussions of this kind that such matters should be referred to, with a view, if possible, of correcting any erroneous impressions which might prevail upon the subject. Bismuth had been referred to in the public papers as having been found in Wales, but in two of the cases mentioned the substance proved to be magnetic iron pyrites, not bismuth. This brought him to that portion of the paper which referred to the lack of proper education amongst the mining community of this country, which was indispensable if they wished to work mines economically. He lamented the want of even an elementary knowledge of mineralogy and chemistry amongst those classes. Numerous attempts had been made, and were still being made, in this direction, and he hoped before long they would be crowned with success. If they compared the general knowledge of the working miner of the British islands with that of the working miner of Saxony, the superiority of the latter in that respect was abundantly proved. He would give them an instance of this. He went down a mine in Friburg, and he showed to a working miner there a specimen about which he (the professor) had some doubts, because he had not his blow-pipe with him at the time; the miner in question, having himself some doubts, pulled out his blow-pipe, and in 3 minutes he tested what the metal was with the greatest accuracy. He afterwards went into the Cornish district, and was introduced to a mining captain; he showed the captain two specimens of metal, and asked him what they were; he replied, mundic. These specimens were both different, one being iron-pyrites and the other arsenical-pyrites; but the captain had no means of proving what they were; had he, however, been acquainted with the use of the blow-pipe, a very simple instrument, which could be bought for a shilling, and the use of which could be taught in about a dozen lessons, he could have told, from the arsenical vapours that would be given off from a fragment not bigger than a pin's head, what the substance was. He might mention another instance of the same kind with regard to another substance referred to by Mr. Hunt, namely, tungsten. He had met with intelligent miners who could not tell the difference between tungsten and oxide of tin. This was easily distinguished by merely scratching the substances with the point of a penknife,—the tungsten would have a brown streak, whilst the oxide of tin was distinguishable by a pale grey streak. A number of other instances might be referred to, shewing a like ignorance of mere elementary matters connected with this branch of British industry. Thus, with regard to the ore of mercury, which was reported to have been found, a blow-pipe would have told in a minute whether such was the case or not. What was wanted in the mining districts was instruction in the first principles of mineralogy, and he hoped that the time was not far distant when every working miner would at least be acquainted with the use of the blow-pipe. The furnace cost less than a shilling, and the trouble was not considerable, and the miner might be made acquainted with it in the course of a month. Therefore, the difficulty was not great, but the prejudice, he was sorry to say was, but he looked to education speedily to overcome those prejudices.

Mr. Hunt begged to make one inquiry of Professor Tennant, which was induced by the observations of that gentleman relative to the alleged discovery of ore of mercury. When he (Mr. Hunt) was in Manchester, a week since, he was told that carbonate of copper had been obtained from Chat Moss, and it was stated that a large deposit of that ore had been discovered in that locality several feet in thickness. A specimen had been exhibited at the Royal Institution, in Manchester. He wished to ask Professor Tennant whether any such fact had come to his knowledge.

Professor Tennant said it was quite new to him. He apprehended the substance alluded to was a green or blue marl, and would probably turn out to be earthy phosphate of iron. He was constantly in the habit of receiving letters from parties inclosing small specimens, with the

* "Report of the Commissioners appointed to visit the quarries, and to inquire into the qualities of the stone to be used in building the new Houses of Parliament, August 27, 1839." Price 6d.

inquiry, "Is this gold?" or "Is this silver?" and in some instances, "Are these diamonds?" This was a matter of great importance to us as a commercial community. Our population became scattered over all parts of the earth, and settled, through the tide of emigration, in every latitude and longitude, and yet what did they know of their British colonies? Had it been reported ten years ago that in the next ten years £25,000,000 of gold would be obtained in Australia, the party would have been looked upon as a madman. If he asked what was known of the Cape—it was nothing; and it was the same with Canada; and, if they went through the entire British colonies they knew little or nothing as to their mineral resources. In Australia they had been throwing away oxide of tin, which was found there to a considerable extent.

Mr. P. L. Simmonds, being called upon by the Chairman to offer some remarks upon the mineral productions of our Colonies, in responding to the appeal, said, he was sure all present would feel the same satisfaction that he had done in listening to the very valuable details which had been read by Mr. Hunt on a subject upon which we had been hitherto lamentably deficient of accurate details, and had been obliged to grope our way in the dark, relying only upon vague and conflicting estimates of the value of any and each of our mineral products. Any one, therefore, entering this important field, possessed of the governmental advantages, scientific information, practical experience, and facilities of arrangement which Mr. Hunt had, and who placed so promptly and so readily the information he acquired before the scientific world, must do the State good service. It was only those who, like himself, were largely identified with the Press, and had frequent occasion in the course of editorial comment, and a comparison of our tradal progress, to require ready reference to facts and figures, who could fully appreciate the value of ample and recent statistics. Of reliable returns regarding our metallic products and mineral industries, those great sinews of our manufacturing wealth, we had been far behind many other countries, such as France, Belgium, and the United States, where details on these subjects were most promptly and fully collected and distributed. There had, he knew, been a desire among our iron-masters, owners of collieries, and others, (which he was glad to hear, from Mr. Hunt's remarks, was fast dying out,) to withhold the statistics and details of their trade, from a mistaken notion that they might possibly furnish Government with data as to their production, which would be turned against themselves for future taxation. There was also a jealousy existing lest others might become as wise and as well-informed as themselves in certain processes, and learn the particular value of various mineral products. Mr. Hunt had shown that the extension of the area of our copper supplies had not been attended with any loss to the copper-miners of the West of England; for, on the contrary, as larger supplies had come in from abroad, the quality had been improved by the mixture of the ores, and the price correspondingly enhanced. Our mineral producers and miners might learn a lesson from other trades which feared to encounter competition. The shipping interest fancied the repeal of the Navigation-laws would be attended with disastrous results to their interests; but, although the foreign tonnage now employed in our trade and ports had increased in a triple ratio to that of our own vessels, every British ship had, nevertheless, been kept fully and profitably employed at very remunerative freights. So the agricultural interest was to have been annihilated by the policy of Free trade. But what had been the result? A greater demand and better prices for agricultural produce never prevailed than within the last few years, when our ports had been thrown open to immense supplies of grain and provisions from all the markets of the world. Mr. Hunt had confined his investigations, and, perhaps, properly so, to the mineral industries of Great Britain, and although, as he had told us, there was no fear of exhausting our subterranean supplies of fossil fuel and minerals at home for several centuries to come, it was satisfactory to know that there were other quarters of our own territories to which we might hereafter turn with confidence to meet the demand that would arise. The British empire was not confined within the narrow limits of the coasts and channels which circumscribed this island. In the words of the poet—

> "Far as the breeze can bear the billows' foam,
> Survey our empire, and behold our home."

We possessed in various quarters of the globe, some fifty colonies, all more or less rich in those subterranean treasures which had formed the subject of inquiry that evening, and wanting but skill, capital, and labour, to develope them to their fullest extent. The living tide of emigration which flowed towards those settlements, at the average rate of 1,000 souls per day, conveyed with it those necessary elements of development, and an occasionally extraordinary impetus was given both to emigration and to mining development in certain quarters. The Great Architect of the Universe, who, in His omniscient wisdom stored up for discovery and for use, at the proper time, those essential aids to settlement, to civilisation, to the extension of the human race over the face of the globe, and to their rapid advancement, by the aid of the metals, in all the arts and refinements which could encourage labour, increase comfort, shorten space, and extend the diffusion of knowledge, would seem, when the flow of the living tide grew sluggish—when a stimulus was required to sever the numerous links of old affections, relationship, and ties of country which cling around the human heart—to hold out, as it were, extraordinary inducements to tempt populations across the ocean, to induce them to face the dangers and privations incident to long voyages and early Colonisation. Hence, therefore, the gold discoveries had led to the peopling of countries to which no other inducement would possibly have drawn population in the same ratio, and States like California and Australia had risen into importance with a fairy-like celerity. Professor Tennant had incidentally alluded to the mineral productions of our colonies, and, if time permitted, he (Mr. Simmonds) would take a superficial glance at the progress they had already made, and the capabilities they possess for the future, for mining industry. Many present would, probably, be surprised at the extent and importance of this wide field. The very transport of crude ores to our shores last year gave employment to upwards of 200,000 tons of shipping, besides the large tonnage intercolonially employed. But the development of mining industry was fraught with numberless collateral advantages to the colonies themselves, to the parent State, and to the world at large. The extraordinary mineral productions of South Australia, had fixed attention upon that province, and by drawing thither British labour and British capital, raised it from a former state of bankruptcy to a thriving colony, with a revenue increased within four years cent. per cent. Although its metallic industries suffered recently to a considerable extent by the abstraction of labour from the lead and copper mines to the gold fields of Victoria, its continuous progress and prosperity were now assured facts. And, as a consequence of these discoveries, we found railways coming into operation, and the interior of the country opened up by steamers on that fine, but heretofore neglected river, the Murray, and its tributaries, navigable to the borders of New South Wales and Victoria. One interest, therefore, as Mr. Hunt justly observed, reacted upon another; for when population congregated around the mines, the agricultural and pastoral interests were likewise advanced, the means of transport were facilitated, shipping was attracted thither for cargoes, and interchange of commodities kept up, thus giving profitable employment to hundreds in the mother country. The copper and lead mines of South Australia appeared to be inexhaustible, and the periodical dividends of the Burra Burra Mine were a

valuable income to the fortunate holders. Spread over the whole of the Australasian group were metals and minerals of immense value. The coal of Van Diemen's Land, New Zealand, and New South Wales became of inestimable importance in a country where the supply of timber, as in the latter colony, was very limited; and now that the inter-colonial steam marine, which linked the several ports into one continuous chain, was so extensive, it might be that in after years, from this future Empire of the South, would emanate metallic productions as valuable, manufactures as extensive, trade as important,—carried on with the dense populations of China, Japan, the Eastern Archipelago, and the Pacific—nay, that would probably far exceed, what had been already developed in Great Britain. The gold fields of Victoria and New South Wales might be exhausted or rendered less productive by many causes, but the rich copper mines in South Australia, the iron and coal mines of New South Wales, would ever afford an independence to the hard-working operative. And as skill, education, and intelligence were brought to bear on the mining interests, other important discoveries, of tin, of slates, of granite, of limestone, and magnesian marble would be made. In New Zealand, coal, iron, and sulphur had been found; specimens of copper, of iron, of lead, and of silver had been met with in Van Diemen's Land, and the island possessed also several coal fields. If sufficient public spirit could be aroused to urge forward the development of those sources of wealth and national prosperity now entombed, he believed the generality of our colonies would not only rival, but probably surpass the mother country in the production of valuable metals and ores. In Labuan we had a valuable coal field, highly important to the interest of commerce and steam navigation in the Eastern Seas. The tin-mines of Malacca had been already alluded to by Mr. Hunt; but in our Eastern Empire scarcely any progress had been yet made in mining. By the completion of the first section of the East Indian Railway of 120 miles, from Calcutta to Burdwan, the valuable collieries of the Bengal Presidency had been brought within reach of cheap transport; and, as the various projected railways there were carried out, the geological formation of the country and its mineral treasures would become more fully known. Another instance of the mysterious workings of Providence in peopling districts and furthering the interests of civilization, was afforded by the recent large discoveries of copper in Namaqualand, in Southern Africa. Whilst Britain had become indifferent to the progress of settlement in the Cape colony,—while difficulties and troubles had been created by mismanagement on the frontier, and collision with the native tribes, and we were drawing in our lines of circumvallation and abandoning valuable British territories to the Dutch Boers, attention became suddenly and forcibly directed to valuable lodes of copper on the extreme north-western borders of the Cape Colony; and, although the distance from Cape-town was many hundreds of miles, a desert intervened, and the difficulty of transporting machinery and supplies over some forty miles of country, without roads, from the sea, were immense; yet within a year a large European population had located itself there,—a considerable quantity of ore had been obtained,—a great deal of local capital and energy thrown into the field,—and commerce and civilization obtained a permanent foot-hold in what appeared one of the least promising quarters of Africa. As a consequence of these mining discoveries, extensive exploration had taken place,—the localities in the neighbourhood had been thoroughly surveyed,—the vast Orange River examined as to its capabilities of navigation, and as a means of communicating across the Continent to the Orange River Free State and Natal, and a steamer built here for merchants in the Cape had just been sent out for this river by his friend Capt. Messum. But we had another most extensive and comparatively undeveloped field of mineral production in our extensive North American territories. There was in British America a coal area twice as large as that of Great Britain, and the coal-mines of Nova Scotia were of a most profitable character to the General Mining Association, and could scarcely keep pace with the demand from the United States. Gypsum and grindstones were also large articles of export from the Lower British Provinces to America, and many thousands of tons of these were shipped annually. Iron ores abounded in Nova Scotia and Canada, which would hereafter doubtless be turned to very profitable account. He was only reading that very day a long and interesting list of the economic minerals collected in Canada by Mr. Logan, the provincial geologist, for transmission to the Paris Exhibition, and that list comprised magnetic, specular, and titaniferous iron ore; zinc, lead, and nickel; copper-pyrites, phosphate of lime, gypsum, shell-marl, and other mineral manures; slates, granite, lime-stone, sand-stone, and beautiful magnesian marbles; materials for pottery, glass, &c., besides various other products interesting to commerce. The copper-mines of Lake Superior, both on the American and Canadian shores, were now being prosecuted with energy, and the nature of the returns to the mining interests might be judged of from the fact, that huge masses, weighing from 6,000 to 7,000 lbs. of pure copper, were frequently obtained. The United States used about 9,000 tons of copper annually, of which not one-fourth was produced in their own territories, but they were dependent on British enterprise for the bulk of their supplies. In the far North-West we had extensive deposits of valuable coal, in Vancouver's Island, available for future use, and for the supply of the important State of California. As a result of this rough survey of our mineral treasures in the out-lying provinces of the British empire, we might perceive that there was no fear of any deficiency of supply, although the distance would offer some little obstacle. But as Mr. Hunt had shown us, it was possible to carry the manufacture, the skill, and the capital to the field of operation, and to raise up elements of prosperity where the raw material thus abounded. It was a proud reflection to think that, although the two great European powers, France and England, were now unfortunately engaged in war with a power which contributed creditable specimens of its metallic industries to the Great Exhibition of 1851, each State was still pursuing, with undiminished zeal and energy, the no less useful arts of peace. We were discussing now, calmly and deliberately, our mineral resources and metallic industries, and our ally was on the eve of opening its Great National Exposition, for the display of competitive skill from all quarters of the globe. Our merchant princes and producers had vied in transmitting thither specimens of their various industries—but the Demidoffs, and other merchant princes of Russia, could no longer enter the lists, being too deeply engaged in the arduous struggle which, for the interests of humanity, and the general progress of nations, it was fervently to be hoped might soon be brought to a satisfactory termination.

Mr. Hyde Clarke observed that periodical reports on the mining resources of the country were of great importance, because they not only showed the condition of existing interests, their progress or decline, but because they were calculated to point out new branches of enterprise, or to develope those now inconsiderable. In a time of war like this, or as it might in another sense, be termed, a period of commercial disturbance, this was the more particularly desirable, because some sources of supply or some channels of consumption being cut off, new materials, calculated to serve as substitutes, might be put forward under more favourable circumstances. The results accruing from the establishment of new branches of enterprise and new discoveries had been well shown by Mr. Hunt, in the case of silver. He would remark that the imported ores to which Mr. Hunt had alluded were antimonial silver ores and argentiferous copper ores, and although he had little practical acquaintance with English

copper ores, yet he was aware they contained silver; and looking to the prevalence of silver copper ores in Germany and other districts with which he was acquainted, he thought it very desirable that the copper ores of England should be examined with regard to silver, as they might prove a source of supply, adding largely to the 700,000 oz. of silver recorded by Mr. Hunt as produced in 1853. With regard to zinc white, although its use might be small here, so far as he was aware the consumption in the United States was large and increasing, and thus it became desirable to know the comparative progress of each branch of enterprise, to find a suitable market, for though in one country, or under one state of circumstances, we might fail, yet, profiting by that communion and connexion of commercial interests to which his friend Mr. Simmonds had alluded, a practicable means might be found elsewhere of successfully conducting the operations.

Mr. Murchison said, after the very able manner in which Mr. Hunt had brought the paper before the Society, he thought it would require very few observations from him to recommend that a vote of thanks be passed to that gentleman; and in so doing he would take that opportunity of expressing his concurrence, in a great measure, in the remarks of Professor Tennant, as to the great want of education that existed amongst the mining population of this country. He believed that nothing was a greater drawback to the progress of the mining interests of the country than this want of education. Professor Tennant had very properly remarked that in the districts of Cornwall there was a substance which was taken for mundic; and, although he agreed with the professor as to the vagueness of the application of the term itself, he could not agree as to the vagueness of the miner's knowledge as to the nature of it. He believed the substance which the Cornish miners took for mundic contained, in some cases, a considerable portion of arsenic, whilst in other cases it contained a considerable portion of iron; in fact, it might be said in all cases to contain a considerable portion of iron, and might be termed iron pyrites. But the instance of the mundic mentioned by Professor Tennant afforded a most striking example of the want of that description of education which was suited to the calling of persons engaged in mining operations. It was scarcely 100 years since copper ores were considered to be of any commercial value, and it was not till the year 1720 that any considerable quantity of it was raised from the mines of this country. He believed it would be found that the substance raised in Cornwall under the name of mundic contained many substances of commercial value. It contained a large per centage of sulphur, and, in some cases of arsenic, and in other cases, of silver, and there were cases in which each of these substances were found sufficiently abundant to render them of commercial value, although, as Professor Tennant had observed, the mundic was thrown aside as being of no value. It was scarcely 100 years since copper was thrown aside as valueless—tin was the only metal considered to be of commercial value; and, therefore, although the paper was not brought before them in what might be termed a technical shape, although the subject was not treated in a geological sense — they could scarcely overrate the importance of the paper now brought before them. It was with the greatest pleasure that he proposed a cordial vote of thanks to Mr. Hunt.

Prof. Tennant begged to second the motion, because it would give him an opportunity of adding a word or two of explanation. He admitted that mundic might be an extreme case, but there would be no difficulty in finding other cases of a similar description. The iron pyrites consisted of 46 parts of iron, and 54 of sulphur. They had simply to draw off the sulphur, and they had a metallic bead left behind, strongly magnetic; and in the other case of arsenical iron pyrites, which consisted of iron 36, arsenic 42, sulphur 21, a sulphuric vapour was given off, and the arsenic was perceptible from the garlic-like odour which was given off, thus indicating the presence of arsenic. These two substances had a similar appearance, but they were easily distinguishable by means of the blow-pipe, independently of the crystalline form. With respect to the silver ores referred to, any person who wished to read an interesting account of the discoveries of silver would find it in Darwin's "Journal of Natural History and Geology." That gentleman, who had travelled extensively in South America, gave a lamentable account of some of the British mining companies there. He gave an account of the cost of machinery, which was allowed to remain doing nothing, as they had no coal or other fuel with which to work it, and consequently very large sums of money had been spent in the purchase of machinery and sending out persons to find out the silver mines, whilst at the same time they had been formerly actually mending the roads of the country with silver ores.

Mr. Billings, after alluding to the variety of topics which had been introduced to the meeting, said, that the question of working granite and hard stone generally was likely to meet with a solution by the induration of soft sand stones, and upon these interesting experiments were in progress at Tonbridge. Sir Roderick Murchison's opinion was strong as to the success of the scheme, and he described the process as almost instantly changing the softest stone into an imperishable rock. The carver had all the advantage of soft stone in his work, and when finished it was easily rendered almost indestructible. It was a matter of grievous import to know that, as an educated people, our working classes were not upon an equality with those of the continent; but the fact was our children were set to hard manual labour the moment their tender hands could clutch a working tool, and they were compelled to work for the mere purpose of relieving the charge upon the parent. Thus we saw, at every step we took, distorted limbs and twisted bodies, instead of men walking erect, as intended by the Creator, and thus it was our labouring classes were uneducated. A simple law, compelling education up to a certain period of life, and prohibiting labour until the limbs were in some degree completed, would leave us a different race in a very short period. The remarks of Professor Hunt touching the black band formation in Scotland, appeared to Mr. Billings as exaggerated, for his belief was, that it formed a very small portion indeed of the iron working of that country, and no speculations, he thought, had been more disastrous than those which arose out of the purchase of estates for the supposed inexhaustible supply of black band ore. The melancholy loss of life connected with coal mines, in the same way as all other accidents connected with works of various kinds, were mainly owing to the carelessness of life and limb on the part of the workmen themselves; and if we took the statistics of railway accidents, at least three-fourths of them resulted from causes within the care and control of the sufferers. The masters were in all cases deeply interested in the safety of their men, the result of accident always touching their property, and it wanted only more care on the part of the workmen to induce greater precautions from the employers. Professor Hunt stated the coal value at the pit mouth to be eleven millions of pounds annually, and the quantity he estimated at sixty millions of tons, making but little more than 3s. 6d. per ton. Mr. Billings considered that twenty two millions of pounds would be much nearer and even under the mark, but if Mr. Hunt's estimate were correct, it would form a most interesting inquiry as to the progressively increasing value until the arrival in our London cellars, where, if the whole supply could come, it would amount to fully ninety millions of pounds.

Mr. George Darlington would offer one or two remarks upon the reduction of zinc. At present that operation was in a very crude state in England. They were reducing zinc in Swansea, by the English process, by a consumption of 25 tons of coals to produce one ton of spelter; whilst in Belgium the same amount was produced by the

consumption of about 7 tons of coals, and in some works in North Wales 6 tons of coals sufficed to produce a ton of spelter. He, therefore, thought they would do well to abandon the English process altogether, and adopt some plan analogous to that pursued in Belgium, by means of which an article of great commercial value might be brought into the market at a much less cost. Attempts had been made towards producing zinc by blast furnaces, and he thought that was a step in the right direction, and he had no doubt it might be made successful were it not that the gases of the furnace carried off a considerable portion of zinc with them—an evil which scientific research might be enabled to remedy. He hoped to see zinc reduced very much in price, inasmuch as it was an article that was capable of being manufactured into a variety of exceedingly useful forms.

The CHAIRMAN, in putting the vote of thanks to the meeting, asked for their indulgence to his bias as an official reformer, when he directed their attention to an administrative aspect presented by the reading of the paper they had heard that night by the Keeper of Mining Records. He (the Chairman) held that all Government departments should report publicly their progress and service, as a part of the accounts for their expenditure. Their officers should be encouraged to go out beyond their official precincts, and give information on points which might be interesting to science, or to the public at large, or to those immediately affected by their administration. The instance of the paper read on the previous night, by Mr. Mackworth, a Government Inspector of Mines, might be coupled with that of that night as partaking of the improvement desirable, giving points of scientific interest; indicating directions for improvements in practical art; and communicating business information to persons engaged in vast branches of industry. Where, from the nature of the subject-matter, it might be done, as in these instances, it would be of additional advantage to subject the accounts of official observation and progress to public examination, cross-examination, and discussion. It was to be hoped that those officers, as well as others engaged in departments having concern with the arts, would be allowed and encouraged from time to time to submit for discussion to the Society, whatsoever matters of progress, or of public obstructions to progress, occurred within their experience and observation. The official reserve, or the so-called dignity, which discouraged or shrunk from such discussion, was commonly a mere cloak to indifference, or ignorance, or imbecility. From ignorance of the great industrial interests involved in the institution of the School of Mines, so ably achieved and presided over by Sir Henry De la Beche, that very institution had been singled out in Parliament, and the low expense of conducting it denounced as an extravagance. Now, it was an under-estimate to state the value of the rude mining produce, unformed and unfashioned, at the pit's mouth, at twenty-six millions sterling. The losses provable from known payments upon shares, for concerns which failed from the ignorance which the survey and information collected by the School of Mines would correct—information beyond the power of private individuals to collect—exceeded, on the average, one million per annum. The whole expenses of the School of Mines—£14,000 per annum—were a trifling per centage on the products of the industry which it would serve to guide, or within one and a quarter per cent. on the present losses, which it would serve to prevent. The department had set an example which it was to be hoped would be followed over the whole field of the public service. Competitive examinations had been instituted for certificates of competency for the public service in the department. Although the public engagements to which those competitive examinations were intended to lead commenced at what for the public service was deemed very high rates, namely, £150 per annum, yet, so highly were the qualifications thus attained valued in the private labour market, that during the last year not one successful competitor could be obtained for the public service—they all at once obtained higher private emoluments. However inconvenient it might be for the department, the test afforded by this fact was decisive as to the value of the information which it imparted. It would be clearly worth while, as means to large economy of money, as well as life, to pay more for a larger staff and a stronger body of mining inspectors. Mr. Hunt had said that mining had hitherto been guided, not by science, but by experience. That which he described as experience was a rude groping in the dark, by rule of thumb methods, as contradistinguished from enlarged observation and comprehensive experience, constituting practical science. If, however, by processes admitted on all sides during the discussion to be so rude and imperfect, what might not be expected from a more instructed conduct of mining operations? That had been answered in part by the facts stated by Mr. Mackworth, as to the greater productiveness of the better instructed mining operations in France and Belgium. The most important points evolved during that night's discussion, appeared to him (the Chairman) to be the contrast afforded by Mr. Tennant, of the educated mining labour in Saxony, to that labour in the country which, as stated by Mr. Hunt, made hedgerows of valuable ores, and threw away some of the best products. The Prussian mining labour was of the same educated character, and was testified to be more productive in its results. It was more productive on the Continent, notwithstanding charges which here would be treated as unmitigated burthens, but which he (the Chairman) must contend were means to great economies, namely, responsibilities for not educating, or not employing educated agents and labourers. Education was placed at a disadvantage, when large employers, in such cases as mining operations, were enabled to throw upon others, as at present, some of the largest consequences of employing ignorance. About the time of the first Factory Commission, the Central Board were consulted by the Prussian government on the whole subject of the employments in mines as well as in manufactories, and they advised the adoption of the principle of imposing all the consequences as insurance charges upon the branch of industry. Though the principle was not adopted here, it was adopted in Prussia, and he referred to the following terms of the Prussian code in which it was applied:—

"Art. 214. The proprietors of mines are bound to take care of the miners who are wounded, or fall into bad health, in their service.

"Art. 215. When the provincial laws do not contain any express provision thereon, the person who works the mine shall pay to the sick or wounded workman four weeks' wages, if the produce of the mine does not cover the expense of the working, or if it be only just equal to it, or if it be required to defray the antecedent expenses of the mine; and when the mine produces a sufficient dividend, the workman shall be paid eight weeks' wages in case the illness lasts that length of time.

"Art. 216. If the illness last a greater length of time, the miners shall be supported out of the sick fund.

"Art. 217. The expenses of medical treatment and of the burial of a miner, wounded or killed by accident, shall be defrayed from the same fund.

"Art. 218. The widow of a miner has also the righ to claim the gratuitous wages fixed by Article 15.

"Art. 219. The gratuitous wages granted to the miner, in case of wounds or death, are not allowed if the miner have killed or wounded himself with premeditation, or by gross neglect, or by working otherwise than in the mine.

"Art. 220. If the wound or death has been occasioned by malice, or the gross neglect of a third person, the latter shall indemnify the sick fund and the proprietors of the mine."

Let him ask them to revert to the consideration of the comparative results, as shown by Mr. Mackworth the other night in his short table, where he said, " he might state that, from published Government Returns, the mortality from accidents was, in the coal-mines of

| | Killed. | Persons. |
|---|---|---|
| Prussia . . . . | 1·89 per 1,000 per ann. | |
| Belgium . . . | 2·8 | do. |
| England . . . | 4·5 | do. |
| Staffordshire . . | 7·3 | do." |

In the country where the assurance charge and responsibilities were at the highest, the so-called accidents were at the lowest, or one-quarter those in England, whilst the money results and productiveness of the mines, as testified more directly, of France and Belgium, were better than in England. If, from the bad ventilation of the mines, there were an excess of sickness, the cost of that sickness fell not upon the parish or upon public rates, but upon the adventure, and the adventurers looked seriously to the practical means of prevention; if from ignorance on the part of the workmen Davy-lamps were misused, and destructive explosions were occasioned, the consequent loss of life, and orphanages, and widowhood, were charged upon the adventure, and there was no treating the ignorance of workpeople as an insuperable barrier to improvements, but the means of popular and practical education, and the selection of well-educated and trustworthy men were anxiously regarded as means of avoiding loss. In the mining and industrial statistics the whole cost should be given, including the cost of sickness, and premature mortality, and disability, which, he was convinced, would be found to be much greater than the public or the mining population themselves at present conceived. In the discussion, just complaint had been made of the deficiencies of the statistics on the subject. The Committee on Industrial Pathology were preparing to urge upon the Government the necessity of getting out the actual mortality, and the causes of mortality attributable to different occupations in different places. The deaths from violence amongst miners had been stated that night as upwards of 900; but according to Mr. Mackworth's return, of more than 4 per 1,000, they would exceed 1,200 per annum. Now he (the Chairman) had got out the numbers of the deaths in actual battle during the twenty-two years of the last war, and found that, exclusive of the wounded, they were 19,796, or 899 on an annual average. Thus, the whole deaths in battle, including the Peninsular campaign and Waterloo, and the whole of Nelson's battles, were exceeded by the violent deaths in the mines. But, from particular cases where he (the Chairman) had obtained returns, from Cornwall, Wales, and Cumberland, he found that one-fourth, or even one-third, was a proportion of violent deaths to the total deaths. Of the great body of 300,000 persons engaged in working our mines, possessing high qualities for cultivation, it might be said, that if the present modes of working continued, the whole were doomed to premature disability and ten years loss of life by excessive sickness, and that fifty thousand of them,—a body equal to the British army in the Crimea,—were doomed to perish, not with the glory and excitement of the deaths readily met in battle, but obscurely by explosions and horrible mutilations in mines, receiving comparatively little active sympathy, three-fourths of which sickness and deaths were proved to be preventible by means already in established practice.

Mr. Hunt in returning thanks for the high compliment which had been paid him, said he hoped they were on the eve of a change in their system with regard to the mining interests of the country. He had found a strong determination in Newcastle to found a school of mines, in which instruction of a purely technical character would be imparted. He was happy to say that the subject had been warmly taken up by the University of Durham, and no doubt it would be very shortly carried out. A similar determination also existed in North and South Staffordshire, and it was proposed to have one school at Stoke-upon-Trent, and another at Wolverhampton, whilst in Cornwall it had been determined to establish a school of mines at Truro, the teachers to which had been already appointed. A similar movement, he was happy to add, was going on in Bristol and the districts of South Wales, where an itinerant instructor went from mine to mine and delivered lectures of a practical nature to such as chose to attend them. He felt that the subject had been brought before the Society in an imperfect state, but on some future occasion he hoped to lay before them more satisfactory data than he had been able to do in the present paper.

Mr. Murchison remarked that the Chairman had alluded to the system in Germany, of the formation of a fund amongst the mining population for relief to the sufferers in cases of accident. He was happy to say that the same plan was carried out in the Cornish mines. It was part of the system there that a certain per centage of the wages should be appropriated towards the formation of such a fund.

The Secretary announced that the Paper to be read at the next meeting, Wednesday, April 18th, was " Notes on the Revision of Architecture in connection with the useful Arts; with a sketch of the Ventilation at St. George's Hall, Liverpool," by Dr. D. B. Reid, F.R.S.E.

## INSTITUTE BOOK ORDERS.

March Account.

| | Full Price. £ s. d. | Red. Price £. s. d. |
|---|---|---|
| Barnsley, Mechanics' Institute | 13 5 5 | 10 5 11 |
| Brighton, Railway Literary and Scientific Institution ......... | 6 10 6 | 4 19 0 |
| Bristol, Athenæum ............... | 6 2 0 | 4 10 4 |
| Bromsgrove, Literary and Scientific Institution ............... | 13 7 4 | 10 12 10 |
| Bury (Lancashire), Athenæum | 2 18 6 | 2 5 8 |
| Colchester, Mechanics' Institution.............................. | 12 2 6 | 9 8 4 |
| East Retford, Literary and Scientific Institution............ | 1 12 1½ | 1 6 3 |
| Hants and Wilts, Educational Society ........................ | 7 16 6 | 6 5 4 |
| Hastings, Mechanics' Institution | 7 4 0 | 5 11 3 |
| Hereford, Permanent Library... | 5 3 0 | 3 19 7 |
| London, Bank of England Library and Literary Association ........................... | 11 11 0 | 8 13 4 |
| Macclesfield, Useful Knowledge Society ........................ | 9 17 6 | 7 15 10 |
| Odiham, Mechanics' Institution | 5 14 0 | 4 4 6 |
| Sevenoaks, Literary and Scientific Institution.................. | 1 2 11 | 0 19 0 |
| Stamford, Institution ............ | 0 19 4 | 0 16 2 |
| Tamworth, Library and Reading Room ....................... | 8 13 0 | 6 11 6 |
| Wells, Literary and Scientific Institution....................... | 5 0 8 | 3 17 0 |
| Whitehaven, Mechanics' Institution............................ | 16 0 0 | 12 10 3 |
| Woburn, Literary and Scientific Institution.................. | 9 15 0 | 7 13 1 |
| | £144 15 3½ | £112 5 2 |

Being a saving of £32 10s. 1½d., or about 23 per cent.

## Home Correspondence.

### STATISTICS OF THE IRON MANUFACTURE.

#### Letter III.

Sir,—I should not have requested the insertion of a third letter on the Statistics of the Iron Manufacture, if it had merely reference to a desire to bring the matter before the public; indeed, I should have thought such a course unnecessary after the subject had been noticed as it has been by Mr. Gladstone, in your *Journal* of the 16th instant, and I do hope that his remarks "may produce good fruit."

With regard to that gentleman's letter, he could not, in my opinion, have said anything more to the purpose with reference to the general arrangement of a plan for carrying such a measure into effect; and, surely, government, with Earl Granville and Mr. Jas. Wilson, M.P., connected with it—the former largely interested in the iron trade, and both aware of the advantages of correct information—may, if their attention be drawn to the subject, be induced to lend their powerful aid to give an impetus to the inquiry.

The object, however, of my present letter is to show the advantage with which some arrangement of statistics relating to the manufacture of iron, might have been introduced into Prof. Wilson's paper "On the Iron Industry of the United States." It was to me, at the time, a matter of great regret that I had not an opportunity of being present to hear that paper read. I had looked forward to it with much interest. I considered that Mr. Wilson had fortunately been placed in a position to convey, through the columns of your *Journal*—a channel equal, if not superior, to any other, as the medium of communication with the intelligent classes—a fund of valuable information relating to the cost of the manufacture of iron, in the raising and carriage of the raw materials, labour, and charges, so as to act as a guide to our manufacturers, and give a complete insight into the operations of our principal customer, and, as some imagine, our future rival—no one ever had so good an opportunity for collecting and making known this much required information. On reflection, I feel pleased that I was not present, as it gives me a better claim to express in writing my regret that, with the opportunities afforded to Mr. Wilson, his commission would appear to have been confined almost exclusively to the localities of the raw material, rather than, in addition thereto, to the cost of raising those materials, conveying them, and working them in the furnace.

Mr. Wilson's paper contains the following facts:—

The iron ores are found in most of the States, and comprise every variety known in Europe. The principal district of the present iron manufacture is Pennsylvania; the coal and ironstone are not here found together. "The ores and the fuel have to be sought for in different localities." "In general the wrought-iron works are carried on as a distinct business from the manufacture of pig-iron." "The principal cause of the separation of the two branches, is probably due to inadequacy of capital to carry on both." Mr. Wilson divides the principal districts into seven heads, giving the quantity of pig-iron made in each, and stating the cost to average from 15 to 25 dollars per ton. He says: "as long as the price of English iron prevents its importation into the Union under 20 dollars per ton for pigs, and under 50 dollars per ton for bar iron, the home manufacture can compete profitably with it in their markets, and the iron industry of the States will flourish and increase.

"The fluctuations in the make are very considerable; in 1840, the quantity made, according to the census, was 286,903 tons, or, by another statement, 347,700 tons; in 1842, 225,000 tons; 1846, 768,000 tons; 1847, 800,000 tons; 1849, 650,000 tons; 1850, by the census, 540,000 tons, or, according to a statement of the Statistical Committee of the Ironmasters' Convention, considerably less, the difference in Pennsylvania alone being 86,890 tons. In 1853-4 it is supposed a large increase took place." The present state of our iron market will probably, as in former instances, occasion a reduction in the make of the United States.

The information given by Professor Wilson is in itself most useful, and very interesting, but it affords little help as a guide to our manufacture.

Of Renton's process it is not necessary here to speak—somewhat similar experiments have been tried in this country, but the general nature of the materials, and the character of the trade, do not hold out much prospect of extensive operations—neither as to the exportation of iron ore, which must be a *far* hereafter, if, which does not appear at present probable, it should ever to any extent be attempted.

When Mr. Cambreleng, in 1830, proposed a modification of the tariff—the friends of the measure, and those opposed to it, prepared statements to support their views; amongst these returns I find some which give an idea of the information which might be made available. Thus, in Pennsylvania, the estimate of making bar iron from pigs was 75 dollars, including the value of the pigs, 26d. 67c.; iron ore to a ton of pigs, 2½ to 3 tons, at 5 dollars per ton; coal to a ton of pigs, 220 bushels, at 5 cents per bushel; and for making a ton of bars from pig iron, 175 bushels, at 6 cents per bushel.

Also with respect to the bearing of the manufacture on agriculture, "The following calculations are derived from the average returns submitted to the Committee from two counties, (those most engaged in the manufacture of iron in Pennsylvania), namely, Centre and Huntingdon, and have been carefully verified by a comparison with returns from 73 furnaces and 132 forges.

For each ton of bar iron and castings made, the following agricultural product is found to be consumed:—

| | | Cents. | Dols. |
|---|---|---|---|
| 25 bushels of wheat and rye, averaged at | | 75 | 15 |
| 57 pounds of pork | ,, | 5 | 2·85 |
| 43 ,, of beef | ,, | 4 | 1·72 |
| 10 ,, of butter | ,, | 12½ | 1·25 |
| 2 bushels of potatoes | ,, | 30 | 60 |
| Half-a-ton of hay | ,, | 7 dols. | 3·50 |
| For every ten tons of bar iron, one horse is employed one whole year, worth 100 dollars, and experience shows that the mortality among horses so employed is per annum one in seven, and constitutes a charge of per ton . . . . . . | | | 1·43 |
| For fruit and vegetables, of which no return has been made, we feel justified in putting down . . . | | | 1·00 |
| | | Total dollars | 27·35 |

Every five tons of iron, as above made, requires one able-bodied man throughout the year. The average wages of the workmen is fully one dollar per day, or say 300 dollars per annum, equal to 25 dollars per month.

The expence of transporting this iron to the different markets, by land and water, may be estimated at an average of ten dollars per ton.

The average wages of 1830 do not materially differ from the rate of wages as given in the Census of 1850:—

| | | |
|---|---|---|
| Average per man per month | on pig iron | 20·76 dols. |
| ,, | on castings | 27·38 ,, |
| ,, | on bar iron | 25·41 ,, |

Any reduction in the cost, therefore, at the present time, must arise from the greater facilities of procuring the raw materials, and economy in their use, assisted most materially by the hot blast, without which the anthracite—a somewhat doubtful fuel—would be almost useless in the furnace.

To give some idea how dependant the American

manufacture at present is on the fluctuations in our trade, as shown in the increase and decrease of their make, I add the following statement of the average price of pig iron at Glasgow, and bar iron at Liverpool, New York, and Pittsburg, for ten years—from 1843 to 1852 inclusive. I give it in dollars and cents:—

| | 1843. | 1844. | 1845. | 1846. | 1847. | 1848. | 1849. | 1850. | 1851. | 1852. |
|---|---|---|---|---|---|---|---|---|---|---|
| PIG IRON. | Dols. | Dols. | Dols. | Dols. | Dols. | Dols. | Dols. | Dols. | Dols. | Dols. |
| Glasgow ........................ | 10·89 | 17·16½ | 18·39 | 16·21½ | 15·73 | 10·72¾ | 11·03 | 10·72¾ | 9·68 | 11·05 |
| New York ........................ | 26·28 | 30·53 | 32·91 | 34·58 | 30·83 | 25·34¾ | 22·93½ | 21·07½ | 20·62½ | 22·48 |
| Pittsburg........................ | 22·00 | 28·00 | 28·30 | 27·90 | 29·90 | 27·60 | 24·20 | 23·20 | 23·00 | 31·60 |
| BAR IRON. | | | | | | | | | | |
| Liverpool........................ | 23·51 | 25·98 | 41·07 | 43·31 | 45·12 | 31·89 | 29·04 | 25·08 | 24·28 | 28·57 |
| New York ........................ | 57·00 | 62·00 | 67·75 | 77·50 | 73·75 | 60·00 | 47·50 | 43·50 | 36·00 | 39·75 |
| Pittsburg........................ | 59·00 | 60·00 | 60·00 | 59·00 | 59·00 | 59·00 | 53·50 | 53·00 | 45·00 | 51·00 |

In 1842 the duty on pig iron was fixed at 9 dollars per ton, and on bars at 25 dollars per ton. In 1846 the duty was altered to 30 per cent. *ad valorem* on pig and bar iron, in fact, on all descriptions. In the present year a Tariff Bill was introduced in the House of Representatives to reduce the duty to 24 per cent. *ad valorem*, but the iron-masters and agricultural interest uniting, threw it out in the Senate.

I will conclude this, I fear too long letter, with a statement of the exports of British iron and ironwares for the years 1852, 1853, and 1854, which, besides its bearing on the subject now under consideration, enables me to complete my paper, inserted in your *Journal* of the 15th Dec., to the latest period, which, at the time I read it I was unable to do for want of the official returns:—

EXPORTS OF BRITISH IRON, HARDWARE, CUTLERY, MACHINERY, AND MILL WORK.

| Quantity. | 1852 | 1853. | 1854. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Pig iron ............... | 240,491 | 333,585 | 293,074 |
| Bar, bolt, and rod ... | 567,692 | 653,902 | 616,898 |
| Other descriptions ... | 227,701 | 273,785 | 287,138 |
| Total tons ...... | 1,035,884 | 1,261,272 | 1,197,110 |

Declared value:—

| | £ | £ | £ |
|---|---|---|---|
| Pig iron ............... | 557,586 | 1,056,310 | 1,242,912 |
| Bar, bolt, and rod ... | 3,406,360 | 5,647,773 | 5,730,107 |
| Other descriptions ... | 2,720,330 | 4,141,339 | 4,695,023 |
| | 6,684,276 | 10,845,422 | 11,668,042 |
| Hardwares & cutlery | 2,691,697 | 3,665,051 | 3,869,313 |
| Machinery and mill work ............... | 1,251,360 | 1,985,536 | 1,932,963 |
| Total ............ | 10,627,333 | 16,496,009 | 17,470,318 |

EXPORTS OF BRITISH IRON, INCLUDING UNWROUGHT STEEL, TO THE UNITED STATES IN THE YEARS 1853 AND 1854.

| | 1853. | 1854. |
|---|---|---|
| Pig iron...............tons | 158,476 | 114,102 |
| Bar, bolt, and rod ... ,, | 411,301 | 340,245 |
| Other descriptions ,, | 84,754 | 85,849 |
| Total tons............ | 654,531 | 540,196 |

Yours faithfully,

HARRY SCRIVENOR.

Liverpool, 24th March, 1855.

## DECIMAL COINAGE.

19, Gloucester-terrace, Hyde-park, March 19, 1855.

SIR,—The following memorandum has no pretence whatever, in any part of it, to be original. It contains, I believe, *nothing* which is not to be found in the publications of the Decimal Coinage Association, or in the admirable papers of Professor De Morgan. The substitution of *numbers* for *names* was suggested, a considerable time ago, in a letter published by Mr. Good, master of the Dock-yard School at Milford Haven.

The only excuse which I have for sending this paper to you is, to exhibit the process which (after trying a good many others) presents the matter in the easiest form to my own mind, and is that by which I should adapt myself to the use of the new coinage, if at once called upon to do so. Every person, probably, will have to make some such system for himself. Some will do it in one way, some in another. The best way for *each person* will be that which is the most readily intelligible to *himself*. I submit this paper simply as the chart of the course which I have myself found the easiest, and which may perhaps help some one else in the same direction, who, like myself, is no very expert arithmetician, and who has no vocation to discuss alloys and exchanges.

I had intended to deliver the substance of the following paper at the discussion to which you did me the honour of inviting me on the 14th of February, but the number of far better authorities on the same subject, who wished to speak, prevented me from doing so.

I remain sir,

Your obedient servant,

R. R. W. LINGEN.

## DECIMAL COINAGE.

Suppose the desired act of Parliament passed, making the farthing the 1000th part of the pound sterling, ordering the coinage of a 10-farthing piece (cent), and the keeping of all public accounts in decimals, viz:—

Sovereigns,
Florins,
Cents, and
Mils (farthings).

In the first place, these *names* would never have to be used, except when it was actually required to mention the coins. For instance, "how will you have change for this pound?" Answer,

5 florins,
30 cents,
200 mils.

Under *all other* circumstances, the coins would be simple "counters," and, so long as there was one coin for each decimal stage, in order to mark each stage for public observation, it would not matter how many intermediate coins there might be, so long as they were always taken and spoken of as *counters*.

Thus, while the pure decimal system of *accounts* would be represented in *coinage* by the,

Sovereign,
Florin,
Cent,
Mil,

counting respectively as,

1000,
100,
10,
1,

it would not, in the least degree, confuse this scale, but

would simply be a practical supplement to it for purposes of exchange, to have coins in circulation *counting*—

500
250
125
50
25
5
4
2

or, in present *names*,

half-sovereign,
crown,
half crown,
shilling,
sixpence,
rimmed-penny,
light-penny,
half-penny.

The only difficulty would arise during the interval in which these intermediate coins continued to be thought of *by their old names*, which suggest the old non-decimal scale, *instead of by their value as counters in the decimal scale.*

Of course, in all new issues of coin, such of these coins as it might be found expedient to retain in use would be stamped with their value as *counters*, on the reverse side.

It is a point of great importance, for the popular comprehension, to bring the change before the country under the form of *counting up* units, instead of *dividing* wholes into parts. It is easier to understand that 10 florins make 1 pound, than that 1 florin is $\frac{1}{10}$th of 1 pound. *Fractions* are ideas not readily grasped, more especially when vulgar and decimal fractions have to be thought of together; but a number representing *so many units* is simple for every one. Each new coin, therefore, should have the Queen's head on one side, and on the other, *not a name only, nor a fraction at all*, but its numerical value as a counter; *e.g.*, the new coin answering to half-a-crown, if retained, should be stamped on the reverse, 125; and so on of the rest.

If the whole country were placarded with tables of this sort,* as London now is with cab fares, people would not long be at a loss to know what it meant when they saw a pair of boots ticketed 725, or tea at 200 per pound. The coins in their pockets would count up the sum, and certain *figures* would soon come to be as completely identified with the values most common in exchange, as other *names* now are with such values. For instance, 75 would stand for eighteenpence, and would very soon come to suggest the same value with equal familiarity, and with equal unconsciousness on the part of the speaker.

Mr. Hugo Reid would make the florin the highest unit of account, omitting the cent as a separate name. The latter point is not material, and the reason which suggests it holds good throughout, viz., to use our money as *counters* in a system of simple arithmetic.

Mr. Reid's reason for taking the florin as the highest unit of account rests on the fact that we lose ourselves in estimating the parts of 1000, but readily carry in our head those of 100. This is quite true, and there is no doubt that, under a decimal system of coinage

| | | |
|---|---|---|
| * SOVEREIGN | = | 1000 |
| Half-sovereign | | 500 |
| Crown | | 250 |
| Half-crown | | 125 |
| FLORIN | | 100 |
| Shilling | | 50 |
| Sixpence | | 25 |
| CENT | | 10 |
| †Rimmed Penny | | 5 |
| †Light Penny | | 4 |
| Halfpenny | | 2 |
| MIL or FARTHING | | 1 |

† One or other of these should be the measure of the fourpenny and threepenny pieces.

and accounts, our mental reference in the small payments of every-day life will be to the florin (or two shilling piece) = 100; wherein 75, 50, 25, will soon establish themselves as resting-places of familiar import. It will not long embarrass us to connect the value of two shillings with every figure in the hundred's place. As often as we see three figures the process we shall at first go through will be—

1. So many of 2s.
2. Such and such a proportion to 2s.

Thus 915 = 18s. and something under 6d.

These mental conversions will continue to be made only so long as it takes us to substitute a *double* shilling instead of a *single* one in our minds as a standard of value in measuring petty payments. As soon as the double shilling shall have rooted itself as the standard of such payments, and as soon as the parts of 100 shall also have become familiarly associated with common values, the stage of difficulty will be over.

No one would be embarrassed by the thousand's place, because he would at once detach it from the other three figures, as he now detaches the £ column from the *s.* and *d.* columns, and thinks of pounds by themselves.

The preponderance of argument for retaining the pound is not to be resisted.

The habitual use of numbers instead of names has this great advantage—that, supposing measures as well as coins and money accounts to be decimalised, we might get rid of the whole vocabulary of each separate table, since it would be enough to say 500 *sterling*, 500 *weight*, 500 *length*, 500 *surface*, 500 *liquid*, &c. *Time* is not equally an open question. Figures, *e.g.*, 500, standing alone, and without any qualifying addition, would continue to denote abstract number.

## Proceedings of Institutions.

BRIGHTON.—The half-yearly report of the committee of the Railway Literary and Scientific Institution, states that the library now contains 2,200 volumes, and duplicate copies of those works most read will shortly be put into circulation. Since the last report the number of members has increased 130, making the total number 464. The following classes are in operation :—Rea ing, writing. and arithmetic; mechanical drawing; French; and dancing. The receipts and expenditure each amounted to £153

### MEETINGS FOR THE ENSUING WEEK.

MON. Architects, 8. Mr. T. L. Donaldson, "On the Architectural Medals of Classic Antiquity, more particularly in reference to the Civil Edifices."
Chemical, 8.
Statistical, 8. Mr. J. W. Gilbart, F.R.S., "A Ten Years' Retrospect of London Banking."

TUES. Royal Inst. 3. Dr. Tyndall, "On Voltaic Electricity."
Civil Engineers, 8. Mr. B. Burleigh, "On the Construction of Railway Crossings and Switches."
Linnæan, 8.
Pathological, 8.

WED. London Inst., 7.
Society of Arts, 8. Dr. D. B. Reid, "Notes on the Revision of Architecture in connection with the Useful Arts. With a Sketch of the Ventilation at St. George's Hall, Liverpool."
Geological, 8. 1. Prof. Merian, "On the Cassian Beds, between the Keuper and the Lias, in the Vorarlberg." 2. Rev. W S. Symonds, "Fossils from the Keuper at Pendock, near the Malverns." 3. Capt. Garden, "On a Cretaceous Formation in Natal, South Africa. With a Notice of the Fossils, by Mr. W. H. Baily." 4. Dr. Sutherland, "On the Geology of Natal."
Royal Soc. Literature, 8½.

THURS. Royal Inst. 3. Mr. G. Scharf, jun., "On Christian Art."
Antiquaries, 8.
Royal, 8½.

FRI. Royal Inst., 8½. Mr. T. H. Huxley, "On Certain Zoological Arguments commonly adduced in favour of the Hypothesis of the Progressive Development of Animal Life in Time."

SAT. Asiatic, 2.
Royal Inst., 3. Dr. Du Bois Reymond, "On Electro-Physiology."
Medical, 8.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, April 5th*, 1855.]

*Dated 19th March*, 1855.

605. B. Cook. Chester-street, Kennington—Consuming smoke.
607. J. Rimmell, Covent-garden—Substitute for turpentine. (A communication.)
609. R. Howson, Lancaster—Screw-propeller.
611. J. Taylor, Southwark—Consuming smoke.
613. P. Roehrig, Paris—Alimentary substance.
615. J. Smalley, Wigan—Railway carriage axles.
617. A. R. Terry, 1, Adelphi-terrace—Copying letters.

*Dated 20th March*, 1855.

619. A. White, Great Missenden—Swinging-beds.
620. J. Musgrave, Bolton-le-Moors—Steam-engines.
621. W. Taylor, Poolstock, Wigan—Pickers for power looms.
622. T. M. Tell, and F. Squire, 74, King William-street—Weighing machine for detecting base coin.
623. T. Stevenson, Little Bolton—Gasing yarns.
625. C. Marsden, Kingsland-road—Tent poles.
624. Earl of Aldborough, Wicklow—Aerial navigation.
626. E. T. Bellhouse, Manchester, and D. Longsdon, Grafton-street, Fitzroy-square—Materials for coverings of buildings.
628. A. E. L. Bellford, 32, Essex-street, Strand—Governor. (A communication.)
629. I. Rogers, North Haverstraw, U.S.—Treating iron ores.
630. A. V. Newton, 66, Chancery-lane—Forming moulds for casting. (A communication )

*Dated 22nd March*, 1855.

631. W. Miller, North Leith—Prevention of smoke.
632. J. Morrison, Birmingham—Metallic pens.
633. T. C. F. Lecour, Paris—Locomotion on canals and rivers.
634. J. Biden, Gosport—Marine engines.
636. M. Semple, Plymouth—Railway breaks.
637. W. MacNaught, Rochdale—Spinning machinery.
638. C. Carnell, Philadelphia—Bricks.
639. J. S. Russell, Millwall—Ship building.

*Dated 23rd March*, 1855.

640. G. Whyatt, Openshaw—Machinery for cutting piled goods.
641. J. H. Johnson, 47, Lincoln's-inn-fields—Combing machinery. (A communication.)
642. J. H. Johnson, 47, Lincoln's-inn-fields—Hydraulic motive power engines. (A communication.)
643. H. J. Morton, Leeds—Gasometers.
644. C. F. Behn, Commercial Sale Rooms, City—Moulds for casting metal. (A communication.)
645. F. Ransome, Ipswich—Artificial stone.
646. W. Young, Queen-street, Cheapside—Fire-places.

*Dated 24th March*, 1855.

647. J. Willis, 75, Cheapside—Umbrella and parasol frames.
648. J. L. Bachelard, 3, Charles-terrace, Old Kent-road, and H. Harvey, 73, Denbigh-street, Pimlico—Animal manure.
649. U. Scott, Duke-street, Adelphi—Carriages.
650. R. J. Jesty, King's-cross—Indicating apparatus between railway carriages.
651. D. Elder, jun., Glasgow—Moulding metals.
652. J. Niven, Keir—Paper and textile materials.
653. T. F. E. Clewe, Paris—Locomotive engines, tenders and railway carriages.
654. Major-Gen. G. G. Lewis, C.B., Woolwich, and J. Gurney, St. James's-street—Knapsack, convertible into a bed, a litter, or a tent.
655. W. Brown, Gresham-street—Preparing sewing silk.
656. L. F. Edwards, New Bridge-street—Furnaces. (A communication.)

*Dated 26th March*, 1855.

658. R. S. North, Gorton, Manchester—Permanent way and sidings.
660. J. Gedge, 4, Wellington-street South, Strand—Machinery for forming curves. (A communication.)
662. C. A. Barrett, W. Exall, and C. J. Andrewes, Reading—Threshing machines.
664. J. H. Johnson, 47, Lincoln's-inn-fields—Flax-dressing machinery. (A communication.)
666. C. A. Busson, Paris—Feeding apparatus, applicable to machines for treating textile materials.
661. F. Crossley, M.P., Halifax—Mosaic rugs.
670. A. W. Williamson, University College, Gower-street—Fireplaces.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed April 3rd*, 1855.

2138. John Perry, Hunslet Old Mill, Leeds—Improvements in preparing wool for combing.
2157. Thomas Roberts and John Dale, Manchester—Improvements in obtaining and treating extracts from certain dye woods, and in apparatus for obtaining such extracts.
2165. Valentine William Hammerich, Altona, Holstein—An improved construction of buoyant mattress.
2190. Arthur Dobson, Belfast—Improvements in looms for weaving.
2197. John Coope Haddan, Chelsea—Improvements in the manufacture of cannon, and of projectiles for the same.
2214. Lionel John Wetherell, Compton street, Clerkenwell, and Augustus Johann Hoffstaedt, Albion-place—Improved construction of pump.
2204. Robert Walter Winfield, Birmingham—Improvements in tubes and rods used in the construction of articles of metallic furniture.
2243. Thomas Allan, Adelphi terrace—Improvements in applying electricity.
2246. William Joseph Smith, Stretford, Lancaster—Improvement in buttons.
2261. Charles Cowper, 20, Southampton-buildings, Chancery-lane—Improvements in preparing to be spun and in spinning silk waste.
2264. Isaac Adams, Massachussetts, U.S.—Improvements in machinery for printing.
2270. William Henderson, Cannon-street—Improvements in treating certain ores and alloys, and in obtaining products therefrom.
2285. Peter Armand le Compte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in bleaching, dyeing, and preparing hemp and flax to be spun. (A communication.)
2993. William Boutland Wilkinson, Newcastle-on-Tyne—Improvements in the construction of fire-proof dwellings, warehouses, and other buildings, or parts of the same.
2299. Charles Blake, St. Leonard's—A method of preventing or lessening the injurious effects arising from collisions at sea and on other navigable waters.
2305. John Coope Haddan, Chelsea—Improvements in projectiles and in machinery for manufacturing the same.
2401. Antoine Edouard Brisbart Gobert, Montmirail (Marne)—A new kind of stamping press.
2550. Edward Hammond Bentall, Heybridge, Essex—An improved construction of locomotive steam-engine.
2573. John Collis Browne, Weston-super-Mare—Improved wrapper, applicable as a coat and other covering.
263. Godfrey Pattison, Glasgow—Improvements in machinery for dressing and finishing woven goods or fabrics.

*Sealed April 5th*, 1855.

2170. Henry Crosley, Camberwell-grove—Improvements in the manufacture of wadding for cannon and fire-arms.
2177. Robert Cruise, Manchester—Improvements in machinery or apparatus for stopping railway carriages.
2179. Thomas Shaw and Richard Dixon, Preston—Improvements in slubbing, roving, and jack frames employed in the preparation of cotton and other fibrous substances.
2207. Thomas Edwin Moore, 3, Great Titchfield street, Oxford-street—Improvements in apparatus for sharpening knives, scissors, and other similar edged tools.
2268. John Rickhuss, Worcester, and Charles Toft, St. John, Bedwardine—Improvements in the manufacture of parian, porcelain, china, and earthenware.
2300. Claude François Vauthier, Dijon—Improvements in blowing machines.
2316. Archibald Craig, Paisley—Improvements in the manufacture of railway wheels.
2408. Lancelot Kirkup, Orchard-street, Newcastle-on-Tyne—Improvements in anvils.
2553. Thomas Cooper, Isle of Wight—Improvements in the construction of pipes, and in the mode of joining the same.
2671. William Porter Dreaper, Bold-street, Liverpool—Improvement in the manufacture of pianofortes.
237. James Howard, Bedford—Improvements in ploughs.
295. Alfred Vincent Newton, 66, Chancery-lane—Improved mode of constructing dry docks.
312. Charles Barnard and John Bishop, Norwich—Improvements in apparatus for cutting vegetable substances.

*Sealed April 7th*, 1855.

2186. François Alexandre Nicholas Delsarte, No. 3, Rue Croix-Boissière, Paris—A new mode of and apparatus for tuning pianos and other kinds of stringed instruments.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3701 | April 4. | Gas Fire Brick | Benjamin Wheeler | Albert-street, Nottingham. |
| 3702 | ,, 5. | Fastenings for Portfolios, and other covers containing Papers and Documents | T. De la Rue and Co. | Bunhill-row. |
| 3703 | ,, 6. | The Alliance Shawl | Foster, Porter, and Co. | 47, Wood-street. |
| 3704 | ,, 7. | Improved Can, Jar, or Case | Wm. Greig, Robert Taylor and John Chandler | Richardson-street, Bermondsey. |
| 3705 | ,, 10. | Clasp or Buckle | Nehemiah Brough | Cox-street, Birmingham. |
| 3706 | ,, 11. | Improved Sling-action Case Beer Engine | Thomas Frederick Hale | Narrow Wine-street Works, Bristol. |

Journal of the Society of Arts.

*FRIDAY, APRIL* 20, 1855.

## EIGHTEENTH ORDINARY MEETING.

Wednesday, April 18, 1855.

The Eighteenth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 18th inst., Thomas Winkworth, Esq., Member of Council, in the Chair.

The following Candidates were balloted for and duly elected :—

| | |
|---|---|
| Baylis, Alexander J. | Jonson, Arthur |
| Burton, Charles H. | Keeling, Alfred |
| Cramp, Francis | McGregor, Peter |
| Crawford, Robert W. | Oxley, J. Stewart |
| Gilbert, Dr. Joseph Henry | Philips, Sir George R., Bart. |
| Hankey, Thomson, jun., M.P. | Price, George |
| | Rixon, Alfred H. |
| Herbert, John Maurice, M.A. | Young, Francis Mortimer |

The paper read was

## NOTES ON THE REVISION OF ARCHITECTURE IN CONNECTION WITH THE USEFUL ARTS, WITH SPECIAL ILLUSTRATIONS OF THE VENTILATION OF ST. GEORGE'S HALL, LIVERPOOL.

By D. B. Reid, M.D., F.R.S.E.

The object of this communication is to submit to the consideration of the Society some propositions connected with the improvement of architecture, and to explain some special points connected with the ventilation introduced at St. George's Hall, Liverpool.

Few questions perhaps have attracted more attention in modern times than the revision of architecture demanded by the general progress of discovery during the last century, and the application of new and more extended resources in ministering to the improvement of public buildings and of the habitations of the people.

Nevertheless, with all these means and appliances, the amount of real progress does not as yet meet the wants of society, and public attention is only now being thoroughly awakened to the fact that architecture is in many respects in a state of transition, and that it never can attain its highest development, till this state of transition shall be thoroughly understood and appreciated, and met in a spirit that shall identify it with all the wants and circumstances of that being for whose use it is especially intended.

The right adjustment of the relative claims of the fine and useful arts, where they meet or interfere, forms the very root and basis of all that is most important, more especially in public buildings. Nothing can attain the highest order of beauty that attempts to do so at the expense of an admitted want. In an assembly room, accordingly, for conversation or debate, or in a church, a court of law, or a school-room, a defective acoustic arrangement cannot be compensated by any amount of decoration, and in the same manner, no brilliancy or beauty of any artificial system of illumination, can make up for any deficiency that renders it more conspicuous as an object of art, than useful as a means of giving that illumination of the countenance which is the best test of a good approximation to the clear and equally diffused light of day.

And though none may go the length of denying such reasonable propositions, it is not the less notorious that the style and type of an architectural structure too often becomes the principal object of attention, instead of being merely the means of carrying out those higher objects for which it was intended.

Special adaptation to an end must ever be regarded as the great aim and object of all human ingenuity, and it is seldom that any collateral benefit can be accepted in place of the primary object, though the blending of the beautiful and the useful must ever be held as the highest triumph of art.

The magnificence and grandeur of a St. Paul's and a Westminster Abbey, with all their hallowed recollections, have a mission of their own, which speaks even from their silent walls in a language not to be misunderstood. A Crystal Palace also has its own mission in another field, being at once one of the greatest monuments of art and science, and one of the most valuable means of promoting their progress. It is not, however, to such buildings that we allude at present, but to those required for the every-day purposes of life and public business. In them the style of architecture must often be regarded as the accidental dress which they wear, whether Grecian, Gothic, or however different from these, while the stability, the accommodation, the lighting, the acoustics, the ventilation and the warming form the realities that ought to be secured, and take precedence of all decoration.

We by no means desire to say that the objects we advert to are altogether overlooked. We do not say that there are not numerous instances of the most laudable zeal, and of a highly successful practice in carrying them out. But we do affirm that the important practical question "what is architecture" is not always so thoroughly entered on, nor so practically sifted, as the nature of the case requires, and that this occurs to an extent that renders it desirable for everyone to record his experience wherever he has reason to believe that it may in any way promote so great an object.

Knowledge and discoveries in practical science have advanced in modern times with a rapidity altogether unprecedented. In architecture, in particular, new facts, new details, and new resources have multiplied on every side. What, then, can be more important than the right organisation of the means by which these resources can be most effectually applied, and how can that reorganisation be effected, except by the careful consideration of the existing practice, and the varied anomalies it presents.

The progress of architecture affects not merely the general comfort and well-being of society and the duration of human life, but the right conduct of business in all public edifices; and having had the opportunity of taking a part in many proceedings connected with the acoustics of public buildings, and the progress of sanitary improvement, I venture to submit to your notice the following notes explanatory of the propositions with which I shall conclude:—

In the year 1833, a building was erected at Edinburgh, that became soon afterwards the basis of plans that have been introduced in numerous public works, and in promoting the improvement of the habitations of the people. It was constructed for lectures and experimental purposes, and the arrangements adopted were founded on results that had arisen from many previous investigations. It presented, in particular, very extended resources for the production and communication of heat, for artificial illumination, and for the instantaneous removal of all noxious gases and vapours evolved during every variety of experimental operations. The general ventilation of the building was also the subject of special attention. The communication of sound, when tested by vocal and instrumental music, as well as by the purposes to which it was applied, was admitted to be clear and distinct, and to be sustained without effort either on the part of those who spoke or those who heard; neither was there any echo nor offensive or prolonged reverberation.

Four walls, and sixteen pillars, each of them a shaft or chimney stack, supported the roof. No fuel was used except gas and prepared coke, unless when required for experimental purposes.

A large central shaft commanded numerous fires, and furnaces, and flues, extending under-ground to every part of the building.

The smaller shafts, which were about 17 feet high, had each an internal flue nine inches square, which was found sufficient to command four ordinary fires, or four small furnaces, each capable of reducing iron from the ore in a Hessian crucible, and giving a button of the metal in analytical experiments.

The conclusions which the occupation of this building pressed on my attention were the following, some of which, as is well known, had engaged attention in former times, though introduced here to give a more complete view of the result of present and past experience:—

1. That the amount of air supplied in general to crowded buildings is far below the standard requisite for the preservation of health.

2. That the ingress of air by an extensive system of diffusion is the great desideratum in practical ventilation, and the most difficult to be secured where special provision is not made for this purpose.

3. That a sustained power can alone regulate and maintain proper ventilation in crowded buildings, or preserve it from the influence of external currents.

4. That air entering a crowded public building ought not to be admitted by ordinary windows, but by special apertures and channels, in which it could be tempered to any extent required.

5. That the milder and more extensive the heating surface, the less injurious was the effect on the quality of the air supplied.

6. That the products of combustion from gas, or any other means of artificial illumination, should be removed as directly from the general atmosphere as the products of combustion arising from any fire or furnace, when not necessarily carried off at once by the general movement of the air.

7. That in any system of artificial illumination, the imitation of the diffused light of day is the great and important desideratum, and not the concentration of great power in one or a few lights.

8. That illumination at the cornice, at the ceiling, or above the ceiling, by a special system harmonising with the general architecture and incorporated with it, would lead to important practical results, and admit of the entire exclusion of products of combustion.

9. That a low roof, combined with a powerful reflection of sound there, and a floor highly absorptive of sound, and apertures by which it could escape, tended largely to improve the communication of sound.

10. That ventilation, acoustics, and artificial illumination, should form primary subjects of consideration in public edifices, and can only be put on the most desirable footing when architects shall come generally to take the same interest in them that they do in the style and artistic features of any work in which they may be interested.

11. That the extension of the use of gas and of prepared soft coke, may be advantageously adopted for all ordinary purposes where heat is required, to the total exclusion of raw bituminous coal, and with the entire prevention of soot or visible smoke.

12. That the general progress of architecture and sanitary improvement, requires that the public be made more familiar with the nature and properties of the materials that more immediately affect the human frame and influence the health in the habitations in which we dwell, and in the varied engagements with which man is occupied. Without this no proper management can be secured, either in the general preservation of health, or in the combination of those sanitary provisions that require all the united co-operation that can be obtained from the resources of the medical profession, the architect, the engineer, and the agriculturist.

I shall now advert more specially to some of the principal topics enumerated, so far as may be practicable in this communication.

### Sound.

There are not many points connected with the practice of architecture where greater discrepancy exists than in the provisions made for the right communication of sound. In many cases it is obvious that this question has been left to take its chance; in others dependence has been placed on the imitation of examples; and, in some, specific rules have been pursued with various success.

To restrict myself to what has come personally under my own observation, abroad and at home, I would say that systematic attempts at acoustic arrangements do not generally receive the consideration they deserve, and are often utterly and entirely neglected.

Few reflect on the tear and wear of the voice of the speaker where he has to adopt it to incongruous circumstances. Whenever the speaker is in difficulty from this cause a corresponding anxiety is felt on the part of those who hear, and the public business is needlessly protracted, carried on with difficulty, and not unfrequently attended with grave mistakes.

It is not to be expected that these defects will be reduced materially till acoustics shall become a primary instead of a mere secondary object of attention in the practice of architecture; till they shall be held of sufficient importance to insure an alteration of design when necessary, and till the science of acoustics shall receive some of that popular attention and elucidation which has been so happily bestowed on optical science.

In different cases to which I have been called, an extreme altitude in the roof was one of the principal sources of evil, and the absence of reflective power on the line of speech and hearing. The voice appeared to be lost, or was sustained with difficulty. By lowering the ceiling, and the introduction of a good reflecting surface, inclined, as much as circumstances permitted, towards the benches occupied, the principal defects were obviated.

In other instances great improvement ensued when a lining of sheet-iron was placed around the wall, and opposite the line or zone of speech, by which I mean the space immediately opposite those who either speak or listen.

In a third series of cases, the great defect having been excessive reverberation, by removing lath and plaster ceilings, and opening them up in every direction, a sufficient escape for superfluous sound was made, and a perpetual noise removed that had previously been equally painful and offensive to those engaged in the apartments.

In a fourth series, the introduction of local reflectors, or absorbers of sound, would often satisfy everything requisite.

But the most important results in rooms for debate or lecture, were always obtained where a low ceiling, or a great reflecting power from still lower walls, was accompanied with such numerous apertures, or such an amount of absorbing surface, that the sound which had once affected the ear never continued to linger on it, but left the course clear, as it were, for the full effect of each succeeding syllable.

It is perfectly true that the room or apartment that may be deficient in acoustics to one, may not be so to another, and that reports on such points can only be received after a careful generalisation of the facts; but, looking to the whole question, it is maintained that the leading phenomena of acoustics as exemplified in all our principal buildings, may be easily and satisfactorily explained, and that we have only to pursue and apply the admitted laws of the production, propagation, reflection, and absorption of sound, to obtain more satisfactory results than are generally secured.

It is a desideratum, however, to extend the inquiries that have been made on this subject to the adaptation of the voice to each particular structure. A soft and gentle voice, or musical performance, may often be heard in perfection, if enunciated slowly, where nothing but con-

fusion would prevail with louder notes, or a more rapid articulation.

It is not the less important, therefore, to bear in mind that the acoustics of special rooms have often been condemned where the fault lay not in its construction, but in the defective elocution of the speaker, who did not know how to manage his voice. With all the power and habits of debate to which the customs and institutions of the country naturally lead, it will be admitted that the cultivation of a clear and distinct elocution is not always characteristic of those who address public assemblies. And if this be the case, it is still more important that they should pay some attention to acoustics, as often some alteration of position, or in the direction of the voice, a sound a little louder or a little softer, or dwelling a little longer on each syllable by merely speaking slower, will enable many to be heard with facility who may be otherwise scarcely intelligible.

The grand object of the architect is to treat the room as if it were itself a part of a musical instrument, and to bring in all the appliances that will sustain sound to the required point, and discharge or suppress it whenever it has done its duty. And here a wide field is open for the use of glass, metal, and wood, in all those varied conditions in which they conduce most powerfully to sustain and propagate sound, arresting their action when the required intensity is given without producing prolonged reverberation.

With a ceiling or walls softened by drapery, or covered by a porous or perforated structure, that prevents reflection, any form of building may be adopted, provided sufficient strength of intonation can be secured to fill the requisite area, and sufficient silence maintained to prevent interruption.

### Ventilation.

It would be difficult to give any good reason why ventilation should not form a primary object in architecture. Without the proper renewal of air, life stagnates or becomes depressed in proportion to the amount of deprivation, and in all crowded buildings the quantity required for use is so great that thin and attenuated as the air may be, it soon exceeds by many times the total weight of all the materials used in their construction. How is so large an expenditure to be maintained without some special provision? How is such a special provision to be secured without a marked effect upon the architecture?

The mere adjustment of apertures, such as doors and windows give, will be sufficient to regulate an imperfect system of ventilation; but wherever the highest degree of certainty and precision are required, there must be a constant force capable of withdrawing any amount required, and for the introduction of as much air as is removed.

But the room or apartment being crowded, where is the air to enter, and how can it be admitted with sufficient gentleness so that it shall fall softly on the person, and not be productive of evils, as serious, or even more so, to some constitutions than the tainted atmosphere they may have been breathing.

In one series of experiments made on this subject the leading peculiarity was the free admission of air given from a very large space or reservoir on one side of a lecture-room seated for 300 persons, but containing on many occasions a considerably larger number. The opening in question exceeded 400 feet in area, and gave the room the appearance of the wall on one side having been in a great measure left out. In one point of view, the lecture-room might be regarded as merely part of a much larger apartment, with which it was in free communication by this opening, there being means of renewing the air to any required extent.

When in occupation, a broad wave of air inclined from the reservoir to the seats at a lower level, and a corresponding movement of vitiated air proceeded from a higher level in the opposite direction. Fresh air constantly gained access to the reservoir below, and vitiated air was as constantly carried off above. But there neither was ingress nor egress around or near the person except what ensued by the gentle movement of this broad flowing and returning wave. The result was on the whole very satisfactory, but in summer, as is usually the case, greater assistance was required in securing an adequate discharge than in winter.

In another series of experiments, a chamber was formed between the ceiling and the roof, and the entire ceiling was made of a porous material that arrested any sudden descent of cold air, but permitted any movement dependent on the relative condition of the air above and below the ceiling, and the consumption required for a common fire, or the waste occasioned by a ventilating flue. This arrangement converted the whole ceiling practically into an open window, so far as ventilation came into consideration, freed from all that inequality that usually attends the unguarded action of the external air, and admitting and discharging air according to the ever varying circumstances of the moment.

In a third experiment, the same general principles were observed, but the diffusion of the air was carried to a still greater degree by extending the porous chamber from the ceiling to the walls, and thus carrying the diffusion to the greatest limits practicable, without bringing into operation the use of the floor.

A further series of experiments was then made, in which the floor itself was made of porous materials, supported on a perforated frame, to meet cases where it was impracticable to gain sufficient ingress in any other mode, and proper precautions were taken, to use the perpendicular surfaces largely, and to guard against the ingress of dust by an efficient system of cleansing. The direct ingress and passage of air from the floor to the ceiling, by a system of universal diffusion, had many advantages that counterbalanced in local positions the disadvantages naturally attending it.

In a fifth series of experiments, a small descending power was placed on every portion of the floor which the foot was apt to touch, so as to carry away by a special channel as much air as would make an inclination in that direction, while the ascent took place from all the rising steps and such portions of the floor as were rarely or never touched by the foot.

In a sixth series, the air entered solely by the ceiling, and was discharged principally at the same level, a gentle, limited descent being maintained by the floor.

In a seventh series, complete power was secured in the movement of air from the floor to the ceiling, or from the ceiling to the floor, and the relative effects of an ascending and a descending movement tried upon the same audience, in numbers amounting to 240, the current being reversed from time to time, till clear proof was obtained of the advantages and disadvantages of the ascending and descending movement.

From all these investigations, under circumstances where no style of architecture, decorations, or any other cause limited the inquiries made, it became evident that systematic ventilation in crowded buildings is far too extensive and important a subject to be dealt with economically, except by arrangements incorporated with the original structure.

That the right temperature and diffusion of the entering air are the points on which all difficulties usually turn, when a proper supply and discharge have been secured; that in public buildings with a variable attendance, nothing meets so effectually all contingencies within, and the changing condition of the external air without the walls, as a fixed power capable of moving any required amount of air.

That a shaft, or chimney tower, is the most manageable and uniform power capable of universal application.

That a mechanical power can be used in conjunction with a shaft in producing a more balanced atmosphere than either can give separately, the one being made to force in just as much as the other withdraws.

That in proportion to the perfection of the structural arrangements by which the utmost freedom of access is given to the air entering any building, and the less it is overcrowded, the more satisfactory will be the results, and the less costly the means required for sustaining adequate ventilation.

That the removal of special sources of injury to the external atmosphere of any building, should be the first step taken in connection with any system of ventilation.

That a vacuum or exhausting power should be placed on all sewers in large cities, especially where tidal rivers or other causes render them liable to temporary obstructions.

That it is vain to conduct any system of ventilation where lobbies, passages, and external doors and windows, are not under sufficient control.

That in ordinary habitations, one great desideratum still too seldom provided is a sufficient infusion of air into passages and staircases, so as to admit of the whole supply being obtained from this source in cold weather, and tempered to any required degree.

That the ingress of air in individual apartments comes next in point of importance, where its entrance is generally too much opposed in consequence of the want of that amount of diffusion that is necessary to break the severity of its impulse.

That an ingress above, around, or in the immediate vicinity of a fire-place or stove, with a proper supply of moisture, removes the most objectionable source of draughts where the air is not previously tempered, and that a discharge from the highest level can alone secure with certainty the most effective removal of vitiated air.

*That in the habitations even of the humblest class the right construction of the window, and an effective system of diffusion of air permitted to enter and escape at the ceiling, is the great desideratum; that the too limited amount of this diffusion, and the consequent local currents of cold air, has hitherto been the practical cause why ventilation has been so much opposed in those apartments that were most in want of it, and that these arrangements, with a proper fire-place, can be executed at a cost that can be more than saved by a slight reduction in altitude, which is more than compensated by the ventilation thus secured.*

## Lighting.

The third point to which we desire to request attention comprises some of the principal experiments made in artificial lighting.

The first series consisted in the aggregation of fish-tail burners, so as to use them in the form of compound burners, or in a position where the products of combustion necessarily ascended till they escaped.

In the second series, illumination was given from the cornice at a level, and under circumstances that equally insured the removal of products of combustion.

In the third series the cornice illumination was effected in a metallic chamber, that constituted the actual cornice, a glazed front converting the chamber into an illuminated cornice, presenting any decoration that might be desired.

In the fourth series, lamps were formed so as to appear parts of the decorations of the ceiling, the products being entirely removed by ascending or descending currents.

In the fifth series, the lights were altogether excluded, and placed above the ceiling, the desire being to imitate the diffuse light of day.

In the sixth series, the same effect was produced practically by converting numerous panels in the ceiling into reflectors, and throwing down the light from an unpolished convex surface.

It will be obvious, that in following out the extended systems of illumination contemplated by most of these methods, and in removing, without recoil, products of combustion from any ordinary lamps putting in motion an immense body of air, the systems of decoration in any public building must necessarily be more or less affected.

Further, I could name, were it necessary, public buildings of the highest importance, where the system of lighting was not even defined, much less incorporated with the works, till it was too late to make the necessary provision, either with the economy or effect that might have been introduced by previous arrangements.

In the introduction of gas at the Houses of Parliament twenty-four hours only were available for the first illustration, submitted in 1837 to the deceased Lords Melbourne, Bessborough, and Durham. Those who are conversant with the details of gas illumination will know how inadequate such an opportunity must have been for anything except the introduction of leading mains, and the demonstration that light could be supplied from a chamber above a glass ceiling, without offensive shadows on the floor, and without the slightest ground of objection from any of those supposed evils that were then too generally considered to be inseparably attendant on the use of gas. Fifteen years elapsed after that period, however, before I had the opportunity of showing this, or any equivalent arrangement, in operation at the ceiling of the House of Commons, during the sittings of the House, even in the imperfect form that was executed rapidly, and during a very limited period, under the instructions of a committee, though, in 1844, temporary illustrations were given of one variety of lighting from the ceiling.

Without entering further on this point, or even taking up more of the many important questions connected with the progress of improvement in architecture that are not exclusively connected with the Fine Arts, as the communication of heat, the construction of fire-proof buildings, the system of drainage, &c., we trust that enough has been explained to demonstrate that architecture has, at this period, been passing through an important state of transition, and that much still remains to be effected before it can be placed on a right footing.

The mere fact of a member of the medical profession having been called to take an active part in the direction and arrangement of numerous practical questions connected with architecture in public buildings of every variety in England, Scotland, and Ireland, including equally the palaces of her Majesty the Queen, to which he is permitted to refer by the Right Hon. the Earl Delawarr, the Lord Chamberlain, under whom he acted, to the humblest habitations of the people, on which he was requested to report by the government, must carry the conviction that something yet remains to de adjusted to bring into harmony, through the *commune vinculum scientiarum*, he combined results arising from the progress of architecture and sanitary improvement; and if I have been compelled at times to make statements and references to my own labours which I would rather have avoided, it will be recollected by those who have watched the progress of events during the last twenty years, that I have, at least, had a pretty good share of those attacks and difficulties that beset the paths of those who engage in questions of public importance.

I submit the following propositions to your consideration, as a means of facilitating the revision of architecture in its position as a useful art, and of placing the useful and the beautiful in a more harmonious conjunction than they generally present in public buildings and in the habitations of the people:—

1. No portion of any public building ought to be commenced till a more complete series of models or drawings is provided than has hitherto been customary, and a special grant should be given for this purpose, exclusive of all competition premiums.

2. The present mode of remunerating architects often leads to the too precipitate commencement of foundations before any system of warming, ventilation, acoustics, lighting, or drainage is fully considered and determined, and these valuable opportunities are often irreparably lost, or restored only at great expense.

3. An extended system of instruction should be provided for the future student of architecture at all the principal colleges or universities in this country, such as has been partially commenced of late years, and the

curriculum placed on the same footing as to honour and position that is awarded to the members of other learned professions.

4. Acoustics, warming, lighting, ventilation, and drainage should be held as objects of study, equally incumbent on the architect as those which have hitherto been found to constitute the more attractive branches of the profession.

In offering these remarks it is hardly necessary to explain that I should not have ventured to have opened these questions in so brief a communication as this has necessarily been, had it not been with the view of explaining more clearly the course pursued in the ventilation of St. George's Hall, to which I have now to advert.

[Dr. Reid then entered into the history of the construction and arrangement at St. George's Hall, and paid a tribute to the memory of Mr. Elmes, who fell a sacrifice to the great work which has immortalised his name. He then detailed the manner in which his department of the works had been carried on after the decease of the architect, and with the successive co-operation of Mr. Rawlinson, Mr. Weightman, the surveyor to the municipal authorities at Liverpool, and Professor Cockerell, who has been engaged in finishing the building.

Dr. Reid here referred to a number of drawings and diagrams, in continuing the illustrations he gave from St. George's Hall of the views he advocated, but as a general description of these works appeared in the 97th number of this Journal, it is thought unnecessary to repeat it here.]

## DISCUSSION.

The CHAIRMAN regretted that, owing to the circumstances of the times, it had not been practicable to secure the presidency of a gentleman conversant with the important subject so fully and ably opened up to the Society that evening, by so competent an authority as Dr. Reid. Under these circumstances the Council had requested him (Mr. Winkworth) to take the chair, and in that position it became his duty to invite discussion on the various points treated upon by Dr. Reid. He must, however, request gentlemen to compress their observations as much as they conveniently could, for, if time should permit, Mr. Henderson would read a paper on Life Boats, illustrations of which were now on the table. St. George's Hall, Liverpool, was well known to be a magnificent specimen of what use might be successfully made of the accumulated materials of architectural and historical knowledge, and great credit was due to the architect, the late Mr. Elmes. In it also the appliances of scientific discovery, as regarded ventilation, were successfully introduced by Dr. Reid, who had so lucidly explained the details connected with that beautiful building.

Mr. T. J. PEARSALL stated that he had inspected the laboratory in Edinburgh, which had been described by Dr. D. B. Reid, and the plans of which were on the table. It was a peculiar building, possessing many qualifications. He had the great advantage of being in company with an architect (now deceased) who had visited, for scientific investigation, the most celebrated theatres and buildings in Europe; and the result of minute trials of Dr. Reid's laboratory showed that, for the purposes of sound, it was a most wonderful building. The lecturer could be heard in every part, even if the students had, of necessity, to continue their work at different furnaces and tables, and, of course, this was a great advantage in the teaching of practical chemistry. One other point he might name, viz., that Dr. Reid had declared *all air passages* should be so large, and so arranged, as to be easily inspected. He had found, by experience, the evils that resulted from passages and channels for air that were inaccessible. It too often happened that in the summer dust would collect, and even birds, mice, &c., find their way in, and the result of accidental depositions of dust and dirt not only vitiated the air, but the whole plan and apparatus were frequently blamed, by those evils that were unsuspected at the outset, and not obviated in the construction of the passages and building.

Dr. WATTS said, his name having been mentioned in connection with one of the large public buildings in London, he would say a word or two upon the subject of acoustics, inasmuch as Exeter Hall was, in his experience, one of the best speaking places he had ever stood in. It was a large place, very plain in its structure, but any man with ordinary powers of voice might be heard to the ful extent of the whole hall without difficulty and without extraordinary exertion. Some 15 years since he was present in the Manchester Town-hall, and at that time it was an oblong building, with two rows of columns cutting off a piece at either end, and it had three glazed domes in the roof—one large dome in the centre, and smaller ones at either end. When he entered the hall a gentleman was speaking in a loud tone of voice, and he tried every possible place in the hall to hear him, but for full an hour he could not make out a single sentence that fell from the speaker. The only mode in which he could account for this was, that the platform on which the speaker stood was not far removed from the centre dome, and the voice ascended and descended, and was reflected from the walls in all directions, and created such a continual echo as annoyed the audience without the possibility of their being very much edified by what the speaker had to say. The observation of Dr. Reid respecting the necessity of considering the question of acoustics, ventilation, and illumination, prior to the commencement of the building, was, in his (Dr. Watts') opinion, the most important suggestion of the evening; and it would not be a bad theory, whenever a public building was proposed, that the ventilation, the illumination, and the acoustics, should be considered together, and fully agreed upon before the building was commenced; and if that were done there could be no finding of fault when the building was completed. The first public building with which he had any particular acquaintance, was the Mechanics' Institute at Coventry. There they attempted the warming of the building by means of hot water; the pipes were small and the furnace was large, and his experience of that arrangement was, that the atmosphere, though very effectually warmed, was very much vitiated—so much so at times to render it very disagreeable; and another great defect in this system was, that unless the apparatus was kept constantly at work, (and that was an expensive process), when the cold weather came the water froze in the pipes, and when a thaw came or a fire was lighted, they burst. He was also connected with the Manchester Free Library, where a variety of experiments in ventilation were tried. The ventilation was undertaken by Mr. Daniel Stone. The building, it should be stated, existed before the free library was thought of, and it was a conversion into a free library, but much money was spent to obtain efficient ventilation, and he had no doubt Mr. Daniel Stone did his best to effect it by means connected with the illumination. Double pipes were suspended over the burners, the inner ones for conveying away the products of combustion, the outer ones the vitiated air of the room. At the ceiling these were connected with channels leading into the flues. The day of opening came, and like most meetings of interest in Manchester, it was a crowded one, and it grew very warm in a little time, but strict injunctions were previously given that neither door nor window should be opened, and one could readily understand that such injuction was necessary if the mechanism for the ventilation was to be duly tested; but Sir John Potter found, after a time, that although the apartment was said to be ventilated on a new principle, yet they must resort to the old one, and open the windows; and they did so.

Mr. SLANEY said it might be thought presumptuous in him to take part in this discussion. He, however, had had the honour of working with his friend, Dr. Reid, for many years, on a Commission of Health, at which time their attention was directed to one of the subjects to which allusion had been made in the paper of the even-

ing. With respect to the dwellings of the public generally, and of the poorer classes in particular, he thought it was of great consequence that ventilation should be thoroughly carried out in them. A simple mode, by which, at a cheap rate, and without difficulty, they might be able to ventilate the humble chambers of the poor, was a subject that appeared to him of the highest consequence; and, without referring to any new plans, he would say there had been simple methods brought forward which had been of great use in that way. In the first place, they had the plan of Dr. Arnott, of a valve placed in the chimney. This was done at a cheap rate, and in a simple form, and although, perhaps, not uniformly successful, yet in a great many cases it had proved quite successful, as he (Mr. Slaney) had proved. In the second place, another simple mode of ventilating the chambers of the poor—their bedrooms—was by the introduction of a zinc pane in the window, perforated with small holes, which was found to maintain a state of atmosphere essential to health. These things, although humble, were of the first importance to the poorer classes. He would not advert to them further, because they were familiar to most present, but these were matters which a little information might tend to carry out still further, and the plans to which he had alluded might especially be usefully employed in school-rooms, and rooms of smaller dimensions, although they might not be adapted for the larger class of buildings, such as those to which their attention had been principally directed that evening. The hint was given at St. Martin's Hall, during the Educational Exhibition which was held there under the auspices of this Society, that a simple and ready means of ventilation was required for school-rooms in which a great many persons assembled. Dr. Arnott offered some valuable suggestions on the subject, but a gentleman from the other side of the Atlantic—the Hon. H. Barnard—gave them an interesting detail of a plan which had been adopted with great success in the school-rooms of America. The plan was stated to be this:—In the first place they had in the centre of the room a chimney, which carried off the combustion from the stove, and around that a second chimney was built. The inner chimney heated the air of the outer chimney, and the pipe was tapped at the upper part of the room, to enable the heated and vitiated air to go into the outer chimney, and it was carried out into the open air, so as to rid the school-room entirely of the vitiated air. The gentleman stated they had found that to be a cheap, and at the same time a very efficient mode of ventilating a large room ike a school-room, in which there were many people assembled, and as such he (Mr. Slaney) had brought it before the notice of the meeting.

Mr. Varley said, nine years ago the medal of the Society was offered as a premium for the best mode of ventilation without complicated apparatus, and that medal was awarded to Mrs. Varley. The plan consisted of a perforated zinc tube, connected with the external air, and passed round three sides of the room, at the cornice; the fourth side had a corresponding perforated tube on the cornice, with its exit into the chimney. This was employed to carry off the vitiated air by means of the ascending current in the chimney. This plan had been successfully adopted in a school-room in Baldwin's-gardens, Holborn, where upwards of 200 children daily assembled; and he thought, from all the circumstances, that was as severe a test as the plan was capable of undergoing. On the subject of acoustics he (Mr. Varley) referred to Drury-lane Theatre, and also the theatre of the Royal Institution, as buildings the most perfect in their acoustic arrangements of any that he was acquainted with, the latter being, in his opinion, well worthy of the consideration of those who were charged with the construction of similar buildings.

Mr. R. W. Billings could not entirely agree with the divided duties which Dr. Reid advocated. Dr. Reid had described his current towers, with covered louvres, and other modes, so as to break the currents of air. He (Mr. Billings) had tried that several times, and, singular to say, he had failed; he had succeeded in some cases, but he failed entirely in one instance, in Forfarshire. He had his flues collected together, in what appeared to be an old turret, in Forfar Castle, and it was a bitter place for a trial, because there were two winds that baffled all his attempts. The turret was louvred in, and his vents came in on the floor. The plan having failed, he removed the louvres, when perfect results were obtained. He had seen a great deal of Dr. Reid's experiments at Edinburgh; his laboratory was certainly a very wonderful thing. The doctor had spoken, amongst other things, of a simple way of getting rid of echo. There was a concert-room in Edinburgh, built by Lord Murray, where the echo was found to be very unpleasant, but that was entirely cured by the hanging of a piece of drapery between two of the columns, and there was no longer any unpleasant effect. One serious objection which Dr. Reid made to architecture as it now stood was, that the ventilation was not settled with the plans for the building. For his own part he (Mr. Billings) should take great shame to himself if he did not consider that ventilation formed a very essential partof the plan in the first instance. It was a matter as much to be studied as the landscape of architecture. A man who built a house without harmony with the surrounding landscape did not understand his profession, and so with regard to ventilation, he should not consider a man understood his profession who could build without due regard to ventilation. Upon the subject of taking the flues into towers he might state that he was building a small church in Cumberland, the whole ventilation of which was carried off at the top of the spire, the air being brought in at the east end, the warming apparatus being placed in the middle of the structure. He had also designed a new garrison church for Edinburgh, and in that he proposed to use the same ventilating apparatus—viz., a tower and air shaft—but all through that building, both at the base of the windows and against the roof, there would be the means of increasing or decreasing the admission or expulsion of air, by means of louvres. The windows for the exit of the foul air were entirely concealed in the heavy matriculation of the work; there would be the power, by means of a screw, of opening the windows, and modifying the supply of air at pleasure. Another building, which he had also designed, was the garrison hospital, in which he proposed to adopt a plan for admitting the fresh air under the beds of the patients. Whilst entering into these matters they must take care that, whilst endeavouring to improve architecture, they did not too much interfere with matters of design. The *elegant* top of the Old Bailey was an instance of this. He did not know whether his friend, Dr. Reid, had had anything to do with it, but that might fairly be denominated a monstrosity which had humbug stamped upon the face of it; and he would recommend any one who had a desire to study the beautiful in architecture to go and look at that cowl at the top of the Old Bailey.

Mr. John W. Papworth, F.R.I.B.A., when, some time since, in the centre of the middle-box of Drury-lane Theatre, found the sound strike in two distinct waves, one on each ear, and confuse the sense of sound; but a slight alteration of position obviated the defect—so, in some cases, it was clear that inconvenient places for auditors might be found in the rooms best adapted for hearing. He asked if Dr. Watts did not think that Exeter Hall had been improved by the little alteration of the ceiling by the architect, Mr. Daukes.

Dr. Watts's experience had only reference to the Hall since the new ceiling was erected.

Mr. Papworth continued. As regarded the question of improvement of *building* (not *architecture*), the science had never perhaps completely met the wants of society, perhaps it never would fulfil them; and the art of architecture had been always in a state of transition. He agreed with Mr.

Billings that no architect who professed to follow his vocation conscientiously could ignore his duty to keep pace as much as possible with the demands of advancing knowledge as to light, heat, fresh air, and acoustics. With regard to acoustics, he might mention that Sir David Brewster himself was modest enough to decline speaking with authority; perhaps nothing of high importance had been added since Brewster's published works, unless Mr. Scott Russell's is-acoustic curve were included. He could imagine that Dr. Reid had experienced cases in which the before-mentioned four points had been, apparently to Dr. Reid, not studied, or at all events not studied with reference to the results of that gentleman's experience, but Mr. Papworth hoped that such cases would be found, as usual, exceptions, proving a general rule of professional attention to such really vital objects. He would refer those who could obtain permission to see it, to Osmaston House, (designed by Mr. J. Stevens, of Derby), as an instance of professional skill, as far as it was unobstructed, in sanitary matters. He could assure Dr. Reid that no reasonable system of sanitary *construction*, was beyond the reach of artistic *decoration*, the difficulty that really existed was the expense apparently entailed. Mr. Papworth did not know in what manner the present objectionable system of professional remuneration for architects, led to a hasty commencement of the works; his own designs were rarely finished before the working drawings were prepared—any other course led to embarrassment. He would say that if competition were good for the decorative portion, he thought it equally good for the scientific part of a design, and believed that there should be one or more separate competitions for the light, heat, ventilation, and acoustic arrangements of a building; and that the artist should not be consulted until those points were determined, It was simply the fault of the public if it were not well served by professional men on those points. He would remind the meeting that large public works did not occur much more frequently than once in a quarter of a century, and that more than one now rarely fell to the lot of a single architect; secondary buildings, such as a church to hold 2000 or 3000 persons, which were quite as important as a Parliament-house, were now submitted to unrestricted competition, so that while the older architects reasonably refused to put their accumulated practical knowledge into the lists gratuitously, the public was caught by the attractive designs in handsome frames, (this was not the case on the continent) of young men who could not possibly be considered, at 25 or 30 years of age, as masters in science and art. He did not refer to the case of the lamented Elmes, who, like two or three more, was educated from infancy, and who had served, it might be said, a double apprenticeship before beginning to distinguish himself in the great public work which was his monument. The public also presented obstacles, at present almost insuperable to the success of Dr. Reid's most moderate views. That gentleman had demanded the use of low ceilings; the new Boards of Health were not unlikely to insist upon high rooms; and the public would at once condemn any builder who invited them to enter rooms of dimensions magnificent in every respect but height. Mr. Papworth might almost call himself a pupil, having studied the steps, of Dr. Reid; and having adopted the results to the fullest extent that he could, it might not be uninteresting to mention some of the difficulties which beset a practical man. In some model stables, he had been vexed, when showing them to a friend, by seeing the apertures fastened up because the groom had seen nothing of the sort used elsewhere, and was not going to be bothered. He had built a dining room with means for ventilation which acted with little manual attention, but he had been told by his client, that the room which was too warm, was allowed to be uncomfortable, because it was too much trouble for a servant to look to a single sash-weight. He had not since adopted any system requiring attention, but having erected a public ball room, and put the best self-acting means of ventilation in his power, he had found the fresh-air apertures in the sides of the room, to be stopped up by the upholsterer. In a pair of second-class houses, the systematic mode of ventilation had been partly impeded, the chimneys consequently smoked, and the effect of his studied design had been completely spoilt by the introduction of zinc tall-boys instead of the ornamental chimney tops. Indeed, when he spoke to any owner of one of the 500,000 houses in London and its surburbs, as to the propriety of expending money upon putting the dwelling into a really sanatory condition, he constantly felt himself open to the suspicion of being "a quack in want of a remunerative case." He would add, in conclusion, that having long agitated the question of diplomas after examination in his profession, it was competent for him to observe, with reference to the object of Dr. Reid's paper, that it was still more necessary to teach *educated* people the sanatory necessities of a house such as a wise man should inhabit, for, in fact, more care was spent upon animals of luxury at the present time than upon reasonable beings, even by those persons who would be affronted if told that they were themselves actually slowly dying in unhealthy mansions.

Mr. Billings begged to say one word further—he said, let there be competition, but let all the competitors be paid.

Dr. Reid would detain the meeting but a very few minutes in replying to some of the remarks which had fallen in the course of this discussion. In the first place, he hastened to clear himself, from what he should very much regret, if any one should suppose that he wished for a moment to cast any stigma on a profession. His object was—not to blame architects or the system of architecture, because he did not think that was more open to attack than the practice of any other profession; but what he maintained was, that every profession was capable of progression, and that where one profession could aid in the improvement of another, it was their duty to aid in any movement that would advance the general progress of art. With respect to the points that had been placed before the meeting by some of the gentlemen who had spoken, he was one of the last who would wish to keep up that system of closeting to which some of the speakers had adverted. Why had he had anything to do with ventilation at all? It was not his first profession: he was engaged in another field; but if it be the fact that many works had been executed which had stood a satisfactory test for various periods, from ten to twenty years, they were, perhaps, not unworthy of attention. The old Houses of Commons had stood the test of fifteen years' experience. He did not allude to the new houses, not because he was unwilling to do so, but because only half the evidence on the real questions at issue there was as yet before the public. He did not think it wrong to say that architecture might assume a new position in regard to ventilation, when in London, in Manchester, in Liverpool, in Paris, in St. Petersburgh, and in most other places he had known, systematic ventilation, with the perfection of which it is now susceptible, was only recently taken up in detail. Architects were not to be blamed for the state of ventilation in previous times more than medical men; nay, rather less. But why should blame be cast on any one? The progress of discovery in modern times had opened up fields of investigation previously unknown, both to architects and medical men. But were they all agreed that architects had embraced that field sufficiently, or had medical men been enabled to effect all they desired as pioneers in this department. They were in a state of transition on the point. What is the best method of meeting that transition? That was the practical point which he wished to bring forward in this paper. Well then, if that be the true position of the case, what was more important than a system of architecture and of study that should define this, and could be brought to bear upon the whole subject? He said, also, they might design a totally new series of arrangements

without in any way affirming that the old arrangements were not capable of being applied, and then they would develope a system of architecture which was not yet before the public, and lead to the highest perfection of acoustics. They might then build rooms that would be to the voice what the violin was to the string, and then they would get a power which it was impossible to obtain by other means. With regard to Exeter-hall, he believed he had delivered twenty lectures there, besides taking a part in other proceedings in it, and he knew that under the old *régime*, it required in a crowded audience an amount of breath for one syllable, which ought to have sufficed for a whole sentence. He had no doubt it was improved since then, and the effect of echo might be cured by the proper application of drapery. None of this was opposed to what he had said, but the point was to reduce the whole to greater certainty in actual practice. If Exeter-hall had the best system of acoustics previously, why did they alter the ceiling? He would say this with respect to architecture, there was no profession in which there was more scope for learning and inquiry, and why should it not have all the advantages that academic powers and systems could produce? Again, with regard to the allusions made to the Old Bailey, he would tell them the brief history of that transaction. The ventilation of those courts was designed by him in the same year as that of the building to which he had chiefly directed their attention this evening (St. George's Hall). In the case of the Old Bailey, a specific sum was voted for the works, and he was to interfere with nothing that was visible in the interior of the courts; he was not to go beyond the grant made; and, moreover, he was not to take more than five weeks for the completion of the work. Unless, therefore, Mr. Billings was prepared to say that the discharge adverted to did not let out the air, he (Dr. Reid) did not know what more he had to be answerable for. As to very low ceilings, they are still more objectionable than too high ceilings. The right proportion is the best, but, in general, excessive altitude is equally injurious to the design and to the ventilation. Allusion had been made to some points connected with the dwellings of the poor. Mr. Slaney had referred to it, than whom no one, from the interest he had always taken in the matter, was more entitled to speak upon it; but nothing which that gentleman had stated was inconsistent with the views which he (Dr. Reid) had advanced. He was not dealing with the dwellings of the poor in this communication, although in another sense it affected the well-being of that class, for this great public building (St. George's Hall) would be open at times for their entertainment and their instruction. They would visit it in families, and being acquainted, by that means, with the benefits of a perfect system of ventilation, they would naturally be led to inquire how those appliances could be made available to the promotion of their own domestic and social comfort and welfare. With respect to the poor man's dwelling, there was one thing which he required to know, above all others, to make his dwelling comfortable, and that was how to make a diffusive atmosphere, and to supply his fire-place without offensive cold in winter, and if the arrangements for ventilation were made with a diffusive surface, having twenty times the present area, then, instead of hissing serpent-like currents, the evils of which they now complained so much would no longer be in existence. Give a large diffusion of air, and free ingress and egress, with control over it at the proper points, and then they would get over the great practical difficulty without any costly arrangement. He was much obliged to the gentlemen who had taken part in the discussion for the observations they had made, and he trusted they would conduce to bring the subject to a practical bearing, and to advance the general progress of science.

The Chairman proposed that the thanks of the Society be given to Dr. Reid for his valuable and highly interesting paper, which was accorded by acclamation.

Mr. Andrew Henderson called attention to a series of models of life-boats, and regretted that, owing to the lateness of the hour, his paper "On the Past and Present Position of Life-boats" could not be read. He, however, still hoped to have an opportunity of bringing the subject before the Society at one of the ordinary meetings; but, failing that, his paper would be printed in the *Journal.*

The Secretary announced that the paper to be read at the meeting of Wednesday next the 25th inst., was "On Public Works for India, especially with Reference to Irrigation and Communications," by Lieut-Col. Cotton.

## Home Correspondence.

### MR. P. L. SIMMONDS ON COLONIAL CONTRIBUTIONS TO THE PARIS EXHIBITION.

Sir,—A few months ago I furnished an outline of some few of the contributions coming forward from India and our colonies for the Industrial Exposition to be opened at Paris next month. I am now enabled to supply some additional information, which I think will prove of interest to very many of the members of the Society of Arts.

I am, sir,
Your obedient servant,
P. L. SIMMONDS.

5, Barge-yard, City, April 12, 1855.

CANADA.

The Canadian Industrial Exhibition at Montreal was inaugurated by the new Governor-general on the 6th March. Sir Edmund Head, after returning thanks for an address presented to him, remarked that these exhibitions form a new epoch in the history of the world. Their effect is to encourage commerce in an eminent degree, by bringing the people of different nations together, and the effect of commerce on the different nations is to promote peace. They are the true peace societies. The appeal is made directly to the selfishness or interests of mankind, it is true, but the object is gained. These Exhibitions are a result of free trade, and they are in themselves a sort of free trade of intellect. Such things would not have been thought of in former times under the pernicious shade of protective policy. Then one people, or individual, would have been afraid to publish discoveries or ideas, lest they should be copied or borrowed by others. It is recognised now that a great truth lies hidden in the doctrine of competition, and that honourable rivalry tends to the advantage of all. Such exhibitions, I believe, are eminently calculated to promote progress, and this country may reasonably expect much from them.

People in Europe have been apt to suppose that Canada produces little else but corn, timber, and minerals, but the fine collection brought together proved that the province was also able to vie with older countries in machinery, manufactures, and mechanical productions. The implements and machinery used for agricultural purposes, and those tending to economise labour, especially as applied to the great staple production of the colony, lumber, were exceedingly good. A good deal of interest attached to Mr. Romain's steam plough, which is designed to take the place of the plough to a certain extent, where the land has already been cultivated, and is free from stones and stumps. It stands about seven feet high, and is six feet broad by twelve feet long, exclusive of the waggon pole to attach horses to. It would appear at first sight incongruous to have horses and steam combined, but practice has shown that the machine cannot be wholly locomotive, and the horses are indispensable to move it from the barn or engine house to the field, and on very undulatory ground to help to turn it at the end of the furrow. Horses would not in all cases be required for this

last evolution; indeed, it is expected eventually to dispense with the horses after the machine reaches the field. While ploughing, this machine will also perform the part of a harrow, levelling the soil and forming a furrow; and to complete the operation of cultivation it is also intended that it shall deposit the seed in the ground. Taking a view from behind the machine we find a strong boiler-plate framework, in the centre of which is placed the boiler. On each side are placed two large wheels, five feet in diameter, with a tyre of fifteen inches broad to stop the wheels from sinking in soft ground; behind the wheels is a transverse shaft, carrying pinions, which gear into the large wheels. These pinions are thrown into gear or out, propelling one or both wheels at pleasure. Behind this shaft is the digging cylinder, made of boiler-plates. Four inches from the periphery of this cylinder is rivetted and bolted a series of spiral knives, which act in succession, and throw the earth up behind it and against the seed box or partition in a fine pulverised state, the onward progress of the machine filling up the trench formed by the knives; behind the leveller is a small wooden roller, which presses on the soil—this is all in the centre of the frame. On the outside of the frame there are two small engines, set at right angles to each other, and attached to two upright shafts by two connecting rods working horizontally, and driving each end of the cutting cylinder with bevil gearing. The whole work is a masterpiece of mechanical engineering. It is principally made of wrought iron, exquisitely finished; the bushes, bearings, and journals are case-hardened, to prevent their cutting, as the machine will necessarily have to be worked in places where a good deal of sand and dust will be flying about. The cylinders are covered with black walnut, and hooped with copper. The framework is firmly stayed together with tubular stays. The boiler is new, and was brought out at first solely for steam cultivation, but can be adapted for ordinary purposes, although not fully tested. Competent engineers pronounce the boiler admirably adapted for the object in view. It is cuniform, or wedge-shaged. The tubes contain the water, and are so disposed as to baffle the heat in making its exit to the smoke-box and funnel. It has every precaution for safety that a railroad locomotive has—glass water guage and cocks, pressure guage, and two safety valves.

The collection of mineralogical and geological specimens furnished by Mr. Logan, and others, was exceedingly rich, embracing magnetic, specular, bog, and other iron ores, zinc, lead, copper, nickel, and native silver and gold, mineral paints and manures, materials applicable for jewellery, and common and decorative architecture.

Some fine blocks of lithographic stone from Marmora, prepared with *fac-simile* autograph signatures of the French and English governors of Canada, from the "Album de Souvenirs Canadiens," of Lieut. Colonel Jacques Viger, first mayor of Montreal, are of interest.

Aerolite.—A mass of metallic iron, of extra terrestrial origin, found in Madoc, C.W., weighs 370 lbs., and is alloyed with 6.35 pieces of nickel. This is the seventy-fifth mass of meteoric iron known, and the first one found in Canada; only one larger is preserved in any collection. The whole number of aerolites described, including those of stone as well as iron, is 338, and there are only ten of them heavier than this.

Canada will be well represented at the Great Congress of Industry, and sufficient will be shown to prove that the country abounds in mineral wealth, in most useful fossils, in timber of the most valuable description, and likewise in mechanical skill of a high order, which, together with the different kinds of grain that will be exposed, and which even in England bore off the palm, cannot fail to attract the attention of the mercantile world at Paris. The number of exhibitors whose produce has found a place was upwards of 300.

NEW SOUTH WALES.

The Commissioners have received nine nuggets of gold in quartz, as a presentation from the Great Nugget Vein Company. Each specimen contains a large proportion of pure gold, and the whole collection, which presents a very beautiful and imposing appearance, weighs about 16 lbs. There are also many other interesting nuggets, obtained from Ophir, Braidwood, and various other diggings in the colony. Some of these specimens are remarkable for the crystaline form of the gold as well as that of the quartz with which it is associated. Among them there is one weighing 16 ozs. of nearly pure gold. To the French perhaps one of the most interesting and unique contributions will be the stump of a tree, bearing an inscription, cut by the party of the celebrated La Perouse, on the occasion of his memorable visit to this island. Through the courtesy of Mr. Commissioner Pearce permission has been obtained to remove the stump from its original position at Botany Bay. To some extent this may be considered as a loss to the colony; but, considering that the stump is a memento which, from its perishable nature, cannot last long, this is, perhaps, the most appropriate way in which it could be disposed of. It will be gratifying to the French to find that a monument so frail has been preserved with almost sacred regard through so many years, out of respect for the intelligence and enterprise of a member of their own nation. A fine sample of manna has been contributed by Mrs. Hay, of Wolaregang, Murray River, New South Wales. It is a white substance, exceedingly sweet and agreeable to the taste. It exudes and drops from the bark of the eucalyptus tree, and is one of the principal sources of subsistence to a large number of birds, squirrels, insects, &c. Among the most useful and practical contributions is a large sample of maize in the cob, commonly called white or bread corn. It differs materially from the ordinary maize, in consequence of its having a peculiar whiteness and fineness of grain, which give it an appearance and taste when ground not unlike those of wheat flour. Although this species of Indian corn is not extensively grown in the colony, we are credibly informed that it yields a much larger proportion of grain than the common Indian corn; that it keeps much longer; and that it is in every respect more profitable. When ground, we are informed that it will yield about 50 lbs. per bushel of fine, soft, white flour, which, when mixed in equal proportion with wheat flour, makes excellent bread. Mr. W. Macarthur has just returned from a tour in the Illawarra district with a valuable addition to the large and beautiful collection of native woods which he has already presented for the purpose of exhibition. Mr. Moore, the active and intelligent Director of the Botanic Gardens, has also submitted some interesting varieties, collected during his late trip to the Moreton Bay and Wide Bay districts. These latter have all been sawn into lengths, planed, and arranged in the Museum. Some magnificent specimens of copper ore in large blocks have been courteously contributed by the directors of the Bula-Bula copper-mine. Some of the blocks weigh from 30 to 40 lbs., and are particularly rich in copper. Some fine large samples of lead ore have also been contributed by Mr. Grosvenor, of Yass. The ore was obtained from a place called Jobbins, about five miles from Yass; it has a very rich and beautiful appearance.

Arrowroot, which is the pith or starch of the root *Maranta arundinacea*, and received its common name from its being supposed to be an antidote to the poisonous arrows of the Indians, is represented in this Exhibition by two or three very creditable specimens. The cultivation of arrowroot, although apparently quite successful in this colony, has not yet obtained for it any demand either as an article of commerce or even of colonial use, beyond a very limited extent. The arrowroot sold in Sydney is mostly that of the West Indies, which is generally admitted to be the finest quality in the British market, and to be much superior to that obtained from the South Sea Islands. The amount of labour required for producing the arrowroot to the state in which it is used for food, will probably, for some time at least, deter the growers from attempting to compete in its production with other

countries, even if the article could command an equal commercial reputation.

One of the samples of arrowroot is exhibited by G. F. Leslie, Esq., having been grown in the garden of Captain Wickham, the Government Resident at Moreton Bay. A second sample is presented by T. Childe, Esq., also from Moreton Bay. Two other samples, both from the above districts, were exhibited severally by T. S. Warry, North Brisbane, and by Ambrose Eldridge, Esq., from the Stockton and Hunton Chemical Works, prepared by Mr. J. E. Blake.

Chemical Preparations.—Sulphuric acid is made by the same process as in England, in large leaden chambers. The sulphur is from New Zealand, and is very pure, containing 95 per cent. sulphur, a very slight trace of selenium, and no arsenic. It possesses an advantage over that by English makers in this respect, that most of the acids, being made by pyrites, contain arsenic. The specific gravity is 1·750 to 1·800. The price at which it can be sold is about 3d. per lb.; but should a large demand arise for stearine candle-making, the working of platinum, silver, or the purer gold ores, it might be manufactured for considerably less; and I am not without hope that a demand of this nature may shortly spring up.

Nitric acid. If this acid should be required, it could be made in any quantity. It would be useful in fumigating hospitals, or in case the colony were visited by cholera or fever.

Muriatic acid, like nitric acid, could be made in considerable quantities, the only drawback being the high price of common salt.

Products of the decomposition of coal tar. 1. Naptha.—So far as has yet been ascertained, the produce of naphtha from colonial coal tar is much less than from the English coal tar, and the quantity of tar obtainable in the colony being small, the manufacture is necessarily limited. 2. Heavy oil, or dead oil, or pickling oil. The first two names are given on account of the great specific gravity of this product, as it sinks in water. Its chief use is in pickling or preserving timber against the effects of salt or of fresh water, cobra, &c. It is in very general use in the East Indies, for pickling piles in forming wharves, and might be most advantageously employed in our waters. To use it properly the timber should be placed in a reservoir from which the air is exhausted, so that the oil, when admitted, finds its ways into the pores of the wood. 3. Railway grease. This is a yellow oil or grease, solid at ordinary temperatures. It is particularly adapted for lubricating the wheels of railway carriages, trucks or tramways, &c., on account of the ease with which it melts, should friction cause any heating of the axle. Mr. Blake states that he can obtain this in considerable quantities. The sample shown is not completely prepared "railway grease," but it contains the substance from which this article is prepared. 4. Pitch. The sample shown is rather small, and was made with the intention of being converted into asphalt, or patent fuel, but at present it could not be obtained in sufficient quantity to make either of these an article of commerce. These are all the products hitherto obtained from coal tar, although the chemical results of the decomposition of this substance are very numerous indeed.

Deodoriser. This is a neutral sulphate of zinc, possessing all the properties of Sir William Burnett's disinfecting fluid. In contact with decomposing animal matter, the acid takes the ammoniacal emanations, while the zinc precipitates the sulphuretted hydrogen, carburetted hydrogen, &c. It is concentrated in the highest possible degree, and in use should be mixed with from ten to fifty times its bulk in water. It can be sold at one-half the Sydney price of Sir W. Burnett's manufacture, and in this warm climate, where the drainage of our hastily built cities has not been attended to, would prove invaluable in counteracting the baneful effects of the exposure of feculent matter. Sulphate of zinc may be crystallised, and can be obtained in a shape admitting of safe and easy carriage.

Marine Products.—Some specimens of sponge obtained from the Heads of Port Jackson, are exhibited by Mr. Hordern. This substance which was formerly supposed to be a vegetable production, but has since been classed amongst the zoophytes, does not seem to have been found in any quantity—a circumstance, perhaps, rather to be attributed to the difficult and hazardous process by which it must be procured, than to any absence of the article along our coasts. The specimens are of small size, and not of very fine quality. The exhibitor has also sent an interesting specimen of marine moss, also gathered at the Heads of Port Jackson.

### CAPE COLONY.

The show of articles illustrative of the resources of this colony, collected by the Committee for the Paris Exhibition, closed on the 5th January.

Though very far from what it might have been, had the interior and frontier districts come forward more freely with their produce, the show was, on the whole, extremely creditable to the Cape, most of the established staple articles of produce being well represented, while the specimens of copper ore from the Namaqualand mines are so rich, beautiful, and abundant, that they cannot fail to attract the attention of the manufacturing and mercantile men who, from all parts of the world, will assemble at the Imperial Exhibition.

The following were awarded prizes:—

Wool.—Clothing quality; prizes adjudged to Messrs. M. and H. Breda, of Zoetendals Valley. Combing quality; to D. G. Breda, of Ratels River. Average quality; to T. B. Bayley, of the Oaks, Caledon.

Minerals.—The prize for the finest specimen of copper was adjudged to one of two large masses of ore, weighing 300 lbs. each, from the mines of Messrs. Phillips and King, at Springbok and Spectacle. A beautiful specimen of ore from the mine of Mr. J. O. Smith, No. 2, was also adjudged worthy of transmission.

Tallow-Candles and Berry Wax-Candles.—Prizes awarded to Mr. James Mossop.

Colonial Woods.—To Dr. Pappe and Mr. Zeyher, for a collection of specimens, and a box inlaid with different kinds of Cape wood, finely polished.

Curiosities.—To Mr. C. Bridges, for lion and tiger-skins. To Mrs. A. J. van Breda, for feather-tippet, composed of feathers of Cape birds.

Grasses.—To Mr. T. B. Bayley, for a collection of grain and grasses, from Caledon.

Tortoiseshell.—To Mr. James Harden, for three superior specimens.

Silk.—To Mr. G. Baker, of Picketberg, for various specimens of reeled and floss.

Cotton.—To Mr. A. Faure, for a beautiful sample grown at Stellenbosch.

Tallow, Soap, and Bees' Wax.—To Mr. James Smithers.

Flour.—To Mr. H. A. O. Truter.

Mealies (Maize).—To Mr. J. C. Gie.

Cape Preserves.—To Mr. Volsteedt.

Hides and Goat Skins.—To H. Hess and Co., Port Elizabeth.

Horns.—To Mr. Bridges.

Salted and Preserved Meats.—Pork, to W. Martin; beef, to P. L. Morkel.

Biltong.—To Mr. Nicholson.

Preserved Meats.—To Mr. Daster.

Medicinal Plants.—To Messrs. Scheuble and Co.

Gum.—To Mr. H. B. Christian.

### INDIA.

The Punjab contribution to the Paris Exhibition was exposed to public view in Calcutta, and attracted an immense crowd of visitors. The collection consisted almost entirely of the silk and shawl manufactures of the Punjab, and comprised almost every species

of the valuable cloths manufactured in the far North-West, from the plain woollen chudder to the famous Cashmere shawl. The *Englishman*, from which I quote, thus notices the contribution:—"The silks from Umritsur, Mooltan, &c., appear to be of a very superior quality to what we remember having seen before, and the contrast of quality between what was sent in 1851 is very striking. The collection of armour is well worth seeing, and shows how very much superior the workmen of the Punjab are to their brethren in Lower Bengal. The assortment of valuable jewellery, comprising almost every sort of ornament worn by rich natives, will show not only the taste of the people, but also the foolish manner in which Bengalees spend their money. We observed in a glass case some very valuable gold articles mounted in precious stones; a golden cup, decorated with rubies, diamonds, and other precious stones, attracted our particular attention. These have been presented to the Governor-General by the King of Ava. In workmanship they very much resemble the China silver work, though the execution is much inferior, indeed almost rough. A pair of ivory chairs, made at Berhampore under the supervision of Capt. Layard, are very handsome, but the velvet covering does not seem in keeping with the exquisite carving. It ought, at all events, to have been embroidered either in gold or silver. The ivory mat from Sylhet is an admirable one, and will give people at home some notion of what the natives of this country can do. The Kincabs and Brocades from Benares are, as usual, very rich, and will attract notice. This was the most valuable of all the shows, and at a rough calculation it cannot cost less than three lakhs of Rupees. The Committee appear to have set to work in good earnest, and they certainly deserve the thanks of Government for the splendid collection they have been able to forward to Paris, a collection three times as extensive as that sent to London in 1851, and valued, we believe, at between six and seven lakhs of rupees," £60,000 to £70,000.

A very extensive list of desiderata and prizes offered at the Madras Exhibition is given in the local papers of that presidency, of which I append a summary, which may furnish many hints to explorers, and considerations for investigation. It will be observed that prominence is given to those substances of a fibrous nature, the demand for which has become so great in consequence of the stoppage of the supply from Russia. As this kind of produce will always command a ready market, its importance cannot be overrated. Particular attention is also called to the "best series of raw materials suited for the manufacture of paper." This is also a subject of great importance, the price of paper having risen very much in consequence of the scarcity of rags. Some short time since I saw a statement in the *China Mail* having reference to this subject, stating that the paper on which that journal was printed was manufactured from the fibre of the bamboo by the Chinese; its quality was excellent, being firm and of good colour. The sub-committee suggests that twenty prizes should be available in the vegetable department, ten in the animal, and fifteen in the mineral; these prizes to consist of pecuniary rewards, prize medals, or honorary certificates. The premiums offered are in the

VEGETABLE KINGDOM.

1. For the best specimen of shell-lac.

Specimens of the lac-bearing branches with the insect, would be interesting; information concerning the mode of collecting and uses of the lac will be thankfully acknowledged.

2. For the best sample of gum elastic, possessing properties similar to caoutchouc or gutta percha, *bona fide* the produce of S. Hindoostan; or for the best sample of any new vegetable production of this kind, which might be advantageously introduced into commerce.

The kuttemundoo gum of Vizagapatam, for introducing which W. Elliott, Esq., received a prize medal, was considered a valuable addition to the India rubber series. It merits a careful examination. Messrs. Healy and Luttrell have shipped a considerable quantity since the favourable report of the Exhibition jurors.

3. For the best series of Indian gums, *i.e.* natural exudations of indigenous trees, containing more or less mucilage.

4. For the best specimen of any fragrant gum-resin, as elimi, anime, myrrh, with information as to the tree producing it, and the quantity procurable.

5. For the best sample of gamboge prepared in homogeneous masses, or run into bamboo moulds, and free of woody fibre or other impurities.

The Coorg and Malabar gamboge being identical with that of Siam, it is desirable to extend the trade by careful preparation of the article.

6. For the best specimens illustrating a starch series, or failing this, any new or superior species of starch.

7. For the best oil series, of which there are a very great number in India.

8. For a good specimen of any new oil, or a series of volatile oils.

9. For the greatest number of vegetable dye-stuffs.

10. For any new colouring materials or dyestuffs.

11. For the best collection of materials which from time to time have been introduced for the use of tanners.

12. For any new or important tanning material.

13. For the best and most instructive collection of cottons, showing the peculiarity of fibre.

14. For the best sample of country cotton (gossypium indicum).

15. For the best sample of Georgian cotton (gossypium barbadense).

16. For the best sample of Peruvian cotton (gossypium accuminatum).

17. For the best sample of flax (linum usitatissimum).

18. For the best sample of hemp (cannabis sative).

19. For the best collection of miscellaneous fibres, as jute, sunn, plantain fibre, yercum-nar, marool, &c.

As the demand for fibres is now so great, it is most desirable that some of the little known fibrous substances should be carefully treated, in the hope of their proving excellent substitutes for the common materials, and thus developing new branches of industry.

20. For the best series of raw materials suited for the manufacture of paper.

As rags have become so scarce in England as to enhance their price, any careful experiments as to the use of other raw materials will be received with approbation.

21. For the most complete and well-arranged collection of timber and fancy woods.

22. For the best samples of tobacco (Lunka and Trichinopoly sheroots, &c.)

VEGETABLE SUBSTANCES USED AS FOOD, &c.

23. For the best samples of E. I. Coffee.

24. For the best series of cerealia, including millets and other small grains used as food.

25. For the best series of pulses and cattle food.

26. For the best sample of refined sugar.

27. For the best sample of raw sugar.

28. For the best collection of spices produced in the Madras Presidency, (cinnamon, cassia, nutmegs, pepper, ginger, &c.) or for any new condiment of a superior description deserving encouragement.

ANIMAL KINGDOM.

29. For the best samples of wool bonâ fide the produce of the Presidency.

30. For the best samples of silk the produce of the Presidency.

31. For the best sample of tussa silk.

32. For the best illustrative series of horns and antlers.

33. For the best sample of mother-of-pearl and tortoise shell.

34. For the best sample of cameo-shells and corals.

35. For the best isinglass prepared in the Peninsula.

36. For the best fish oil.

37. For the best samples of mylabris cichorei.
38. For the most comprehensive collection of feathers and down.
39. For the best skins, tanned and curried for exportation.

MINERAL KINGDOM.

1. For the best series of iron and wootz-steel ores, in its different stages of preparation.
2. For the best samples of native plumbago and antimony.
3. For any other metallic ore, holding the promise of being marketable.
4. For the best chrome ore.
5. For the best sample of alloys, brasses, bell-metals, type-metal.
6. For a good sample of coal.
7. For the best sample of carbonate of soda prepared from dhobies earth.
8. For the best sample of saltpetre.
9. For the best samples of native salt.
10. For the best samples or series of native soaps.
11. For the best materials for making glass.
12. Materials for pottery.
13. Granite, laterite, and building-materials.
14. Emery and corundums.
15. Oil-stones, hone-stones, soap-stones, and lac grind-stones.

## THE SLAG OF SMELTING FURNACES.

Sir,—It may be interesting to some of our members who have joined the Society since 1848, to be informed that a paper entitled "Pyrolite or Artificial Lava," dated the 17th of April of that year, was read at one of the Wednesday evening meetings, and was afterwards printed in the Transactions. In that paper I shadowed out, suggestively, many of the useful applications of slag, of which the practicability has now been shown by Dr. W. H. Smith, of Philadelphia, in the valuable paper read before the Society on Wednesday last.

The Society's Prize List for 1848, contained a notice of a Premium of 50 guineas offered "for the best series of experimental researches on, and specimens of the application of slag or other allied products to new purposes, useful or ornamental," and reference was made to the suggestions contained in my paper. No competitor having presented himself, the premium was withdrawn.

I deposit herewith a printed copy of the paper in your hands for reference.

Yours, &c.,
T. TWINING, Jun.

Twickenham, 3rd April, 1855.

## THE DECIMALISATION OF OUR CURRENCY AND ACCOUNTS.

Sir,—In Mr. Rathbone's letter in your last number appears the following quotation:—"There seems little likelihood that while the Americans and the French have *unsuccessfully* attempted to introduce *three* of account, we in England should be satisfied with the comparatively complicated system of *four*."

With no intention to prolong this discussion, I ask permission to observe, that it does not follow because the *decimals* florins, cents, and mils—are to be substituted for the *fractions* shillings, pence, and farthings—ergo, we must adopt *four* coins of account.

It is not necessary that £1, 9 florins, 9 cents, and 9 mils, should be entered under *four* distinct coins of account, when it is evident the same may be expressed in *one* coin, as £1·999; or under *three* separate columns, £1, 9 florins, and 99 mils. The cent in *account* is unnecessary.

The argument that, because you adopt the decimal term cent, for brevity of expression, you must necessarily introduce it for the purpose of account, if worth anything, would apply to every coin in use; and, therefore, because at present we have 12 coins in circulation, we must also have 12 coins of account.

A rich specimen of what logicians call *dicto secundum quid, ad dictum simpliciter*—"That which is bought in the shambles is eaten for dinner; raw meat is bought in the shambles; therefore, raw meat is eaten for dinner."

Yours, &c.,
JAMES S. TRIPP.

Kew Green, March 17th, 1855.

## DECIMAL COINAGE.

Sir,—In the Journal of the 19th of May last, I suggested that the rendering of accounts *in terms of one denomination only*—the unit being a defined weight of silver, namely, $1\frac{3}{4}$ grains, to be termed the "coin" of account—would accomplish the desired reformation in our monetary system, with the least possible difficulty and inconvenience to the public.

Since then I have tried various experiments to discover practical objections, if any, to the use of the existing money tokens, regarded as multiples of the proposed "coin;" and because facility in counting so as to make up any required sum, is obviously the first essential, I endeavoured to realise in my own mind the degrees of difficulty likely to be experienced by persons totally ignorant of arithmetic, such as, unfortunately, the great mass of the humbler classes.

Thus, in purchasing an article costing 47 "coins," to be paid for with pence, halfpence, and farthings, a person would have to count by fours, twos, and ones; and if he happened to be unpractised in the multiplication table, he would certainly find the first of these operations so troublesome, that I doubt the propriety of allowing the "coin piece" to stand part of the system. If suffered to remain, as some propose, in conjunction with a "rimpenny" counting *five*, the matter would be much worse, as may be verified by asking an illiterate servant girl to add up the following numbers in the order given:—5, 4, 5, 4, 4, 4, 5, 4, 4, 5, 1, 2.

Addition by fives, however, would present very little difficulty to the smallest intellect, and here I would venture to propose a measure which has not hitherto, to my knowledge, been even hinted at, namely—let all the existing penny tokens, with or without rims, count as *fives*, the halfpennies and farthings still counting as twos and ones respectively.* The table will then stand thus:—

| | | | | |
|---|---|---|---|---|
| 3 copper | Farthing, equivalent to | 1 | coin | |
| | Halfpenny | 2 | coins | |
| | Penny | 5 | ,, | |
| 5 silver | 10-coin piece | 10 | ,, | |
| | 20-coin piece | 20 | ,, | |
| | (Sixpence) | 25 | ,, | (temporary) |
| | Shilling | 50 | ,, | |
| | Florin | 100 | ,, | |
| | (Half-crown) | 125 | ,, | (temporary) |
| | 200-coin piece | 200 | ,, | |
| | (Crown) | 250 | ,, | (temporary) |
| 2 gold | Half-sovereign | 500 | ,, | |
| | Sovereign | 1000 | ,, | |

I think it will be found, on close investigation, that the plan here proposed presents fewer objections to an immediate adoption than any other which has been made public.

I remain, sir,
Your obedient servant,
SAMUEL A. GOOD.

H.M. Dockyard, Pembroke-dock, 16th April, 1855.

P.S.—It has occurred to me that the word "cash" would be preferable to "coins" in speaking of sums of money. For instance, "Price, 37 cash" seems to sound better than "Price, 37 coins." If the terms "cent" and

* Of course the immediate issue of new copper tokens, with the numbers stamped on them, would be advisable, and the old ones should be withdrawn from circulation as soon as possible.

"mil" were applied in their natural sense, as brief synonyms for the words "hundred" and "thousand," instead of "hundredth" and "thousandth," as some propose, the names "florin" and "pound" might be dispensed with, and we should have the following convenient table:—

100 cash make 1 cent.
10 cent make 1 mil.

This expression would accord with the technical expression "per cent." which would then signify "per hundred cash."

### TAKING OUT PATENTS.

Sir,—I took out a patent in January, 1855, for an invention for "Constructing vehicles without axletrees, and thus affording an improved method of lowering the body of the vehicle." On going to town with a view to dispose of my invention, curiosity led me to visit the Free Library of the Commissioners of Patents, where I found, on inspecting the printed indexes, that a patent (No. 4581) had been taken out in 1821 for the very same thing, though my patent agent had informed me that he believed my invention was quite new. Had I possessed the means of access to these indexes in my native town so fatal a mistake could not have occurred; but, as it is, being only a working mechanic, the blunder will, in all probability, lead to the most injurious results.

I am, Sir, yours, &c.

WILLIAM TOWNSEND.

Coventry, April, 1855.

## Proceedings of Institutions.

Barnstaple.—The completion of the first decennial period of the existence of the Literary and Scientific Institution was celebrated on the 10th inst. by a *soirée*, which was honoured by the presence of Viscount Ebrington, Chairman of the Council of the Society of Arts, and W. F. Rock, Esq., of London, a munificent patron of the Institution. Upwards of 400 persons, consisting of members and their friends, were present on the occasion. A report had been previously published by the Committee, reviewing the progress of the Institution from its foundation, and recurring to the somewhat peculiar circumstances which attended its origin. Early in the year 1845, when a movement was on foot for the establishment of a Literary and Scientific Institution in the town, not without some misgiving as to its ultimate success, Mr. Rock, a native of Barnstaple, announced his desire of supporting such an undertaking, and proposed to contribute an annual sum of £100 for the purpose. The Institution was consequently founded, and on a comprehensive scale, embracing not only the usual features of reading and newsrooms and library, but likewise the promotion of popular education by means of lectures, a system of class instruction, and a museum; and the generous assistance of Mr. Rock has been continued to the present time. The history of the past ten years will be illustrated by the following abreviated Statistical Table:—

| Year ending in March. | Total Number of Members. | Strangers introduced. | LIBRARY. | | | | LECTURES. | | | Total number of Classes. | Total number of Pupils. | FINANCE. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Volumes. | Volumes presented. | Circulation. | Circulation per head. | Literary. | Scientific. | Total. | | | Total Income. £ s. d. | Total Expenditure. £ s. d. |
| 1846 | 430 | 218 | 2,070 | 1,790 | 4,896 | 11·3 | 7 | 16 | 23 | 4 | 72 | 456 11 0 | 371 14 4 |
| 1847 | 393 | 160 | 2,360 | 67 | 6,160 | 15·6 | 7 | 14 | 21 | 2 | 56 | 369 14 10 | 370 12 11 |
| 1848 | 368 | 124 | 2,680 | 161 | 7,432 | 20·2 | 3 | 4 | 7 | 1 | 22 | 311 0 4 | 310 13 9 |
| 1849 | 338 | 135 | 2,970 | 22 | 6,966 | 20·6 | 4 | 3 | 7 | — | — | 281 3 7 | 280 16 4 |
| 1850 | 326 | 108 | 3,104 | 18 | 6,308 | 19·3 | 6 | 5 | 11 | 1 | 26 | 273 11 11 | 273 2 7 |
| 1851 | 328 | 107 | 3,233 | 40 | 7,239 | 22 | 3 | 7 | 10 | 2 | 43 | 276 11 2 | 284 11 11 |
| 1852 | 333 | 89 | 3,403 | 87 | 6,761 | 20·3 | 4 | 4 | 8 | 1 | 30 | 285 2 9 | 278 14 3 |
| 1853 | 339 | 90 | 3,570 | 53 | 6,178 | 18·2 | 2 | 3 | 5 | 2 | 45 | 265 11 8 | 260 3 6 |
| 1854 | 325 | 82 | 3,750 | 18 | 6,168 | 19 | 5 | — | 5 | 4 | 86 | 262 0 7 | 263 19 9 |
| 1855 | 307 | 118 | 4,025 | 117 | 5,165 | 16·8 | 7 | 2 | 9 | 6 | 109 | 270 15 1 | 272 11 9 |
| | 3,487 | 1,231 | | 2,373 | 63,273 | 18·3 | 48 | 58 | 106 | 23 | 489 | 3052 2 11 | 2967 1 1 |

The arrangements for the *soirée*, to which allusion has been made, were admirably carried out by a special committee On the walls of the large lecture-room were hung upwards of a hundred choice paintings, contributed for the occasion from various private collections in the locality, and the high class of which will be evident when it is stated that they included works by Raphael, Da Vinci, the Caracci, Salvator Rosa, Claude, Zuccherelli, Wouvermans, Teniers, Vandyck, Lely, Kneller, and Reynolds. Two rooms were devoted to the beautiful collection of photographs, nature-prints, and chromo-lithographs, lent by the Society of Arts; another to miscellaneous local photographs, and a superb series illustrating Venice. In the library were a few choice engravings and water-colour drawings, and the tables were occupied by a crowd of microscopes, and a group of stereoscopes (kindly lent by the Society of Arts), which were well exercised during the evening, to the infinite amusement of the visitors. Another room was devoted to a series of illustrations of the war; and another, filled with a collection of fine engravings, after Hogarth's popular works, recalled the associations of the last century. In the museum were arranged a variety of works of art, derived from various sources—stained glass, the tasteful work of Beer, of Exeter; *terra cotta* articles from Blashfield, casts of architectural ornaments from Brucciani, besides Italian bronzes, porcelain, artificial flowers of great beauty, series of monastic seals, &c., &c., contributed from the neighbourhood. An interesting arrangement of local fossils, and specimens of the woollen manufacture of the town, were also exhibited. The assembly was presided over by the mayor of Barnstaple, John Harris, Esq., by whom and the hon. secretary of the institution, J. R. Chanter, Esq., it was successively addressed; the latter, on behalf of the committee, presenting to Mr. Rock, a handsomely bound volume of the ten years' Transactions, in graceful recognition of his liberal and disinterested regard

for the intellectual welfare of the inhabitants of his native town. The Right Hon. Viscount Ebrington, M.P., then addressed the crowded audience in happily-expressed terms, remarked on the earlier course of the Institution, which exhibited the usual burst of enthusiasm at the outset, the rapid decline, and slow but healthy revival, which was the best evidence of the soundness of the undertaking. He asked particular attention to the arrangements of the Society of Arts for the examination of the classes of Institutions, and predicted much benefit therefrom. Mr. Rock feelingly expressed his great gratification at the scene around him, and rejoiced in the numerous results of his own efforts and those of the committee, of which he had been made aware. He concluded by introducing Edward Capern, a poet, whose talents had been developed within the institution. Mr. Capern then recited a selection from his poetry with great energy and effect. In the intervals of the foregoing incidents, some excellent pieces of music, glees, &c., were performed by a highly-efficient amateur orchestra, and during the evening, tea and coffee were dispensed in a temporarily-covered space, called the "parterre," tastefully decorated with evergreens, and lighted with a profusion of variegated lamps. The exhibition of paintings, photographs, and works of art, was kept open to the public on the two succeeding days.

Bedford.—On Wednesday, the 11th inst., Lord Charles J. Fox Russell gave a very interesting lecture on the "Normans and Normandy." Thomas Bernard, Esq., mayor, presided. A hearty vote of thanks was given to his lordship for his kindness in delivering the lecture. The annual meeting of members was held in the previous week, W. Blower, Esq., M.P., in the chair, when the vice-president, treasurer, secretary, librarian, and auditors were unanimously re-elected, and the vacancies in committee filled up. Mr. Coombs, the secretary, read the Report, which stated that the number of members had somewhat increased during the year, the library had been enriched with many good books by purchase and donation; among the donors was the late Ambassador to St. Petersburgh, Sir Hamilton Seymour. The Treasurer reported a handsome balance in hand—and the society's affairs were altogether in a most prosperous condition.

Cheltenham.—A second course of lectures to the working classes has been delivered at the Literary and Philosophical Institution. The subjects were: "On the Seasons, as treated by the poet Thompson," by the Rev. R. Greaves; on "Mental and Moral Heroism," by the Rev. A. M. Brown, LL.D.; on the "Eddystone Lighthouse," by the Rev. C. H. Bromby; on the "Life of Edward Baines, as Illustrative of Self-Advancement," by W. M. Tartt, Esq.; on "Sanitary Reforms and the Health of Towns," by H. Dangerfield, Esq.; and on the "Use of Knowledge, and how to get it," by T. Wright, Esq., M.D. On the termination of the course, the working men intimated their intention of having a tea meeting at the Town-hall, at which their thanks would be offered to the gentlemen who had lectured, and they were invited to be present. It took place on Wednesday in last week, under the presidency of the Rev. C. H. Bromby; there was a very full meeting, and both those who encouraged, and those who were likely to benefit by the progress of education, passed a most gratifying evening. After tea, an excellent selection of vocal music was given between the addresses (chiefly of a practical character) which were delivered on the occasion; one of the best of which was by Mr. Garrison, a working man, and an active promoter of the lectures.

Clapham.—The Lecture course of the Literary Institution closed on the evening of the 30th ultimo. Mr. Topham lectured on "Shakspeare's Incidental Teaching" to the largest audience of the session. The lecturer said, that even Shakspeare's marvellous poetry was rivalled by his humanising philosophy. He drew attention to much of his counsel, which was illustrative of the loftiest axioms of Christian morality; and gave many illustrations from his dramas, wherein Shakspeare practically enforced the truth of his own phrase, "kindness is nobler ever than revenge." Shakspeare, it was said, always discouraged any manifestation of scornfulness, and so depicted the lowly as to bring out the "one touch of nature that makes the whole world kin." The mountaineers in Cymbeline, notwithstanding their "rude" lives, are represented as full of sympathy and tenderness. The Apothecary, in Rome and Juliet, is so depicted as to arouse compassion for poverty tempted into crime. The Magician, in the "Tempest," is so sketched as to impress us kindly and compassionately for those who at this period had to endure the penalty of burning at the stake; and his representation of the mob, in the historical plays, although thought by some to be a depreciation of the people, rather tends inferentially to teach the necessity of spreading knowledge and education among them. The lecturer touched most ably upon a variety of other topics—Shakspeare's general portraiture of humanity—his views as to the government of the world by Providence—his winning female delineations—and finally his feelings as to patriotism—that principle with him being specially identified with *gratitude* for *national justice*. A unanimous vote of thanks was given to the lecturer.

Hastings.—The Lecture Session was brought to a close on Monday evening, April 2nd, when Frederick North, Esq., M.P., one of the Vice-Presidents of the Institution, gave a lecture "On the Geography and Characteristics of Eastern Europe." The Swan Assembly-room, which had been engaged for all the lectures since Christmas, owing to the limited accommodation in the Institution's own premises, was densely crowded. The honourable gentleman gave a lucid description of the Eastern parts of Europe and their inhabitants, their physical and intellectual qualifications, and interspersed his description with reflections, tending to place Western Europe and its inhabitants in striking contrast with the East. Protestantism and intellectuality seemed to go hand in hand in the progress of the human race and the inhabitants of the West, with their institutions and modes of government. The honourable member advocated the means taken by Mechanics' Institutions in diffusing knowledge by means of public lectures, and expressed a hope that succeeding courses would be even more successful than the past. The president, George Scrivens, Esq., occupied the chair. The session just terminated has been one of the most prosperous, as far as regards numerous audiences, of any in the history of the Institution. This has been mainly owing to the fact, that the committee, on principle, encourage nothing of a light and frivolous character in the lecturing department, but aim at imparting instruction rather than amusement, being of opinion that Mechanics' Institutions are not the vehicles for finding amusement for the people. The following lectures have been delivered during the session:—Two on "Geology," and one on "Phrenology based on Ethnology," by Mr. D. Mackintosh; two on "Oxygen and Hydrogen Gas;" one on "Electrical Conductors, and Non-Conductors;" and one on "Time," by Mr. John Banks; also one on the "Stars," by the same gentleman; one on "Eastern Habitations;" and one on "Australia and her Gold Fields," by the Rev. John Stent; one on the "Geology of Hastings," by Mr. Joseph Pitter; one on "Little Things," by the Rev. G. Stewart; one on "Botany," by Mr. Keyworth; one on "Local Botany," by Mr. Arthur Ransom; one on "Crime and its Remedies," by Mr. R. Dawson; one on "Chronology," by Mr. Womersley; one on the "Homes of the Middle Ages," by Mr. W. Caveler, President of the Literary Institution, Margate; one on "Oliver Goldsmith," by Mr. T. Hudson, of London; one on the "Pendulum," by Mr. Dobell; and one on "Joan of Arc," by the Rev. R. N. Young. With the exception of five of the above, the lectures were by members of the Institution, and many of them have been delivered during the winter at other Institutions in the county which are in union with the Society of Arts. Endeavours will, in all probability, be made by the committee to obtain, ere another session, more com-

modious premises. The Institute at present possesses but three classes, owing mainly to their scant accommodation.

LIVERPOOL.—The public lectures delivered during the spring at the Collegiate Institution have been as follows: Two by Byerley Thompson, Esq., on the "Army and Navy;" two by J. M'Cann, Esq., on "Extinct Animals;" and two by T. C. Archer, Esq., on "Silk and Wool."

REPTON.—The first annual report of the Institute states that there are now 110 members, but comparatively few working-men, or agricultural labourers. The Savings' Bank numbers about 140 depositors, by whom the sum of £150 has been deposited. The library contains 350 volumes. A Recreation Club has been established in connection with the Institute.

ROYSTON.—On Tuesday and Wednesday, 13th and 14th March, Dr. Trevethan Spicer (of London) delivered two excellent lectures, at the Mechanics' Institute, "On Physical Geography," which were listened to with marked attention and evident pleasure by large audiences. The lecturer introduced the subject by adverting to the necessity of commencing with the *beginning* in every branch of study, and pointed out the mischief that accrued from plunging in *medias res*, without the precaution of laying a solid foundation, by generalising on science as a whole, before investigating any subject in particular. He gave it as his opinion that the atomic theory was the basis on which the superstructure of scientific knowledge must be raised. That matter consists of ultimate atoms, invisible, indivisible, and indestructible, is the opinion of most philosophers, and that the variety of appearance is due merely to difference of arrangement; so that, although the primary atoms are all alike, and emphatically the same, yet, owing to the mode in which they are united, the variations in the amount of matter, and the extent of interstice, nature provides us with an inexhaustible variety. That the atoms are all identical is proved from the simple circumstance that it matters not what we eat, the result is blood—from which fluid is elaborated, by the mysterious agency of life, all the multifarious components of the human body—bone, flesh, skin, nail, hair, &c. Then, again, how wondrous is the law of form! (Morphology.) Another point to be considered is the connection of the sciences, for it is absolutely impossible to study one branch of knowledge without reference more or less to all the others. Another question of great importance is that of "Destruction and Reproduction." The circulation of nature is constant—the destruction of one form of matter is the creation of another—the death of some organised beings is the creation of others. Thus the earth by its very constitution is eternal, and can only be destroyed by the Almighty hand of Him who called it into existence.—On Tuesday, 3rd April, Mr. Joseph Fearn, of London, delivered an impressive lecture "On the Poetry and Lyrics of Charles Mackay." The lecture was interspersed with critical observations, in which it was shown that the poet always wrote with a holy purpose; and among many other excellent qualities to be found in Mackay's writings, Mr. Fearn signalised the *true-heartedness* which was so conspicuous in all. The large audience separated evidently delighted with the lecture.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on* 31*st March*, 2*nd*, 3*rd*, 5*th*, 7*th*, 12*th*, 13*th*, 14*th*, *and* 16*th April*, 1855.

Par. No.

145. New South Wales—Copies of Orders in Council.
146. Victoria—Copy of Order in Council.
149. Expiring Laws—Report from Committee.
65. (2) Trade and Navigation—Accounts.
143. Paupers (Scotland)—Return.
147. Chapters—Return.
148. Russian Exports—Return.
152. Education of Pauper Children—Communications.
155. Committee of Selection—8th Report.
162. Wounded Officers (Crimea)—Return.
110. Local Acts (21, Exeter and Exmouth Railway; 22, Llynvi Valley Railway, and Bridgend Railway; 23, Oxford, Worcester, and Wolverhampton Railway)—Reports from the Admiralty.
153. British Spirits—Return.
113. (1) Linseed, &c.—Return.
133. Shipping and Tonnage—Accounts.
165. Steam-ship *Philadelphia*—Correspondence.
82. Cholera (Sandgate)—Report by Mr. Blackwell.
144. Russian Vessels—Return.
160. New Zealand—Correspondence.
146. Victoria—Copy of Order in Council (a Corrected Copy).
161. Quarantine (Gibraltar)—Report by Dr. Baly.
163. Poor Law (Scotland)—Communications.
140. Civil Services Estimates—Classes 1, 2, and 4. (No. 1).
127. Metropolitan Districts Paving, &c.—Return.
154. Commissariat Chest Account, 1853-4.
156. Army before Sebastopol—2nd Report from Committee.
137. Increase and Diminution (Public Offices)—Abstract of Accounts.
63. Bills—Public Libraries and Museums (Ireland).
64. Bills—Marriages (Scotland).
67. Bills—Friendly Societies (as amended by the Committee, and on Recommitment).
69. Education (Scotland).
71. Places of Religious Worship Registration.
73. Parliamentary Representation (Scotland) Act Amendment.

Transport of Stores, &c., to the East—Papers.
Highways (England and Wales)—Receipts and Expenditure.
Steam-ship "Morna"—Report by Commander R. Robertson.
Medical Charities (Ireland)—3rd Report of Commissioners.
Turnpike Trusts—2nd Report by the Secretary of State.
Local Charges upon Shipping—Report of Commissioners (Ireland).
Sardinia (Reciprocal Opening of the Coasting Trade)—Convention.
Turkish Troops (British Service)—Convention.
Public General Acts—Cap. 11 and 12.

*Delivered on* 17*th April*, 1855.

Fairs and Markets Commission (Ireland)—Minutes of Evidence. Part 2.

*Delivered on* 18*th of April*, 1855.

151. Appointment of Children (New South Wales)—Copy of Communications.
70. Bill—Free Schools.

## MEETINGS FOR THE ENSUING WEEK.

MON. Antiquaries, 2. Anniversary.
Geographical, 8½.

TUES. Royal Inst. 3. Dr. Tyndall, "On Voltaic Electricity."
Syro-Egyptian, 7½. Anniversary.
Civil Engineers, 8. Mr. J. Barton, "On the Economic Distribution of Material in the sides or vertical portion of Wrought Iron Beams."
Med. and Chirurg., 8½.
Zoological, 9.

WED. Royal Soc. Literature, 3.
Society of Arts, 8. Lieut.-Colonel Cotton, "On Public Works for India, especially with Reference to Irrigation and Communications."
Microscopical, 8.
London Institution, 12 p.m. Anniversary.

THURS. Royal Inst. 3. Mr. G. Scharf, jun., "On Christian Art."
Numismatic, 7.
Royal, 8½.

FRI. Philological, 8.
Royal Inst., 8½. Sir Charles Lyell, "On the Origin of certain Trains of Erratic Blocks on the Western Borders of Massachusetts, U.S."

SAT. Royal Inst., 3. Dr. Du Bois Reymond, "On Electro-Physiology."
Royal Botanic, 3¾.
Medical, 8.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, April* 13*th*, 1855.]

*Dated* 27*th March*, 1855.

674. J. C. Bourne, Holmes-terrace, Kentish-town—Photographic apparatus.
676. W. Yates, jun., Woburn-place, Russell-square—Treatment of grain from which beer or spirit has been made.
678. J. Getty, Liverpool—Vessels.

*Dated* 28*th March*, 1855.

680. G. L. Turney, Wood-street, Cheapside—Packing pins and needles for sale.
682. J. S. Perring, Radcliffe—Permanent way.
684. F. E. Hudde and J. B. E. Fouquet, Paris—Pyrometers.
686. W. Dray, Swan-lane—Gear. (A communication.)
688. E. H. Becker, Altham—Projectile.

690. T. McLow, Middle-row, Holborn—Screw propellers.
692. J. Peabody, Old Broad street—Motive power by action of wind. (A communication.)

*Dated 29th March*, 1855.

694. J. Gedge, 4, Wellington-street South—Stopping railway trains. (A communication.)
696. M. J. T. Gillot and C. C. Beauvois, 30, Upper Charlotte-street, Fitzroy-square—Purifying grain, &c.
698. J. Porritt, Stubbins Vale Mills, near Ramsbottom—Steam engines.
700. J. Blair, Glasgow—Hats.
702. J. H. Johnson, 47, Lincoln's-inn-fields—Anchors. (A communication.)

*Dated 30th March*, 1855.

706. H. W. Parnell, 13, Bryanstone-square—Ships and boats.
708. W. Swain, Birmingham—Furnaces.
712. J. Morgan, Manchester—Candles.
714. E. V. Neale, Russell-place, and T. Dawson, King's-arms-yard—Umbrella handles, &c.
716. T. W. Bunning, Newcastle-upon-Tyne—Steam-engines.

*Dated 31st March*, 1855.

718. C. Whitley, Manchester—Drilling machinery.
720. W. Corbitt, Rotherham—Warming and ventilating.
722. W. E. Newton, 66, Chancery-lane—Centre-bits. (A communication.)
724. G. F. Wilson and G. Payne, Belmont, Vauxhall—Treating oils.
726. E. and M. Abbott, Horningsea, Cambridge—Stays.

*Dated 2nd April*, 1855.

728. A. E. L. C. Finimerhaus, Liege—Forcing projectiles.
730. J. Shand, 245, Blackfriars-road—Fire-engines.
732. C. Crews, 8, Montague-terrace, Bow-road, and H. G. Gray, St. James's-street—Disinfecting compounds.
734. R. Peyton, Birmingham—Iron gates and fences.
736. W. Lund and W. E. Hipkins, Fleet-street—Cork-screws.

*Dated 3rd April*, 1855.

738. R. E. Witty, 9, Torriano-avenue, Camden-road-villas—Reflecting solar light.
740. T. Prideaux, Birmingham—Draining plough.
742. H. Powers, Florence—Tiles.
744. W. E. Gill, Totness, and H. B. Sheridan, Parsons-green—Fish oil.
746. J. Maas and J. Adams, White-hart-yard, Southwark—Mills for grinding grain.
748. H. R. Fanshawe and J. A. Fanshawe, North Woolwich—Waterproof fabrics.
750. M. Evrard, St. Etienne—Drawing compresser.
752. C. Nickels, Albany road, and J. Hobson, Leicester—Weaving pile fabrics.

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## WEEKLY LIST OF PATENTS SEALED.

*Sealed April 13th*, 1855.

2189.—Sir James Caleb Anderson, Bart., Fermoy—Improvements in locomotive engines.
2191. Charles Frederick Stansbury, 17, Cornhill—Improved apparatus for heating buildings.
2193. William James Barsham, Stratford—Improvements in machinery or apparatus for crushing mineral and other substances.
2195. John Harrison, Brighouse—Improvements in the bosses applied to millstones.
2200. Christopher Holt, New-road, St. Pancras—Improvements in fastenings for the laths of iron bedsteads, couches, and other similar articles of furniture.
2201. Robert Pinkney, 26, Long-acre—Improvements in bottles, jars, and other like vessels, and in the method of stoppering them.
2205. John Henry Pape, Paris—Improvements in the manufacture of boots and shoes.
2208. John Bonnall, Spittlegate, Grantham—Improvements in apparatus for holding oil for lubricating purposes.
2216. George Scheutz and Edward Scheutz, Salisbury-street—Improvements in machinery or apparatus for calculating, and printing the results of such calculations.
2304. John Wainwright, Birkenhead—Improvements in fitting up shops, offices, and other like places and shop fronts.
2314. Thomas Prosser, New York—Improvements in condensers of steam-engines and parts connected therewith.
2488. John Davie Morries Stirling, Blackgrange, Clackmannan, N.B.—Improvements in the manufacture of metallic tubes.
250. George Ritchie, 3, Monmouth-place, New-cross, New Kent-road—Improvements in beds or mattresses.
282. William Sandford Roberts, Lodersville, Susquehanna, U.S.A.—Coupling railway carriages.
284. John Grainger, Birchwood, Alfreton—Improvements in the manufacture of pantiles.
290. George Tomlinson, Bousfield, Sussex-place, Loughborough-road, Brixton—Improvements in looms for weaving ornamental figured fabrics, and in the constrution of the rollers to be used upon the pattern chains of such looms.
306. William Bridges Adams, 1, Adam-street, Adelphi—Improvements in the construction and application of elastic springs for sustaining loads or moderating concussion in fixed or moving machines or carriages.

*Sealed April 17th*, 1855.

2218. Louis Cornides, 4, Trafalgar square, Charing-cross—An improved apparatus for amalgamating the gold and silver contained in pulverized ores.
2221. Alfred Illingworth and Henry Illingworth, Bradford—Improvements in machinery or apparatus for combing wool and other fibrous substances.
2223. Robert John Chippindall, 39, Rue de la Rochefocauld, Paris—An improved pencil case.
2230. John Mason and William Robertson, Rochdale—Improvements in machinery or apparatus for preparing and spinning cotton and other fibrous substances, part of which improvements is also applicable for shifting straps by which motion is communicated in other machines.
2236. Samuel Mason and William Beeby, Northampton—Improvements in the manufacture of coverings for the human leg and foot.
2237. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in the construction of grates.
2238. John Platt, Oldham—Improvements in machinery or apparatus for making bricks.
2245. Julius Smith, Gainford-place, Barnsbury-road, and Frank Sandom Thomas, South-terrace, Walworth—An improved apparatus for steering ships and other vessels.
2248. John Jamieson, Oldham—Improvements in steam engines.
2253. Henry Hales, Brighton—Improvements in the machinery for propelling vessels.
2262. François Jean Bouwens, Mechlin—An improved rotary engine.
2267. John Welsh, Greenock—Improvements in extracting liquids from saccharine and other matters.
2272. Richard Roberts, Manchester—Improvements in machinery for preparing and spinning cotton and other fibrous substances.
2284. Charles Henry Olivier, 37, Finsbury-square—An improved apparatus for drying.
2301. Richard Archibald Brooman, 166, Fleet-street—Improvements in centrifugal machines, and in driving the same.
2317. Bewicke Blackburn, Clapham-common—Improvements in the manufacture of pipes.
2377. Ignace Porro, Paris—Certain applications of total or partial reflection of light on transparent surfaces, either alone or combined with the refraction.
2452. Richard Keefe, Nock Mills, near Trim, Ireland—Improvements in dressing flour.
2561. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury— Improvements in coating and colouring metals and alloys of metals.
2718. Charles Henfrey, Turin—Improvements in the construction of railway for steep gradients, and in the machinery or apparatus employed therein or connected therewith. (A communication.)
2716. Warren de la Rue, Bunhill row—Improvements in treating products arising from the distillation of a certain tar or naphtha to render the same suitable for dissolving or removing fatty or resinous substances.
67. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the construction and manufacture of ordnance.
211. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—An improved machine for manufacturing thimbles employed on board ship or elsewhere.
239. Martin Samuelson and Alexander Samuelson, Scott-street Foundry, Hull—Improvements in steam-engines.
255. James Timmins Chance, Birmingham—Improvements in the manufacture of pipes or tubes of glass or other vitreous matter.
284. George Audemars, Lausanne, Switzerland—Improvements in obtaining and treating vegetable fibres.
287. John Grove Johnson, 18 A, Basinghall-street—Improvements in surgical bandages.
301. George Fergusson Wilson and George Payne, Belmont, Vauxhall—Improvements in treating glycerine.

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## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3707 | April 18. | Emett's Chimney Top, for the Prevention of Smoky Chimnies, &c. ... | Alfred Emett .................. | 13, Mount Pleasant, Liverpool. |
| 3708 | " " | French and Portable Cooking Lamp...... | Knight, Merry, and Exley | Birmingham. |

Journal of the Society of Arts.

FRIDAY, APRIL 27, 1855.

## NINETEENTH ORDINARY MEETING.

Wednesday, April 25, 1855.

The Nineteenth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 25th inst., Robert Lowe, Esq., M.P., in the Chair.

The following Candidates were balloted for and duly elected:—

| | |
|---|---|
| Alexander, Caledon | Norton, John |
| Allison, George | Powell, Francis |
| Almgill, Thomas | Pritchard, John, M.P. |
| Chevallier, George Smart | Simmonds, Peter Lund |
| Gordon, J. W. | |

The paper read was

## ON PUBLIC WORKS FOR INDIA, ESPECIALLY WITH REFERENCE TO IRRIGATION AND COMMUNICATIONS.

By Col. Arthur Cotton, late Chief Engineer, Madras.

This is a vast subject. It seems impossible to compress even the leading points of it into the compass of a short paper; you will bear with me, therefore, if I come at once to the point.

The first thing, then, seems to be the state of India in respect of public works. Besides innumerable minor works, which are required in every country, fully to develope the material and even moral welfare of a people, in whatever climate, and which cannot be even touched upon here, there are, first of all, in a tropical climate, or even in an extra-tropical one, which has a rainy season that is sometimes very scanty, works of irrigation.

Secondly. In all climates, communications.

Thirdly. Harbours.

It seems most obvious that the fundamental principle in political economy is to secure, as far as possible, an abundant supply of food, with only such an expenditure of human labour as shall leave a large surplus of the time of the community for all those things which constitute the difference between the mere animal and the intelligent being. Until a large portion of the community are set free from labouring to produce food, there can be no cultivation of the mind, even if, with the labour of all, a supply of food is secured; but if to this degree of difficulty of obtaining food there is added, from occasional failure of periodical rains, famine, the misery and evil, both physical and moral, is indescribable. Now, in a tropical climate at least, the managemement of the water is, according to my 30 years' experience in India, undoubtedly, and beyond all comparison, the most important thing to be attended to, in order to provide for these two things, a supply of food that shall be, first, as certain as possible, and, secondly, obtained with only a moderate degree of labour. I think this is clearly shown by this very simple fact. In India, water is raised from wells and rivers in every district from the Himalayas to Cape Comorin, by means of bullocks and men, for the purpose of irrigation, at an average of about 6,000 cubic yards for a pound sterling. This is an unmistakeable proof that it is worth, at least, so much, otherwise it would not continue to be raised by millions of cubic yards, year after year, at that cost; and then, further, water can be provided by means of works on a large scale, and applied to the land at the rate of 100,000 to 300,000 cubic yards for a pound. This is proved by the actual cost of large works executed by our government.

I will only here give one instance of the provision of water on a large scale. The system of works for the irrigation of the Delta of the Godavery, 400 miles north of Madras, consisting of a weir, or anicut, as we call it, across that river, with the channels and various works of masonry required for distributing and regulating the water throughout the Delta, will cost about £300,000. The works are now approaching completion, and they are, to a great extent, in operation. The water will be distributed over 1,200,000 acres, and allowing 4 per cent. interest on the outlay, and an equal sum for management and repairs, the actual cost of the water will be about 30,000 cubic yards for a pound. This, however, also includes the making the channels navigable, so that the whole Delta will be pervaded by a system of water communication, all the large ones being fit for steam navigation. This is certainly one of the most favourable situations for such irrigation, but if we take even 200,000 cubic yards of water for a pound, the cost is not one-thirtieth of the proved value of water for irrigation. There can be little hope that any means of cheapening food can be found to surpass this. It is just as if a man in this country found a kind of manure that would cost a pound an acre, and increase the produce by 70 bushels of wheat, worth £30. Another proof of the effect of water is given by the government return of all the new irrigation works in the Madras Presidency for 13 years, which showed an average result of 70 per cent. on the outlay, in government revenue, so that, including the profit to the landowners, it could not have been less than 200 per cent. in all, or fifty times the interest of money.

But besides this effect of water in diminishing the labour required for raising food, there is an absolute necessity for such works, to prevent actual famine. Almost every part of India is occasionally visited by famine, from the failure of the Monsoon rains, and there are few parts in which hundreds of thousands have not died of it under our rule. Only last year, in one district, the government had to provide 100,000 people with employment for several months, while they fed them to prevent them starving.

Secondly, with respect to communications, I need not say much on the value and necessity of them, as they are equally required in all climates, though the importance of them in a vast continental country, where the distances are very great, is incomparably greater than in a small country, like England, with its natural very cheap water transit round its coast, within a comparatively few miles of every part of the country. With respect to the movement of goods, the fundamental principle seems to be *that everything is worth more in some other place than where it is*, and consequently that an increased value can be given to it by moving it, if it can be transferred sufficiently cheap; and things which are utterly valueless where they are found, will be of some value in other places, and hence that an increased value can be given to the product of a country, by a system of cheap transit, to an extent which cannot be calculated, but as whatever the transit costs is so much deducted from the net profit of transit, the object to be aimed at is the *annihilation of the cost of carriage.* This should never be lost sight of. The question is not "Is such a mode of transit cheaper than such another?" but, "Is it the cheapest that can be devised for such a line of communication?" When first tram-roads were invented they used wheels of very small dimensions, because, they said, the draught was so easy that large ones were unnecessary; but in time they have found out that there was no sense in throwing away the further advantage to be obtained by large wheels. However, that mode of reasoning is constantly applied to this day in arguing about communications; and there will be a hard battle fought before England is provided with a system of steam boat canals, in which the goods can be conveyed at one-eighth of a penny a ton a mile; instead of the present

modes of conveyance by railway at 1d., and by small canals at ½d., exclusive of tolls, and by the coast at ⅓ to ⅐ of a penny.

And, with respect to the conveyance of passengers, the principle seems to be, that in proportion as time and cost are diminished, is the power of communications increased in innumerable ways, many of them far beyond our perception. But time is a far more important element in the question of passenger transit than in that of goods; yet it is far less so than is generally supposed, as is proved by this, that in the summer by far the greater part of the first-class passengers travel by sea in 50 hours from London to Edinburgh, with all the risks and inconveniences of a sea voyage, in preference to going by land in twelve, the cost of the sea transit being 14s., and that of the railway from 60s. to 80s., from which it is evident that, even in the wealthiest country in the world, almost the whole of the travellers would prefer going at 10 miles an hour at a certain cost, than pay five times as much to go at 40 miles: and hence we conclude safely that in a poor country like India cheapness is the grand desideratum both for goods and passengers, and that high speed is comparatively quite insignificant.

The third essential in the way of public works seems to be harbours. No country in the world can supply itself with all that is required for a highly-civilised state of society, and consequently to provide for the cheap shipping and landing of goods is essential to the welfare of every country; but especially in this case, where a country like India can at once obtain all the benefits of the manufacturing skill and capital of a country far more advanced than herself by sending her own raw produce to purchase it.

The cheapness of sea transit depends in a great measure upon the safety of the shipping at the ports, and the facility of landing goods; and as the whole world is here brought into competition, upon this cost of shipment must depend whether a country's produce is saleable at all, or not, and in proportion as that which a country has to sell is bulky is the importance of cheap ports to her.

It is not for the sake of her few hundred tons of indigo, but for her hundreds of thousands of tons of rice, oil seeds, sugar, hides, &c., that it is of such consequence to India whether a ship's expenses in port are a shilling or ten per ton o goods.

We cannot proceed further with this subject without an attempt at a really fair estimate of the actual state of India at present with respect to these great essentials, public works. And it is impossible to travel a hundred miles in India without being quite satisfied on this point, that there never was a more astonishing failure in the world than ours has been in our management of India with respect to this, which lays at the very foundation of all improvement. Nay, we cannot land at many places, and, among them, at no less a place than Madras—a seat of government, and a city of 600,000 inhabitants—without unmistakable proof of the unaccountable apathy we have shown about such improvements. This great port is not only at this moment without shelter for shipping, but without any means of avoiding the surf, so that we are still using the very native surf-boats that were found there 100 years ago; and, besides the enormous expense that is incurred in shipping goods, not a year passes without people being drowned in crossing the surf, and the most dreadful wrecks with prodigious loss of life, take place, within pistol-range of the Fort and the houses of the town, under the eyes of the governor himself, and the members of Government. Let us take, next, a district at this moment in the state in which the great mass of of the country is now lying—nineteen out of twenty—of the 100 and more districts into which the country is divided. Let us suppose a rich traveller; he sends on, a few days before he starts, to have fourteen men posted at every twenty-five or thirty miles to carry his palanquin, and one pair of baskets to carry seventy pounds weight of clothes. The bearers are brought from, perhaps, 50 miles, perhaps 100 miles, to their appointed stations. With these preparations he sets out, and manages, if he travels through the burning sun, to proceed at 3½ miles an hour, at a cost of from about eightpence to a shilling a mile. In each district he passes through there is, perhaps, fifty miles of imperfectly made road, on a surface of 10,000 square miles, equal to ten English counties—perhaps not a single mile, excepting the carriage drive at the principal European station. There are certainly some miles of made road, provided with bridges in some districts, and there is one extended line up the Valley of the Ganges, but these do not fairly represent the state of the country—they are very rare exceptions. If our traveller has goods to take up the country, and he stops at 400 miles from the port, they will reach him in six weeks, if they have not been stopped by the rivers, at a cost of £6 a ton.

Now imagine a portion of England without a mile of made road, or canal, or railway; without a bridge, and wholly impracticable to anything but a man on foot or an animal, and even to them for several months in the year; and then suppose this tract of land to be cut off from the ocean by from 1 to 500 miles of similar country, and an idea will be formed of the state of the people in India. For seven or eight months in the year, when the surface is dry, and there is no water in the rivers, goods are conveyed in bullock carts, by stages of ten miles a day, at a cost of 4d. a ton a mile, in a country where money is about six times the value it is here, calculated from the cost of labour and food; so that this charge is equivalent to 2s. a ton a mile in England, and when we add to this, that whereas in this country the distances to be traversed to reach a port or a market, are perhaps one-fifth what they are in India, this cost of transit forms as heavy a tax as 10 shillings a ton a mile would be in England. If we compare simply the cost per mile, without considering the distances, it gives us a totally false notion of the state of the case.

Let us take the instance of a ton of Berar cotton, and compare its cost of transit in India and England. It costs £12, and is conveyed 400 miles for £6, to the Indian port. On its arrival in England, it is conveyed from Liverpool to Manchester for, I believe, 5s.; its inland transit in England, therefore, costs one twenty-fourth of that in India, but the £6 in India represents 2 tons of human food, and the 5s. in England represents 30lbs. weight of flour, the proportion being as 1 to 150. This is the true way of comparing the state of transit in India with that in England. Now, if we consider what would be the consequence if the tax upon the transit of goods were increased in England 150 fold, we may understand what India is suffering from want of commerce, and this is the actual state of India generally. The exceptions are, that two or three main lines of road, such as the grand trunk road leading from Calcutta up the valley of the Ganges, have been partially made, but even on these many bridges are wanting. In the Agra presidency, in the Punjaub, and in Mysore, a good many miles of road, more or less complete, have been made. Only one district, I believe, in all India has been regularly provided with practicable roads, steadily carried on year after year for the last 30 years. So that it has now 1000 miles on a surface of about 5000 square miles; these are almost completely bridged, but the roads are not metalled, though they are practicable throughout the year.

There are also a few miles of railway; about 150 are now open, and they are now proceeding at the rate of perhaps 100 miles a year. They talk of carrying them on more speedily, but all that can be done in this way must be utterly insignificant towards opening India. England has already one mile of railway to ten square miles, and even at this rate it would take 130,000 miles for India. So that if they were to proceed at ten times the present rate, it would take 130 years to open the country even to the extent England is provided with communications of

this kind, and it is evident that even then several hundred thousand miles of common roads, or light railways, or canals, would be required. But further, no extent of railways would answer the purpose. As main lines of communication for goods, railways do not, and never can, answer. They totally fail in the two grand essentials; they cannot convey the quantity of goods required, neither can they convey at the low price required. The Ganges is at present estimated to transport 2,000,000 tons a year, and if the whole country were provided with cheap communications, connecting it with the interior, the traffic would very soon be 5,000,000 tons, while the most crowded railway in England only conveys about 400,000 tons. And as to the cost of transit by them, it seems now clearly ascertained that the railways cannot carry at less than 1d. a ton a mile, including wear, management, and cost, exclusive of interest on capital, if the said railways were worked with fast trains, while for the long distances in India, the cost ought to be reduced to one-tenth or one-twentieth of a penny a mile. In America, on the Hudson and Mississippi, it is about one-seventh of a penny. In England, a very small portion of the traffic is conveyed by rail, probably nineteen-twentieths are carried by water, either by the coast or by canal. Between Manchester and Liverpool, eleven-twelfths of the traffic in goods are by canal, according to the last parliamentary inquiry. On the east coast of England, 3,500,000 tons of coals alone are conveyed, and probably 8,000,000 or 10,000,000 tons of goods in all, while on the Great Northern Railway only 400,000 tons, as before stated, are carried. Were there a canal for 300-ton steam-boats, like the St. Lawrence Canal, between Durham and London, as it could convey goods at about half the cost of coast transit, the goods traffic would be greatly increased, and could be hardly less than 5,000,000 tons a year, the coals alone being at present 4,000,000 tons, producing a saving of more than £1,000,000 sterling a year. How much more unfit would the railways be to accommodate the goods traffic of a continent like India.

But the most remarkable exception to the state of India generally, with respect to communication, is the district of Rajahmundry, before alluded to. The new works there have already provided about 600 miles of connected water communication, and when the works are completed there will be full 1,000 miles. Thus the whole Delta will be provided with one mile of the cheapest communication to every three square miles of surface, and will be thus really and effectually opened out. Of the effect of this upon the people, an idea may be formed from this, that in the principal canal, which was opened in 1851, there passed, last year, nearly 8,000 boats, besides great numbers of rafts of timber and bamboos, in the fourth year, on a line over which there could not have been 5,000 tons moved before. But in a few years, when the whole Delta is opened, there can be no doubt that more than 100,000 tons will pass along it, and when the Upper Godavery is navigated,—and this canal forms the outlet of 130,000 square miles of country, which is throughout provided with cheap transit,—perhaps 500,000 tons will soon be conveyed by it.

Another exception is the opening of the Upper Godavery, here referred to. This case is one of the most striking proofs of the unaccountable misapprehension of the subject of communications shown in our management of India. This magnificent river and its branches, passing through the best cotton country in India, cotton purchased at about 1½d. a lb., a country also producing excellent wheat at from 8d. to 1s. 6d. a bushel, though proved to be navigable by the use made of it by an enterprising European house at Hyderabad, for two or three years previous to its bankruptcy, has been totally neglected by the government, and the petty Zemindars on its banks have been allowed to stop all use of it by claiming whatever tolls they pleased, excepting that timber has been floated down the lower part. With this river passing through the middle of the cotton country, and terminating at a safe harbour, the cotton has all been hitherto carried on bullocks 400 miles, either to Bombay or to the banks of the Ganges, at an expense of £6 a ton, besides risk and damage, while it could have been carried by the river for 10s., if only the Government had attended to it, put a stop to the interference of the Zemindars, and expended a moderate sum in improving its bed. An officer has now, after several years that the matter has been pressed upon the government, been appointed to superintend the improvement of the river. The sum of £5,000 has been placed at the disposal of the Governor of Madras, and a small steamer has been sent out. The engineer has been peremptorily ordered on no account to exceed that amount, which, as about 700 miles of river can be used, amounts to £7 a mile. Such is the view of the value of a river connecting a first-rate cotton and wheat country with the coast, a communication which there is every reason to believe will powerfully affect the whole empire, by supplying England with abundance of cotton.* Some further water communications are also in progress in Madras. Works similar to those in the Delta of the Godavery are under execution in the adjoining Delta of the Kistnah, and a line of canal is being executed from 60 miles north of the Godavery to Cape Comorin, 850 miles parallel with the coast, and connecting the three rivers, the Godavery, the Kistnah, and the Cauvery. A similar line is forming by connecting the backwaters for 300 or 400 miles along the west coast of the peninsula, so that within three years, we may reckon upon having about 4000 miles of connected water communication in the Madras Presidency. In Bengal, the grand canal running along the narrow strip of country between the Ganges and Jumna, for 450 miles, and with its branches measuring in all 850 miles, is also well advanced, and will form a communication of immense importance, though, strange to say, very little account of its use for navigation has been taken, and, perhaps, it will be left imperfect in that respect till the matter of communications is better understood.

There are two points particularly to be observed with respect to the communications:—

1st. That which is doing has been almost all undertaken within the last few years, and solely under external pressure; and, 2nd, that they are only isolated works, that there is not, as yet, any symptom at all of, properly speaking, a system of communication for all India being undertaken.

Nothing worth mentioning is as yet doing in by far the greater part of the districts, nor even any preparations for it.

What has been done, and is now doing, in Rajahmundry or corresponding works, according to the nature of the country should be at this moment going on in every district in India. About ten years will have sufficed to give that small tract of 3,000 square miles 1,000 miles of really cheap communication. If this were done in every district at once—and there is no imaginable reason why it should not—ten years would suffice to provide India with 100,000 miles, which would be at the rate of one mile to every thirteen square miles. The expenditure in Rajahmundry has been about £30,000 a year, and it has almost all been expended on the spot, in quarrying, building, excavating, &c. In other districts a large proportion of the outlay would be on light railways, in which case, perhaps, half the money would be spent on material; so that, with the same amount of money and local labour a much larger amount of improvement might be accomplished.

When I speak of nothing whatever being done towards a systematic arrangement for supplying India with communications, I do not mean to say that people do not

* The sum not to be exceeded is just the cost of half a mile of high-speed railway, so that 700 miles of river navigation, that will carry at from one-eighth to one-fourth of a penny a ton a mile is considered exactly equal in value to half a mile of railway that will carry at one penny, so strangely perverted are the present ideas on Indian communications.

fancy that they are doing this. They continually talk as if what was now doing about railways was really the supplying India with a system of communications; but there could not be a more palpable delusion. Suppose England were surrounded by land instead of water, so that it had no coast communication, that it had no turnpike roads or canals, and that all that was doing was to make half a mile of high-speed railway a year on each of three lines, such as from Southampton to London, from Liverpool to Birmingham, and from Edinburgh to Glasgow, so that, in 100 years, three or four main lines of such railway would be open, while all the rest of the country was waiting for these works; and when the founders of this scheme are remonstrated with, they reply, "Wait a little, we are making a grand experiment; we are trying whether we cannot have perfect communications at once." So they begin in spending five years in laying 150 miles of railway, during which time the country has lost at least 150 millions sterling for want of communications—for this want causes a loss of at least thirty millions a year to India—much more than the whole of the taxes. This is rather an expensive experiment.

I will now proceed to consider the state of the country in respect to its irrigation. This, in fact, corresponds exactly with that of the communications. One single district, Tanjore, has been in a certain sense systematically attended to, almost from our first obtaining possession of it. About 30 years ago, one or two of the old Mahommedan canals in the North-west were restored and improved, and within the last eight years two extensive systems of works—one on the Ganges, and one on the Godavery, already mentioned as communications—have been undertaken, and are both now partially in operation. But, with these exceptions, there is scarcely a district in India in which even the old native works have been fully kept in repair; indeed, there is not one in which multitudes of works (where they exist) are not in every stage of insufficiency down to complete ruin, though in some districts many of the most important have been both kept in repair and improved. Of the consequences of this, in the awful famines that have repeatedly desolated the country, we have had abundance of lessons which *à priori* one would have thought it was impossible that men could help learning from. In one district of Guntoor, in 1833, 200,000 out of half a million inhabitants, perished. On this occasion nothing could induce the Government to move a finger till 70,000 of those starving men, having left their families to perish, invaded the city of Madras, when it was found that *something could* be done; but it was then too late. But I am not speaking only of 20 years ago; only last year there was a severe drought, which gave a certainty of scarcity, and probably famine. The matter was pressed upon the Government, especially with reference to the district of Bellary, where the scarcity was greatest. But nothing could induce the Government to take any really effective steps to provide for the time when the means of the people would be exhausted. The consequence was that 100,000 people had to be fed at the Government expense, without any proper preparation or organisation, and almost the whole of the money so expended was in consequence thrown away. Had preparations been made, 100,000 men in six months might have executed a system of irrigation works which would have secured the district for ever from actual famine, unless under such circumstances as have never hitherto occurred. There are only two districts at this moment in the whole Madras presidency, excepting those I have mentioned, where, if there were such a failure of the Monsoon as has often before occurred, there would not be all the horrors of famine, and this is generally the case throughout India. The way in which the actual state of things has been hidden from the people of this country has been by mentioning two or three works that have been undertaken within the last few years, as representing the general system of management, which is nothing more nor less than a complete deception.

I must, however, give some account of what has been done. In Tanjore on an average about £8,000 a year has been laid out for forty years on public works, and this trifling sum has been sufficient, not only to keep the old works in repair but to pervade the whole district —in a rude way, indeed—with an effective system of irrigation and common roads with bridges; and the results have been that the population has increased from 800,000 to 1,500,000, and the revenue from £320,000 to £500,000, while the other districts have remained nearly stationary. This district has never had even a scarcity; and on every occasion, without exception, of famine in other parts of the country it has poured out enormous supplies of food. While almost the whole of the lands of the presidency are worthless, that is, unsaleable, the whole of the Tanjore lands are saleable at prices about equal to those of England, allowing for the difference in the value of money. The works of the Godavery were commenced 8 years ago, and a large portion of the 1,200,000 acres to be ultimately benefited, are now receiving water, though in an imperfect way. The result already is, that last year, one of severe drought, when all the surrounding country suffered greatly, so that grain was double the ordinary price, the revenue of the district was 25 per cent. higher than the average of years before the works, a difference of £50,000, and the sea exports of produce alone were £170,000 against £30,000 the average of years preceding the works, and this besides the vast exports to the surrounding districts by land.* The cost of these works has been about £200,000, and probably about £300,000 in all will be expended.

A similar set of works is now commenced on the next river, the Kistnah, and they are also partially in operation.

But the greatest work is the grand canal led from the Ganges, from the point where it enters the alluvial country before alluded to. It will cost about 2 millions, equal to 12 millions in this country, so that it is the largest engineering work in the world. It was begun about 8 years ago, and some water has already been admitted, but it is only in operation to a very small extent yet. It is, however, a noble and most important work, not as a work of irrigation only, but as a line of steam boat communication, if it is perfected. As such it will be, excepting the Erie and the St. Lawrence canals, the most valuable communication in the world, and if it were carried on to Calcutta it would be the most important without exception.

The state of the coast in respect of harbours is just the same as the interior in respect of communication and irrigation, Madras is at this moment in precisely the state it was when we first occupied it; there is neither a breakwater for the shipping, nor any means for communicating from them to the shore, except by the catamarans and masoolah, or surf-boats, that we found there. Not £20,000 has been spent in all the ports in the Madras presidency. At Coringa, on the east coast, there is a safe anchorage, but for want of a dredged channel of 3 or 4 feet deep through a bank, ships cannot get into the river for repairs if they draw more than nine feet. In almost all the ports a master-attendant is paid perhaps £100 or £150 a year, and as it is seldom that an efficient man can be found at such a price, I have known one so employed who was not a seaman, and who was utterly without one qualification for the duties. Such is the astonishing misapprehension of the value of ports to the country.

It must not be supposed that there was not nominally a system of management for public works, but that the department was ludicrously inadequate. In a tract of country requiring twenty Europeans, and an expenditure of £50,000 a year, there would be one European, and an expenditure of £1000 a year. In the district of Rajahmundry, the expenditure had been, up to 1840, £400 or £500 a a year, for all the roads, tanks, canals, rivers, &c., and a

* One year the exports of *produce* (exclusive of a small cloth trade) of this, nearly the richest alluvial tract in the world, had actually fallen to £9,000, a tract capable of bearing 2½ millions of people.

fifth share of the time of one engineer, in a district containing 7000 or 8000 square miles, one-seventh the size of England. Now surely nothing can be more obvious than this, that on taking possession of a tract of country, the very first thing should be to form a department and sanction an expenditure adequate to the following works:

1st. To keep in repair all existing public works, such as tanks, canals, &c.

2nd. To provide it with some kind of rough communication with bridges.

3rd. To apply our western science in improving the rude works of the natives.

4th. To extend the means of irrigation till the district was in some degree secure from famine.

5th. To provide some kind of communication superior to common roads in at least a few main lines.

Without this it is absolutely impossible that the country can increase in wealth, and provide the means of instruction, &c., or even for justice, &c. While the whole population of a country is employed in raising food, nothing can be done towards elevating them. England is rich, and can afford to acquire knowledge, because by means of public works so much is done that must otherwise be done by human labour, the necessaries of life can be provided by the labour of only a small portion of the community, and there is consquently a vast amount of human labour available for other things. India is poor, because, excepting bullocks, it has nothing that saves human labour, and this lies at the root of all its evils. Its courts of justice are 100 or 200 miles apart, because with the present revenue, the Government "can't afford" to have more. The whole people are in a state of the greatest ignorance, because the government "can't afford" to educate them. It is impossible for any person who has not been for some time resident in India, to conceive the indignation one feels at the sight of these masses of people so utterly neglected. To have some adequate apprehension of this, one had need to have laboured for thirty years among these millions, wholly without the knowledge of anything worth knowing, and generally in the lowest state of poverty, because not provided with those public works which are essential to improvement of any kind, while we had it in our power to bestow upon them a share of all those advantages which we possess in England. Of the way in which the subject of communications has been valued, not fifty years ago, but quite lately, two anecdotes will enable one to judge. A demand was made for £1000 to provide for an expedition being sent up from the Delta to examine the Upper Godavery. Papers by the Civil Engineer, Revenue Commissioner, the Board of Revenue, and others, giving at length information on the subject, showing that it was the natural communication between the coast and ten millions of people, that it opened up the best cotton tract out of America, that 30,000 tons of cotton a year were now sent from it 400 miles on bullocks' backs, that it could supply cotton enough for England two or three times over, &c. This was sent to the government of India, and so utterly insignificant did it appear to them, that they did not think it worth while to answer a single paragraph of any of the papers, but merely replied, in three lines, that they doubted whether it would be useful, and that in the present state of the finances the money could not be granted. At the time that this £1,000 could not be spared to examine a river by which England could be supplied with cotton, there was, according to a letter from the India House to the Government of India, £13,500,000 sterling, in rupees, in the treasury.

The other case is this:—An engineer sent in an estimate of £700, for cutting a few miles of canal, to connect two long lines of backwater on the west coast of the peninsula, on which there was already a great trade. In refusing this, the Madras Government directed the engineer in future to attend to matters of more importance, and not to occupy himself with such things.

Again, in a paper by the Government consulting engineer, Col. Baker, written by order of the Governor-general, on the subject of public works, he sums up his views on the subject in a series of conclusions, in which not a word is said on the importance of giving India generally a system of communication without delay; not a word on the effect of cheap transit, nor a word on the importance of irrigation.

These things show the astonishing misapprehension of the whole subject that still exists on the part of old Indians, and the absolute necessity of bringing the matter under the notice of the people of England, who, not having breathed the atmosphere of indifference to Indian improvement by means of public works for thirty or forty years, are capable of receiving right impressions on the subject.

What I insist upon is this:—

1st. At this moment the great mass of India is without those public works which are essential to the welfare of the people. The works which have been carrying on of late years, in a few localities, viz.,—the Punjaub, Agra, Rajahmundry, and Tanjore, if brought forward, as they constantly are, as representing the general state of India, convey a totally false impression of the actual state of things. They are merely exceptions; and,

2nd. That after all the pressure of English public opinion that has been brought to bear upon this subject, there is as yet no symptom of the formation of a department of public works at all adequate to the wants of the country. As to the great railways, as at present carrying on, meeting the demands of the country, no greater delusion ever existed. Suppose Yorkshire was without one mile of canal or common road, and the inhabitants were told that Government were laying a first-rate railway from Southampton to London, which, in course of time, might be extended northward, so as at last to pass through that county. Such is a correct representation of the case as respects the great mass of India.

Even were it possible to lay 100 miles of these railways where they now lay one, they would not answer the purpose. What would be the state of Yorkshire, even when the railway did reach it? Would a single railway running through it supply the place of its 10,000 miles of canal, light railways, and turnpike roads. It is not one communication passing through a country that opens that country. The whole country must be pervaded by communications. Again, they propose to charge on these railways a penny a ton a mile, corresponding with sixpence in this country. In the first place the Ganges, in its present unimproved state, carries at one-third of a penny a ton a mile, and were it improved, as it might be —were a hundredth part of the money required for a mile of these railways laid out on each mile of the river—it could be worked at one-sixth of a penny. But even where a railway has not to contend with water carriage, as in the case of the valley of the Ganges, what effect will it have upon the distant traffic of the country, carrying at a penny a ton a mile. This on 500 miles would amount to £2 a ton. It is evident, from all that has been written upon these Indian railways, that nobody concerned in them is aware that the railways scarcely touch the distant traffic even in England and America. At a late meeting of the English North-Western Railway proprietors. it was stated that the average receipts were:—

| | s. | d. |
|---|---|---|
| Per ton of coals ............ | 2 | $3\frac{1}{2}$ |
| Do goods ......... | 7 | 2 |
| Per Passengers ............ | 2 | $8\frac{3}{4}$ |

I do not know exactly what the charges for coals are, but if we allow only a penny, which is certainly below the mark, they are thus only carried, on an average, $27\frac{1}{2}$ miles. The charges on goods are from $1\frac{3}{4}$d. to 9d.; if we take the average so low as 3d., the distance they are carried is only 29 miles; and the passengers at an average of $1\frac{3}{4}$d. a head, the average distance is under twenty

miles. In *Herapath's Journal*, again, it is stated, that the total receipts in all England for 42 millions passengers is only $3\frac{1}{2}$ millions sterling, which gives 1s. 8d. only per passenger, and allowing $1\frac{3}{4}$d. as the average per mile, it gives an average distance travelled of only 12 miles, showing, at the prices charged on English passengers, how extremely small the amount of travelling is even in this wealthy country on long distances. Again, Lardner gives the average distance that goods are conveyed in America by the railways, at only 38 miles, and adds—"*But little merchandise is transported by them, the cost of transit by them being greater than goods in general are capable of bearing.*" He also shows that in Belgium only 12 out of 1,000 tons are carried more than 100 miles. Again, in all that has been written about these Indian railways, the great fundamental principle of traffic is never once referred to, viz., that its amount on any given line is proportioned to the cost of transit. On the main line of all, that up the valley of the Ganges, it is proposed to convey goods at three times the cost by the river in its unimproved state. But even on other lines, it is merely proposed somewhat to reduce the present cost, as from $1\frac{1}{2}$d. or $2\frac{1}{2}$d. to 1d. But the real question is not, will the railway carry it at a rate somewhat lower than the present rates, but will they carry at the lowest rates that are attainable. If goods are carried at 3d. a ton, there will be, we will suppose, a traffic of 50,000 tons a year; if on the same line the rate is reduced to a penny, perhaps 100,000 tons will be carried; if to 1-8th of a penny, perhaps half a million, and if to 1-16th, probably a million.

The value and quantity of goods conveyed on any line in India, supposing a million conveyed may be something like this—

10,000 tons of £50 a ton, and upwards.

100,000 tons of £10 and upwards, such as cotton, sugar, saltpetre, iron, &c.

300,000 tons of £3 and upwards, such as rice, salt, &c.

600,000 tons of inferior grains, firewood, straw, building materials, &c.

Nineteen-twentieths of these things would not bear transit for any distance at 1d. a ton a mile; yet upon every ton moved there would be some profit, or they would not be transported at all. It is stated that in the Ganges the traffic is two million tons a year. Were the country deprived of this river navigation, and left dependent on the railway, at least nine-tenths of this traffic would be destroyed, Calcutta reduced to a fourth-rate port, and all Bengal and the Upper Provinces paralyzed, just as would be the case now with Manchester. The railway could not possibly carry a quarter of the present traffic, and if the water communications were destroyed, Manchester would be like a sailing ship becalmed.

Thus nothing is really doing towards the two grand objects, irrigation and the effectual opening up of India. Even from want of the latter alone, though the actual loss is really immeasurable, yet it can easily be shown that the annual loss for want of cheap communication is certainly more than the whole amount of taxes, that is, 25 millions, and, consequently, that at least this sum is thrown away every year that this work is delayed.

What is required is that arrangements should be made for "at once" irrigating and opening up every district in India. There is no shadow of a reason why what is now doing in Rajahmundry should not be at the same time carried on in every other district. The money is procurable, and the European superintendence necessary is also procurable to any extent, and if £50,000 were expended annually in every district, or about five millions a year, within ten years the whole face of India would be changed.

But the money must of course be expended with some sort of judgment. Suppose, instead of watering and draining 1,200,000 acres in Rajahmundry, and supplying it with 1000 miles of water transit, at a farthing or less per ton per mile, at a cost of £300,000, the district had been left in its former neglected state, and one line of 30 miles of fine railway made in one corner of it instead, would the advantages of this expenditure have been one-hundredth part of those derived from the present works. Would it have raised the revenue by £50,000 a year, and the exports from £?0,000 to £170,000 in a few years, and before half the works are in operation? Would the district in the last year—a year of extreme drought—have been selling the largest crop ever produced at famine prices, instead of buying at those, or rather at much higher prices?

All the districts, certainly, could not be improved in exactly the same way as Rajahmundry, because it is a delta, and has peculiar advantages both for irrigation and water-communication, but they ought all to be improved on the same principle; that is, every advantage should be taken of the peculiar natural facilities of each district, to supply it as quickly as possible with these two grand requisites—irrigation and cheap transit. Is not this a palpable principle? But, as a further illustration of the strangely blind way in which the improvement of India has been set about, let us again refer to the case of the Godavery. Here is a river which has already been navigated (for as many months in the year as the Erie Canal is navigable, upon 360 miles of which £6,000,000 sterling has been spent), leading from Berar to a safe port. The work which has been recommended, and upon which already, I believe, £500,000 has been spent, with the proposed object of getting at the Berar cotton, is a railway to ascend 2,500 feet, and then descend 2,000 feet, to be 400 miles in length, to cost about £3,000,000 to £4,000,000, to take from ten to twenty years to construct, and, when finished, to convey the cotton at probably 1d. a ton a mile (the projector estimated the cost of transit at $2\frac{1}{2}$d.); while the river is now available to carry it at one-eighth or one-fourth of a penny a ton a mile, and which may probably be made an excellent communication throughout the year for a tenth or twentieth of what the railway will cost, and convey the cotton at a tenth part of the cost of transit by rail.

Ultimately, the basis of a system of communication for India must be water-communication. Nothing else can meet the wants of India. This is fully proved in America. All the heavy and distant traffic is carried by water. The Hudson, the Mississippi, the Erie Canal, the St. Lawrence navigation, &c., are the only lines that carry a great traffic in long distances. The Erie Canal was first cut as a mere ditch, 360 miles, from the Lakes to the Hudson, for £1,500,000 sterling. In 1840, ten years after railways were in operation, it was enlarged, at a cost of £4,500,000—three times its first cost,—but still worked with animal power. It has been determined greatly to enlarge it, for steam power, that it may contend with the St. Lawrence steam canals, and yet these canals are shut up from five to six months in every year by frost.

Hence, whatever the feeders are, the main communications in India must ultimately be canals or rivers.

But the immediate question is not so much—what is the cheapest mode of transit, as, what are the means by which the main weight of this tremendous incubus, which completely paralyses the energies of India, may be most speedily removed? There can, I think, be but one answer to this. Over by far the greater part of India nothing can be done so quickly as to lay down light railways to be worked at low speed; these can be laid down by thousands of miles in all the populous parts of India, without the least difficulty. Wherever river or canal communications on main lines can be speedily obtained, they should of course be established, and the light rails laid as feeders to them.

In the course of the experience I have had in public works, I have had to lay several miles of light railway in India, which have been worked for years, and in this way I have had good opportunities of learning what was really wanted in a low-speed railway, such as would, at the least expense and in the shortest time, provide the means of getting rid of the greater part of the cost of transit. But

nothing I had tried or thought of satisfied me till I saw Mr. Crosskill's specimen of his railways at Beverley, in Yorkshire. The roads that he had formed exactly met my idea, and I would send out many thousand miles of such roads to India every year. Mr. Crosskill proposes three different kinds of rails for heavier or lighter waggons, and one of these three, I think, would be admirably suited to the different sorts of lines that would occur in India. In some parts of India, near the forests, I would saw up timber on the spot, and only send the iron from England; but for a great extent of country I would send the rails complete with timber, ready to be laid down, and I would have the least possible amount of labour expended on the ground, so as to get the rail into operation as soon as possible.

I should mention that some consideration is beginning to be given to this question of rapidly opening India. A line of light rails has been ordered to be laid from Negapatum, 180 miles south of Madras, to Trichinopoly, due west 90 miles. A line has also been ordered in Bengal, and the Governor-General has lately called upon Col. Baker, the consulting engineer in Bengal, for a report upon the papers I have written upon this subject. In Col. Baker's paper, as I have mentioned, he scarcely touches upon the main points of the subject, viz.:—the effects of very cheap transit; and the enormous loss the country is sustaining every year that it is delayed, &c.; but he says, "The consideration of this question has left me deeply impressed with the importance of the subject, and though I dissent from many of the views expressed by Col. Cotton, and though I dispute many of his calculations, I cannot but feel that he argues from sound principles, and that his plans for the improvement of communications at small cost in some localities by means of canals and rivers, and in others by an inferior class of railway, are eminently deserving of attention." He also calculates that light railways can be laid at one-fourth of the cost, and in one-fourth of the time, that high-speed railways can be constructed; so that he grants that at the end of ten years, for instance, one might have either 1000 miles of high-speed railway or 4000 of low speed, at the end of 20, suppose either 5000 of high speed, or 20,000 of low speed, and so on. If the question was this alone, surely there could be no doubt which should be preferred in a country requiring at least 100,000 miles of main lines, and 400,000 of secondary ones. Col. Baker's paper is the paper of a very candid intelligent man—obliged suddenly to write on a subject of vast extent and importance wholly new to him, so that he had not even time to discover the main points in the question; and at the same time feeling himself on very delicate ground, as the views he was called upon to examine were diametrically opposed to the principles upon which public works are now being carried on in India.

The gentleman who has revenue charge of the district adjoining Rajahmundry, and one side of which consequently receives water from the Godavery works, has lately written a report endeavouring to impress upon Government the great effects of money expended, as it has been there, upon irrigation and canals, and it seems well to make here some quotations from him, to show what is the state of the greater part of the country, and what it may be made and ought to have been many years ago:—

"I have above alluded to the wretched state of the Culdindy Pergunnah, (small division of a district), which contains a very large quantity of valuable land, the greater portion of which has long been waste, chiefly from want of the means of irrigation. The average revenue has been £340 per annum. This year an irrigation channel was *commenced*; immediately tenders for the Pergunnah came in: and it has been given on three years' lease for £700 the first year, £750 the second, and £810 the third," so that the moment the channel is begun the revenue is increased twofold, and within 3 years 2½ fold. He goes on to say—"but no estimates of the quantity of food which has been produced through improved irrigation, no actual return of increase of revenue realised in an irrigated district in a year when such heavy remissions of taxes have been found necessary in other less favoured tracts, can convey any idea of the benefit which has accrued both to the Government and the people, at all to be compared with that derived from actual observation of the effects in travelling through the district. No one could have witnessed, as I did, the wretched condition of the people, and the crops on the Kistnah side of the district, the difficulty of obtaining even the scantiest supply of only moderately impure water, and then have passed to the Godavery side and witnessed with delight the contrast, the abundance of pure water, the splendid crops and the comfort of the people, without being deeply sensible that no figures can at all convey a true idea of the priceless blessing which the waters of the Godavery, brought by means of the weir and channels through such an extent of delta have conferred upon the people. In May I was encamped at Avenguddah on the banks of a large branch of the Kistnah, then a sheet of sand. The cattle were dying by numbers from starvation; no signs of vegetation were apparent; the water was wretched, and I hope I may never again see so much poverty and wretchedness. The month of June was passed by me at Akeed, more than thirty miles from the nearest point of the Godavery, but there fresh water and forage were abundant. The water of the Godavery, which had passed through the head sluice fifty miles up the channel, flowed past my tents, and numerous boats, laden with the produce of the neighbouring lands, daily passed to and fro. Grain was far lower in price than in any other parts of the districts, and I do not doubt that the cost of transit has been reduced to one-third of what it was before. I have already advocated the extension of a canal in continuation of that which passes Akeed to the port of Masulipatam. The same grain which sells at £5 5s. per ton in Akeed brings £6 15s. in Masulipatam. If the canal were continued, 5s. a ton ought to be about the difference, instead of £1 10s."

He goes on to show that there has been an increase of revenue of 42 per cent. on the Godavery side of the district. But may it not well be asked why is this the state of things on one side the district, after we have possessed the country fifty years? Is it only now discovered that public works make the difference between the most abject poverty and wretchedness and abundance and comfort?

It is impossible to touch upon the hundredth part of the points of importance on this subject in so short a paper as this, and the view of it taken here must necessarily be most imperfect. I have endeavoured to select the most essential points, and the following propositions will show, in a small compass, the views which I hold:—

1st. That the greatest possible mistake has been made in our management of India, in neglecting to execute those works of irrigation and communication which lay at the foundation of the improvement of the people, not only material, but also moral.

2nd. That nothing can be more obvious than that in every district, the moment it was taken possession of, a sufficient establishment and expenditure should have been allowed—1st. To keep in repair the old native works; 2nd. To construct new and far more perfect ones, worthy of our superior means and knowledge.

3rd. That the improvements that have of late years commenced in a few districts do not at all represent the general state of things throughout India, but that at this moment the great mass of India is utterly unimproved, and unprovided with those works which are essential to all improvement.

4th. That the construction of a few hundred miles of high-speed railway will not in the least meet the wants of India; that every district ought at once to be supplied with works of irrigation, and pervaded with an extensive system of communication of cheap transit.

5th. That to spend £10,000 on a single mile of communication, when the same time and money could be expended in other ways, so as to produce from 10 to 100 times as much useful effect, is the greatest mistake.

6th. That nothing but canal or river communication can provide India with sufficiently cheap transit for its long distances and the small value of its main articles of transport.

7th. That the grand point of all, as respects communication, is to get any rough works executed to a vast extent over the whole face of the country in the least possible time, so as to relieve it from the tremendous incubus which at present effectually represses all its energies.

8th. That a department ought immediately to be formed adequate to the vast work which has to be accomplished.

9th. That every facility should be given to really free private enterprise. The railway companies at present existing are no more really private companies than the Indian Civil Service.

10th. That while the *value* of water for irrigation is at least £1 for 6,000 cubic yards, it can be provided on a large scale at a cost of £1 for 300,000 cubic yards, or 1-50th part of its value.

11th. That probably steamboat canals can be worked at one-eighth of the cost of working high-speed railways, and improved rivers also at one-sixth or one-eighth of the latter.

God has been pleased to set before us the duty, not to say the unspeakable honour and privilege, of incalculably promoting the welfare of 150 millions of people, one-seventh of the population of the whole globe, and as, according to the laws of His kingdom, it is impossible to do good to our neighbours without benefiting ourselves, there has been, at the same time, necessarily placed before us the opportunity of immensely increasing the glory and power of the empire, by raising five-sixths of its population from a state of abject poverty, ignorance, and despondency, to that of a thriving, wealthy, educated, and Christianised people. But hitherto, though we have indeed given them internal peace, we have entirely failed to be the instrument of conveying those blessings to them that as a civilised and Christian nation we ought to have done. But I do feel confident, that in God's good providence, the time is at hand when we shall arouse from our torpor, and introduce a new order of things into India, an order of things which will effectually prevent the natives pointing to the ruined tanks and weirs, and remarking upon the superior abilities and benevolence of their own great rulers to us, when in so many instances we have not even kept their noble works in repair.

Here lies before us now in India an unbounded field for the utmost display of the energies, the science, and the benevolence of England, and an equally unbounded field for the employment of her capital, and the improvement of the supply of all those raw materials which are required for the still increasing development of her manufacturing powers. And it must be remembered that in proportion as the natives of India become sellers of their own produce, they must necessarily become purchasers of our manufactures, and thus also will our care for our fellow subjects necessarily return in extensive benefits to ourselves.

To give some idea of the comparative cost of transit by different modes, I add a statement of the actual rates on various lines of communication:—

OCEAN TRANSIT.

| | Land miles. | | | |
|---|---|---|---|---|
| London to Calcutta, | 15,000—outward ... | £1 10s., | or $\frac{1}{40}$d. | a ton per mile |
| Do. do. | homeward | 3 0 | $\frac{1}{20}$ | ” |

COASTING.

| | | | | |
|---|---|---|---|---|
| In India ..................... | 200 to 500 miles ... | | $\frac{3}{8}$ | ” |
| Colliers in England...... | 350 ” ... | 9s. | $\frac{1}{3}$ | ” |
| Steam do., as stated at late C. E.'s meeting | | 4s. | $\frac{1}{4}$ | , |

RIVERS.

| | | | | |
|---|---|---|---|---|
| Ganges (by men)......... | 500 to 1000 miles | | $\frac{1}{4}$ to $\frac{1}{3}$ | ” |
| Do. ......... | 160 ” | | $\frac{3}{4}$ | ” |
| Mississippi (steam)...... | up to 2500 ” | | $\frac{1}{6}$ | ” |
| Hudson do. ...... | 160 ” | | $\frac{1}{7}$ | ” |
| Indus do. ...... | 500 ” | | $1\frac{1}{2}$ | ” |
| Do. do. ...... | ” | down do. | $\frac{1}{2}$ | ” |
| Ganges do. ...... | 700 ” | up stream | 3 | ” |
| Do. do. ...... | ” | down do. | $\frac{3}{4}$ | ” |
| Weaver Navigation, in England (animal power) .................. | 24 ” | | $\frac{1}{2}$ | ” |

CANALS.

| | | |
|---|---|---|
| Rajahmundry Canals, men, 20 to 80, no tolls ... | $\frac{1}{6}$ to $\frac{1}{3}$ | ” |
| Madras Canal, men, 40, including toll ............ | $\frac{1}{4}$ | ” |
| Erie Canal, animal power, 360, including heavy tolls ...... .............................................. | $\frac{7}{8}$ | ” |
| St. Lawrence Canal, steam, 700, including tolls | $\frac{1}{3}$ | ” |
| English Canals, animals, without tolls ............ | $\frac{1}{3}$ | ” |
| Do. do. with tolls ............... | | |

RAILWAYS.

| | | |
|---|---|---|
| In England, steam, 10 to 200, with tolls ......... | $1\frac{3}{4}$ to 9d. | ” |
| Do. mineral lines with low speed, 10 to 30, with tolls.......................... | 1 | ” |
| In America, steam, moderate speed ..... .......... | $1\frac{3}{4}$ | ” |
| German States, steam ............................ | 2 to 7 | ” |
| France, steam ................................................ | $1\frac{1}{2}$ | ” |
| East Indian, steam, proposed ......................... | 1 to 2 | ” |
| Belgium............................................... | $1\frac{3}{4}$ | ” |
| English Railways, actual cost of working (1847), according to Lardner ..................... ............ | $1\frac{1}{9}$ | ” |

COMMON ROADS.

| | | |
|---|---|---|
| In India, bullocks ............................................ | $1\frac{1}{2}$ to 4 | ” |
| Passengers by English railways ...................... | 1 to 3 | ” |
| Do. on the Hudson, at 20 miles an hour. | $\frac{1}{6}$ | ” |
| Do. by sea, from London to Edinburgh.. | $\frac{1}{3}$ | ” |
| Do. on the Rajahmundry Canals, in boats worked by men........................... | $\frac{1}{8}$ | ” |

It thus appears, that by far the cheapest transit is that by the ocean on long distances, and is from one-twentieth to one-fortieth of a penny per ton per mile; that the next is by inland steam navigation, being about one-sixth of a penny when there are no tolls; and in the St. Lawrence canals, one-third of a penny with tolls; that in the Indian rivers it is from one-third to three-fourths of a penny, worked by men; on Indian canals from one-sixth to one-fourth of a penny, also worked by men, and for very short distances. On long distances this would, of course, be reduced to perhaps one-half, or from one-twelfth to one-eighth, and on canals suited for steam-boats of considerable tonnage, certainly less than these rates, or probably one-sixteenth of a penny. By coasters, on distances of from 300 to 500 miles, about one-third of a penny both in India and in England, and it is stated that by steam coasters the actual expense would not be more than one-seventh in the latter. By canals worked by horses in England, the actual cost is stated by a canal manager to be one-third of a penny, exclusive of toll. On the Erie canal, open only six months in the year, and yielding very large profits, worked by animal power, seven-eighths of a penny, including toll.

By railway, as far as I can ascertain, the actual cost of transit, including a fair share of all expenses, where the railway is worked by quick passenger trains, as in England, at least one penny. On a mineral line, worked at six miles an hour, I was informed that it was rather under a penny; the cost of trucks alone, at that low speed, was stated to be from one-eighth to one fourth of a penny. If the coasting trade can be carried on at one-third of a penny by sails, and at one-seventh of a penny by steam, certainly a steam-boat canal, for vessels of 300 tons burthen, like the Canada canals, could, in England, be worked at one-tenth of a penny a ton, exclusive of tolls, for distances of 100 miles and upwards; and in India they could probably be worked at one-sixteenth of a penny for long distances. They reckon upon charging on the railway in India at least a penny, which is probably eight times what would be charged on steamboat canals, including tolls, and six or eight times as much as improved river navigation would cost there.

The Indian mail just arrived contains a remarkable case in confirmation of what I have said of the strange misapprehension of the subject of communication:—

"The Indigo Planters' Association have just remonstrated with the Government upon an extraordinary case of this kind [neglect of public works]. The communication between Calcutta and the Ganges is by two canals. One of these, called the Eastern Canal, has long been closed, so that the native traffic of this large city (stated in the railway pamphlets at two million tons a year) is confined to the other. Its length is 2½ miles, and its condition is such, write the Association, *that it ordinarily takes* 9, 11, *and even* 13 *days to effect a passage through it.* They further go on to state, that the road to it is so blocked up, that it cannot be got at; that the canal is in such a foul and fœtid state as to be highly injurious to public health; that the tolls yield a large surplus revenue to Government; and that heavy demurrage rates have been established on boats remaining more than two days in the canal, though, owing to the neglect of Government, it is in such a state that it takes from 9 to 13 days to pass through it."

This is represented to be the state of things in the case of a work under the very eyes of the Government, and through which the whole trade of Calcutta with the interior passes.

By the same mail also it is reported that one short step has at length been taken in the right direction. A loan of 2¾ millions has been opened, to be expended in public works in India.

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## DISCUSSION.

The Chairman said, it was now his duty to invite the observations of the meeting upon the paper they had heard read.

Mr. Gregson, M.P., said, it was impossible to digest all the various points contained in the paper, and he should therefore confine himself to a few notes which he had taken during the reading of it. The subject appeared to be divided into three principal parts, viz., irrigation, communications, and harbours; and with regard to irrigation, the gallant gentleman had stated the reduction in the cost of water which could be effected by the system he proposed to be,—that whereas £1 was now expended upon 6000 cubic yards of water, the same amount would be sufficient for raising 300,000 cubic yards, which he thought was a most astonishing extent of improvement. Then, again, the advantages of this irrigation had been most ably and clearly pointed out, and that the necessity for this irrigation existed for the purpose of increasing the production of food was most evident, because, without referring to the more recent instances of famine, the whole history of India pointed out that that country had always been more or less affected by the most dreadful famines. With regard to India it always appeared to him that ever since that country had fallen into the hands of Europeans it was the duty of the Government to take serious and important steps towards procuring an increased supply of food, inasmuch as famines had occurred at different periods of the history of that country —sometimes extending nearly over the whole country, and at other times over only certain provinces. In the third year of the reign of Aurungzebe a dreadful famine occurred. He (Mr. Gregson) did not know whether the present Government did what was then done by that ruler. He remitted the rents and taxes of the people: his treasury was thrown open without limit; corn was conveyed from the districts where it was cheapest to those where food was dearest, and so great was the economy practised, that, laying aside the expenses and luxuries of a court, affairs were so ably managed that every district suffering from the famine was supplied by a reserve from his own treasury. They had heard that as many as 200,000 of the population had perished in one year (1833) through famine, and last year the Government, it was stated, had to employ 100,000 people in order to provide them with the means of existence, at an expense of £1 per head, whilst they had heard from the gallant gentleman that the expenditure of £100,000 in works of irrigation, would have for ever prevented famine in that district. The next point he would notice was a most extraordinary statement by the gallant author of the paper, with regard to the roads in India. They had been told that cotton, which could be purchased at 1½d. per lb., cost £12 and as much as £6 per ton to convey it to the port for shipment, whereas it was stated that by the improvement of the river navigation the charge of transit would be reduced from £6 to about 10s. per ton. They had heard that only two or three improvements had been made in the valley of the Ganges; and with regard to the railways, they were told that at tenfold the present rate of progress it would require 130 years to produce the same means as now exist in this country. It seemed to him most extraordinary that no improvement for a hundred years had been made in the harbour of Madras, but that they were still using the primitive surf-boats at the cost of many lives every year for want of a small improvement there. The results of improvements in India had been strikingly exemplified by the fact stated by the gallant author of the paper. In one province, where public improvements were carried out, the exports increased from £30,000 a year to £170,000, and, in another instance, the revenue from £320,000 to £500,000, and, moreover, no scarcity of food had occurred since those works had been carried out. The gallant author had also mentioned that an engineer was authorised to carry out works to the limit of £1000 a year, whilst he (Mr. Gregson) ventured to say the salary of the engineer himself was £2000 or £5000 a year. With respect to the canal of the Ganges, that appeared to be a very great work, and was a great credit to the government, and, perhaps, with the assistance of his hon. friend in the chair, improvements had been carried out which would not otherwise have been effected. He differed from the gallant author of the paper in the statement that the £2,000,000 expended upon the canal of the Ganges was equal to an expenditure of £12,000,000 in this country; he thought £5,000,000 or £6,000,000 would come nearer to the real state of the case. He fully agreed with the gallant gentleman that India presented an ample field for the exercise of the science, the energy, and the benevolence of England. He (Mr. Gregson) had resided in that country, and he took a deep interest in all that concerned it, and he had still many friends residing there. The natives were the most gentle and tractable people on the earth; they had, moreover, climate, soil, and every other advantage, and he hoped the Government had taken steps to improve the advantages within their reach. The order of improvement he thought should be thus:—1. Irrigation. 2. Improvement of native works. 3. Communication by bridges and roads. 4. All works to be kept in repair. 5. Superior water and land communication. He hoped this would be the object and aim of the chairman, deputy chairman, and every director of the Hon. East India Company; for, after all, it must depend upon them to advance the interests of this important country, inasmuch as when the proprietors of the stock received their dividend it was to be feared that they did not take much interest in the welfare of the country. He had heard the remark made that we cared very little about India, but that we sent young gentlemen there to pick the pagoda trees, and to come back with the liver complaint.

Mr. Ayrton said, the importance of this subject induced him that evening to offer a few observations to the meeting, and he would simply address himself to some of the remarks which had fallen from the gallant author of the paper, because he apprehended the object of this discussion was to investigate truth, and not to support any one theory in particular, but, if possible, to elicit from con-

flicting opinions what measures would be most beneficial to the people of India. He thought the gallant author had commenced his paper under the influence of a theory of his own, which had pervaded it to the end; and although he (Mr. Ayrton) concurred in much that he had said, yet he believed that in some material particulars the theory had been too generally and extensively applied to India. The gallant colonel committed the error which most people fell into when speaking of India—viz., he had suggested a general theory for the whole of India, which was only applicable to certain districts, whilst that vast country, extending over so many thousand miles, was affected by circumstances varied and conflicting, embracing not merely immense kingdoms, but people of different nations and languages, and geological features as different as the lowlands of Holland are to the Alps of Switzerland. It likewise embraced a variety of soil, climate, and temperature, proportionate to its vast extent of latitude, from the Indus to Cape Comorin. It might almost be assumed, that any general theory for the whole Indian empire was sure to be wrong. What would be a good system for the lowlands would not be practicable for the uplands. The uplands comprised the whole of the mountain districts, also the highlands and hill-lands of Central India, much of which constituted the most fertile portions of the country. No theory of a canal adapted for Madras or the level valley of the Ganges would be applicable to the upper districts, or the highlands of India. To suppose that a canal could be carried over a district to a summit of 500 feet, was to state that which in an engineering point of view was impracticable. What was the usual characteristic of most of the rivers in India? In the first place they were influenced by periodical rains; they were not rivers fed by perennial showers, rising and falling within narrow limits, but they were one day small streams, and another mighty torrents—at one time mere gravel beds, with here and there a rill of water, so that they might be crossed on foot, and at other times impassible even by boats. They could not use the rivers for the purposes of navigation if at one moment they swept along impetuously, and the next were all but dry. Still less could they be used for profitable navigation for the transport of the produce of the country, for at the season of the harvest the rains ceased, and the rivers began to fall, and the beds of the rivers were dry, and impracticable for the purposes of transit when the harvest was made and the produce was ready to be transported to market; then, in fact, there were no rivers at all. He would illustrate the question by a particular instance. Looking at the map of Calcutta, they might assume, by a too hasty generalisation, that the region far around it was a level admirably suited for canals; and though this was partially the case, yet if they were to examine the Damooda river, which flowed from the Ranegunge coal-fields to the Hooghly river, and were to visit that great source for the supply of coal to Eastern India, what would they find to be the condition of things there? That splendid coal-field was by the side of the river, on the banks of which, through eight or nine months of the year, they stored the coal in stacks—they were obliged to get the boats up when they could; this, be it remembered, was at a distance of 70 miles from Calcutta. They waited for the periodical rains and the river floods; they hurried the coal into the boats, and if Providence helped them, they got the coals to market. But sometimes the boats could not make even that voyage, to reach only a direct distance of 70 miles. As they proceeded downwards on their journey the river began to fall, and they were obliged to throw coals overboard for want of sufficient water, and in some cases the whole cargo was thus sacrificed. The consequence was, at this short distance from Calcutta, with a large river running from the coal-fields, there was no reliable means of transport, and the only remedy for that was in the railway which was now constructed, for they were aware that a river subject to great floods could not easily be made into a canal, and if a river was so steep in its descent, and subject to such difficulties as these, that might be taken to be a district in which canals could not be economically made, but they would be far too expensive in construction to surmount the difficulties of an engineering character, and to fulfil the purposes required. The meeting must not judge of this matter by their experience of the state of things in a country like England, where a meandering stream, running through a level valley, could be dammed up and converted into a lake or a canal. That was not the case in India. Again, the author of the paper, who had enlarged so much upon the advantages of canals, had ascribed to them results and benefits which he thought they did not deserve, and this meeting ought not to go away impressed with his views, without more accurate evidence than had yet been given of what would ensue from these works. The author apprehended in canals a remedy for famine. Canals, as applied to irrigation, would be no remedy for famine. The rice, wheat, and other varieties of grain, would not be raised by artificial irrigation when they could be grown by the showers of Heaven without cost. The great staple food of man and cattle in India would be produced by those crops which were given by the bounty of Providence from the sowing of the seed, and by the action of the periodical rains upon a naturally fertile soil. It was to be remembered that produce did not fail till all the mischief was done, which no artificial irrigation would remedy. When the husbandman sowed the seed, he was under the expectation of the ordinary periodical showers; he waited for them from day to day, and if they failed then famine had arisen, and no system of irrigation would ever prevent the calamity. He saw some gentlemen shake their heads. He was not going to enter upon a long argument on this subject, but he merely threw it out for the consideration of those who wished to pursue it further, and to point out to them a different view of the question. But the real remedy for famine consisted in improved communications. Famine was rarely, if ever, general throughout India. It occured in particular districts where the rain had failed, and the remedy for the evil would be found in the means of easy transit, whereby the superabundance of one district might supply the failure of another. He must be allowed to correct what he considered another serious error of the author of the paper. In speaking of improving the rivers of India, and using them for purposes of transit, he forgot to tell them that some of the largest rivers, such as the Taptee and the Nerbuddah, were wholly impracticable, and never could be made navigable. He (Mr. Ayrton) knew that they had been surveyed and examined, under the direction of the Government, for that purpose. They would find that these rivers, large as they were, were of the character which he had described—at one period sweeping everything before them, and at another time having their beds almost dry; and it would be a misapprehension of the geographical features of the country to compare rivers like these with the constant and sluggish waters of the Mississippi and other rivers of America, which afforded great and reliable facility for transport, but with which the rivers of India should never be compared; therefore, he with deference recommended gentlemen to receive the suggestions of the gallant author with the limitations that were necessary to be imposed on them. Canals were only applicable to certain districts of India, and when the gallant author referred to railways ascending to a height of 2,500 feet, which, however, should have been 1,900 feet, and descending to the same extent, they would see that in many cases railways would be more economical than canals, inasmuch as a railway could be carried up to those heights without difficulty, and at a moderate cost, if they were content with a low speed, but water, finding its own level, required a plain for a canal, and where that did not exist naturally, it could only be obtained by artificial works at an enormous cost. The moment they came to the undulating hills and mountains of India, wherever the rise and fall exceeded the limits of economical construction for canals, then they must be superseded by other

means of transit; those means, he contended, could only be by railways. He would not speak of the carrying power or economy of railways for purposes of transit, because the meeting must be as well acquainted with that subject as himself, and could therefore judge of the extent of error into which Colonel Cotton had fallen respecting them. He thought the gallant gentlemen had also fallen into the error of undervaluing the advantages of the proposed railways for India, because their mileage was small for our great extent of territory there, compared with the mileage of railways in this country. The value of a trunk railway in a country thinly-peopled, like India, was one thing, and the value of railways radiating through a manufacturing country like England, where at very short distances were great seats of productive industry, was a totally different question. A railway through the interior of India alone would accomplish enormous results. It would, in fact, connect districts and kingdoms with the great ports of trade. They might leave the village roads as they were, to take care of themselves. Those roads would no doubt be improved in India locally in due time; they interposed little difficulty to the transport of merchandise, which was the great question under consideration, for, as regarded the agriculture of India, when the harvest was made, the cultivators had their cattle all around them, ready to be employed to transport their produce, which they could convey to any point within their own district or country at scarcely any cost, and then they would place it on the great trunk line of the country; but the difficulty began when the produce was to be conveyed hundreds of miles to a distant port by a separate class of carriers, and the transport then became a heavy charge on the produce, before it reached the market, therefore they must not suppose that railways could do nothing for India. He contended that, leaving out of consideration all ramifications of a railway system, which must, of course, be dispensed with over a large extent of India, the mere construction of one or two thousand miles of railways through the heart of India would accomplish enormous results, results which would surpass their imagination. They would by railways alone make, as it were, a Mississippi from Bombay over the ghauts as a means of transit into the centre of India; and however much Col. Cotton might decry them, he (Mr. Ayrton) held them to be the most advantageous means of transit that could be adopted in that part of our Indian empire.

Mr. Cornelius Nicholson, in addressing a few observations to the meeting, would state at once that he was officially connected with one of the companies prosecuting railways in India, and would, therefore, speak of the subject in a practical point of view. The object of this discussion was, he apprehended, to elicit the truth, and he had risen with a view to correct one or two of the statements contained in the gallant colonel's paper; and in order to make himself intelligible, it was necessary for him to refer to the diagram which was before the meeting. In order that the gallant colonel's theory of water-communication might have all possible force, of course he had put down on the diagram the *smallest* quantity of railways that he said had been contemplated by the Government. He had said, in broad terms, there was no "system of communication" contemplated by the Government and the railway companies, which, he added, were not in fact private companies at all. In order to show what was contemplated by the Great Indian Peninsular Railway Company, the one with which he was connected, the gallant colonel had exhibited to them a line running from Bombay and terminating in the Berar cotton field. He also pointed to the Scinde railway, which had just been projected, proceeding till it met the Indus; and he pointed to a third leading from the Hooghly, at Calcutta, up to Mirzapore, also another line from Madras (no, he found the gallant colonel had left that out entirely), but there was a small portion of a tram railway which was put in the diagram subsequently. He would, with the permission of the meeting, mark out the system of railways that had already received the sanction of the Indian Government. To the great and lasting credit of Lord Dalhousie, since he had held the office of Governor-General of India a grand system of railway communication had been laid down, which had received the sanction of the authorities at home, and was now in course of construction. It was quite true that in the mind of Colonel Cotton, and other persons, some blame attached to the Government for not having sooner prosecuted railways in India, and because these works had not been pushed on more rapidly than they had; but they must remember that railways, when first prosecuted in England, did not proceed at a very rapid rate. The Liverpool and Manchester Railway was spoken of in 1826; it was four years before that experimental line was opened, and it was not till five or six years afterwards that others of the principal lines in England were opened for traffic; so that it might be said that railway communication in England was not opened out until nearly ten years after the system was first projected. It had been five years since railways in India were set on foot, and within that period they had 150 miles opened. There would be fifty miles more opened in Bombay next year; there would be seventy miles in Madras, and 150 miles more opened next year in Bengal; and he hesitated not to say, in opposition to the statement of Colonel Cotton, that at the rate they were going on *at present* it would not take 100 years to give sufficient railway accommodation to India. There were now five companies authorised, and in less than ten years from this time there would be 4,000 miles of railway communication in operation in India. First of all there was the Bengal line, passing up the valley of the Ganges, having a branch to the Ranegunge collieries, and passing on to Agra and Delhi. That line was sanctioned by the Government. Now from Bombay, the line proceeded to the western ghauts—which were represented to them as insurmountable—almost wholly impracticable. They were intended to be crossed by two lines, one to the north-east through the Thul ghaut, which was crossed, not at an elevation of 2,500 feet, as the author stated. It then extended into the Berar cotton field, across the peninsula, to join the Bengal line at Mirzapore; so that there was a complete line of railway communication sanctioned between Calcutta and Bombay. The other line, commencing at Bombay, bi-forked near Callian, crossed the Bhore ghaut, and proceeding to Poonah, was now in course of construction as far as Poonah; there it stretched on till it met with the Madras railway on the frontiers of the two presidencies of Madras and Bombay. The Madras line met the Bombay on the borders of the two presidencies. There was also another line from Madras to the western coast, almost in a straight direction across the peninsula. Then there was again another line recently sanctioned from Surat, which proceeded in the first place to Baroda, and was intended ultimately to join the Bengal line at Agra. The Scinde railway would bring the traffic from the Indus—and he begged them to notice this argument, viz., the fact of that railway being established after the most minute inquiry and investigation, was sufficient proof that the mouths or deltas of the rivers which had been referred to were not adapted for water conveyance, or else those railways now projected would never have been thought of. From the west they had, or would have, three lines across the peninsula, a system of about 4000 miles of railway communication, and five companies were now engaged in surveying and constructing these lines, and if they proceeded no faster than they were doing at the present moment, or than they had done during the last year, in the next 10 years 4,000 miles of railway would be opened in India. One other point he would allude to. The gallant Colonel had stated that cotton was now produced at Berar at 1½d. per lb., which cost about £6 per ton for conveyance to the sea-board, east or west, but that hereafter, by the Nerbuddah or the Godavery being made navigable, it could be carried at 10s. per ton, that

was 500 miles of water communication at 10s. per ton. He would take that data of 10s. per ton, and he must now state that it was 160 miles from Bombay to that same point in Berar, and a penny per ton per mile for 160 miles amounted to 13s. 4d.; thus they would bring for 13s. 4d. to the best and nearest ports, in 8 hours, that which Colonel Cotton would bring 500 or 600 miles to Caringa, or to the Bay of Bengal, on the east coast, for 10s. per ton! But all this was contingent upon those rivers being *made* navigable, which they were *not* at present, and, at a moderate calculation, it would take several weeks to convey the cotton to Caringa. With regard to the ghauts, the gallant colonel seemed to look upon them as an insurmountable barrier to railways, but they had only to go from London to Glasgow to find a nearly analogous case—the Shap Fells. It was not a position of altitude above the level of the sea; they had, in reaching the ghauts, overcome half the altitudes of these hills. The worst gradient they had was 1 in 38, for $3\frac{3}{4}$ miles, and that was the gradient to which the company would have to adapt their engines. But any one who had travelled between Birmingham and Bristol—and he presumed most present had done so—had been carried up a gradient of 1 in 37, with one engine, at the rate of 15 miles an hour! Therefore, there was nothing impracticable—nothing extraordinary, either in the cost of construction, or in the way in which they surmounted the ghauts. With regard to the cost of construction of railways in India, the gallant colonel had fallen into a great mistake. He had mentioned £20,000 per mile, whereas he (Mr. Nicholson) could tell them that they had constructed 120 miles of railway on the Bombay side at a cost of £8000 per mile, and that £8000 per mile *included* the heavy works at the ghauts, which had been proclaimed to be impracticable. Therefore, he said there were no unusual difficulties to be surmounted in the construction and working of railways in India, and whatever was due to the gallant gentleman (and much was undoubtedly due to him) for the way in which he had brought the subject of water communication in India before the public in England, he ought not, in seeking to do justice to his own theory, to do injustice to the subject of Indian railways.

Col. Sykes said, having been honoured with an invitation from the Council of the Society to be present on this occasion, he had great pleasure in responding to it, and he appeared there as Colonel Sykes and an old Indian, to express his opinions upon the subject under discussion, and not as the deputy-chairman of the East India Company. Colonel Cotton, unquestionably, had greatly distinguished himself by his zeal, his energy, and the enlarged philanthropy of his views. He believed that he was most anxious to promote the well-being of the people of India, and to advance their material interests; but in doing so, he thought Colonel Cotton had generalised from particular facts in a manner that exposed some of his deductions to question. He appeared to regard India as a country like England, with a dense population tolerably uniformly dispersed, exercising industrious commercial pursuits, great mechanical ingenuity, and powers of production in every branch of art; with great available capital and disposition to social combinations; whereas, the population was not found dispersed over the country with anything like a degree of uniformity; in one part they might find a density of 700 to the square mile, and in other parts they would not find 7, masses being divided from each other by impenetrable jungles; there was little mechanical ingenuity, little disposable capital, and aversion from social combinations. It was unphilosophical, therefore, to draw contrasts unfavourable to the progress of the social and economical arts in India, from what were become normal conditions in England. On the subject of generalisation from particular cases, he would instance the following:—The gallant officer had used these expressions, "Thus nothing is really doing towards the two great objects,—irrigation and the effectual opening-up of India." And again he said "That the greatest possible mistake had been made in our management of India, in neglecting to execute those works of irrigation and communication which lay at the foundation of the improvement of the people, not only material, but also moral." And what was the character of the illustrations he had given in support of these broad assertions? One was that the government had done nothing for a harbour at Madras—that the surf-boats were still used on that coast, that it remained in the same state as for hundreds of years past; and he argued, because surf-boats were not superseded, *ergo*, nothing had been done in India. But what were the facts? Some years ago, a company was got up, and attempts were made to run out a pier through this surf. The character of the soil was ascertained, over which the surf beats, piles having been driven to see whether a platform could be put up. It was found that the piles were forced out by the action of the surf, and came floating back again to the beach. The project was impracticable; and great part of the Coromandel coast presented the same physical difficulties to the construction of piers and harbours. Could the Government be justly blamed for not carrying out impracticabilities? Take one other illustration. It was asserted that nothing had been done to open the rivers of India to navigation, and the upper part of the Godavery was instanced. No doubt the gallant colonel was acquainted with the geological character of the Deccan — a trap region, extending from the Western Sea to Nagpoor, and lying in tables at different levels, and not with a gradual incline. The bed of the Upper Godavery, in the Valley of Arungabad, was 1,500 feet above the level of the sea! In the Monsoon months the river became a furious torrent, that would almost sweep away hills before it, and in the dry months, which were eight months out of the twelve, it was scarcely more than a trickling stream, over which, in some places, one might pass dry shod. But the river had to descend over a succession of terraces, one below another. The rocky margins of these terraces offered impediments to the descent of the water, and would necessarily be obstructive to navigation; but they kept back the water in many places in the bed of the river, so as to form, as it were, great lakes, called *dhaos* by the Mahrattas, and which served for the purposes of irrigation, but if these barriers were swept away upon the plan suggested by Colonel Cotton, the river would run completely dry during the hot months of the year. But the barriers to which he had alluded might be made good use of if they were converted into so many locks to preserve the great backwaters, and to admit of the descent and ascent of boats upon the principle of the Caledonian canal. He doubted, however, whether it would be worth while to insure navigation by such means. Was the government to blame because it did not surmount physical difficulties of the kind described. Colonel Sykes spoke only of the Upper Godavery,—he knew nothing of the lower parts of the river. Another assertion of Colonel Cotton's was, that the great public works of the native princes of India had been suffered to fall into decay and ruin under British rule and management. If Colonel Cotton could point out a single public work of that kind north of the Kistnah, it was more than he (Colonel Sykes) was aware of. He believed that with a 50 years' acquaintance with India, and having traversed it from Delhi to the Kistnah, he might possibly have seen more of that country than the gallant colonel himself, and he must say that he never met with one of these Mahomedan works, (and they were all Mahomedan north of the Kistnah), that had been allowed to fall into decay by the neglect of the British Government. They had been, in fact, ruined a hundred years before the country came into British hands, under the exterminating wars of the five insurgent kings of the Deccan, in the decline of the Mogul power. Candeish, which was a very rich district, had been full of those works, but they were all destroyed before that territory came into our possession. There was always a

risk of defeating admirable objects by generalizations that could not be borne out. With respect to the statement that nothing was really doing in India, he might mention, in the first place, that there were three departments of public works in active operation under the three different governments of India, for the purpose of opening up roads, extending canals of irrigation, and for forming railways; and these departments were under a responsible supervision.

Mr. Dickinson, hon. secretary to the India Reform Association, said he merely wished to address a few words to the meeting, in consequence of a remarkable incident which had occurred to himself within the last forty-eight hours, with reference to this subject, but the misrepresentations which he had heard that evening had been so extraordinary, that he must notice one or two of them, to give an idea of the way in which interested parties attempted to answer Colonel Cotton. The gentleman who had just sat down, Col. Sykes, had cited as an example of Col. Cotton's unfairness towards the Indian Government, his charge of their neglecting to open, at a comparatively trifling cost, the navigation of the Godavery to the cotton country of Berar. Whereas, said Col. Sykes, this river, being 1,500 feet above the level of the sea, in the valley of Aurungabad, descended from thence, during the monsoon, in "a torrent powerful enough to sweep away a mountain" if it obstructed its course, and in the dry season had its bed entirely dry in the intervals between the different levels of the trap rocks over which it flowed, and stood in pools above those successive shelves of rock. Now, he (Mr. Dickinson) should like to know what on earth this description had to do with the navigation of the river to Berar? Col. Cotton talked of navigating the river to the cotton country of Berar, and the highest level of the river to that point was 420 feet above the sea, or the height of the Grand Junction Canal, at Tring, above the Thames. Col. Sykes answered him by describing the state of the river where it was 1,500 feet above the sea, and said how unfair to propose the improvement of the navigation of such a river! Why, nobody that he knew of had proposed to navigate the river in the part described by Col. Sykes; but the lower part of the river, referred to by Col. Cotton, had been navigated both in the dry season and the monsoon, and there was a gentleman in the room who had been up and down it several times. The next thing he wished to notice was an assertion of one of the railway advocates, who had addressed the meeting on the same point. He said, "Col. Cotton proposes to open a river to the cotton and wheat country of Berar, because, he says, it would require the construction of 500 miles of railway to reach this district. So far, however, is this from being the case, that our railway is sanctioned, and will be completed in a few years to Malligaum, the very centre of Berar, which is only about 150 miles from the sea." Now, there were gentlemen sitting in the room who had been officially employed in the country, and could corroborate what he was about to say, when he informed the meeting that Malligaum, so far from being in the centre of Berar, was actually not in Berar at all, but in Candeish, about 250 miles due west of the centre of Berar. This was a fair specimen of the dependence that was to be placed on all the other statements of the railway gentlemen who had addressed the meeting that night, but, as he could not go into them at that late hour, he would at once conclude by mentioning the incident which induced him to address the meeting:—A native gentleman called on him, on Tuesday, whose name and family would be known, probably, to every person in this room, for his father, Mr. Dwarkanauth Tagore, resided for years in England, was intimately known to the best society in London, was a personal friend of all the leaders of our political world, and was certainly one of the most accomplished men who ever visited this country. His son, Mr. Mohun Tagore, was introduced to him (Mr. Dickinson) by a Calcutta barrister, as one of the most highly-educated and intelligent natives of India at the present day. Well, in the course of conversation with this gentleman, on Tuesday, he happened to ask Mr. Tagore a question about Indian finance, when he at once interrupted him by saying—"Oh, as for the finance difficulty, I consider it entirely settled and disposed of for ever by Col. Cotton's book on 'Public Works in India.' He has proved to demonstration that the government can make as much money as they want whenever they please, by investing in public works in the same proportion, and if they want money henceforward it is entirely their own fault. I was speaking to Mr. Halliday about this book only two or three days before I left Bengal, and was surprised to find that he had not read it. I said to him, 'how is it that I, who am only a country gentleman and farmer, find it my interest to read this book, and that you, in such a responsible official position, do not think it worthy of notice.' Mr. Halliday said, 'Oh! Col. Cotton is too sanguine; when people talk of profits of 30 or 40 per cent., it makes one very suspicious of the soundness of their views.' 'What, 'said I,' is it the profits of 30 or 40 per cent. on public works which seem to you incredible, Mr. Halliday? why you have nothing to do but to refer to the Government records, or, as you are now going on a tour through your Government, to go to see scores of instances on the private properties of Zemindars, which I can refer you to, where the profits of banking, irrigation, road-making, &c., have been not 30 or 40, but 70 or 100 per cent., and you may see with your own eyes that the field for such investments is practically unlimited in India.'" Mr. Tagore then went on to inquire how it was that English capitalists were blind to these notorious facts? How it was that they invested millions upon millions sterling in every country except India, where they could get cent. per cent. for their investments for many years to come? How it was that when he saw the cost of Russian hemp jumping up at once £5 a ton, and when it had been proved, by trials at English dockyards, that we could grow much better and stronger hemp in India, that capitalists never attempted to develop the resources of that country? Mr. Tagore said a good deal more to the same effect, and he was very sorry that he was engaged and could not himself attend the meeting that evening; but he thought the testimony of such a very intelligent native of India to the value of Colonel Cotton's doctrines about public works in that country, was sufficiently important to warrant his addressing this assembly to repeat such a conversation, and he would leave Colonel Cotton to answer the scientific objections to his proposed improvements.

Mr. F. Carnac Brown said—Amongst all the speeches that had been delivered on this subject, no one had appeared as the representative of the natives of India. Now as he was connected with that country by property, he begged to say a word in their name. He would ask the meeting to realise to themselves the condition of that country, and, supposing the persons present were called upon to decide whether they would have some thousands of miles of communication of the nature on which the meeting was at present divided, at the same cost which they could pay for the more expensive means of communication by railways, which would they choose? He would ask them, supposing there were no turnpike-roads, and no canals in England, and it was put to them whether they would have turnpike-roads and canals, or whether they would have a high-speed railway; what would be their choice? For they must remember that India was, in its interior, utterly devoid of all communications. They had been told by Colonel Cotton, that it was impossible to transport the abundance of one county—he might go farther, and say, even of one hundred of a county—to assuage the famine which prevailed in another county; and there were parts of India where such a thing as a wheel conveyance was altogether unknown. With regard to what had fallen from Colonel Sykes, the deputy-chairman of the East India Company—and who had read

from papers which he could only have obtained in that capacity—

Colonel Sykes.—They are all before Parliament.

Mr. Brown.—At all events he (Mr. Brown) could have no access to them. He had told them that he, with the other directors, had given a guarrantee of interest upon £27,000,000.

Colonel Sykes.—No, no. I said £17,000,000 was guaranteed for railways, and £20,700,000 was the total amount guaranteed and to be expended.

Mr. Brown went on to remark that a great parade had been made of the guarantee of 5 per cent. upon the property to be invested in Indian railways. The vast liberality of the East India Company in that respect had been proudly paraded before them; but he would put it to the meeting—supposing it was their money that was going to be dealt with in that way, would they not think they were entitled to have a voice in the matter? and again he would ask, if the question were submitted to them, whether they would have the description of railway which Colonel Cotton advised, (and recollect the gallant author had not spoken disparagingly of high-speed railways in countries where the necessities and exigencies of the case called for such,) or whether they would adopt a system of communication of which the great bulk of the Indian population, so impoverished, and, he regretted to add, so degraded as they were, could not avail themselves—what would be their choice? To ask the great bulk of the population of India to use a railway on these terms, was like asking them to use a coach and six; but they could use, and would use extensively, those tram roads which Colonel Cotton had advocated, for the reason that they were more economical, and would provide far more extensively for the wants and requirements of the country. He must beg of the meeting, in deciding this question, to put it to themselves what the choice of the natives would be in the matter,—the choice of those whose money was guaranteed to pay this 5 per cent. upon the expenditure for railways? With regard to the opening of the Godavery, Colonel Cotton had said nothing about the upper part of that river. All he had said was, that with its tributaries it was navigable 700 miles from the sea. But he (Mr. Brown) would ask, did not Palmer's house use that river, 30 years ago, as a communication to Hyderabad? This matter was not one to be decided by a 5 per cent. guarantee; and since the natives had not a voice in the disposal of their money, those who placed themselves in the position of disposing of it should bring before their eyes what the country required. He was sure that if the voice of the natives had any influence, they would decide for as cheap and extensive communications as could be made with their money.

Mr. Sidney was not an Indian, but he had made the commercial resources of that country his study for many years, and he desired to recal the attention of the Society to the subject really under discussion, from which they had been led astray by all the speakers except the last. Railway officers and railway directors had occupied much time in proving that railways, executed and projected, were a sufficient substitute for every kind of road or public improvement, which was natural—and the deputy chairman had made a clever speech to show that the government of India was perfect—which was natural, too; all governors thought the same of their government. But it did not require Indian experience to judge of the value of the paper read by Colonel Cotton; when the facts were admitted, its value would be fully appreciated by any man of common sense and common commercial experience without the aid of Indian experience. That paper might be divided into two parts—an account of the resources of India, and of the best mode of developing them. No speaker had ventured to contradict Colonel Cotton's first positions, the foundation of all his conclusions. It was admitted that India was a country of admirably fertile soil, where, under a tropical sun, with a sufficient supply of water, enormously increased supplies of produce could be grown, by the aid of 150 millions of half-naked, wretched, but industrious natives. That of this produce in cotton, sugar, rice, and tobacco, England was prepared, at a price, to consume an amount practically unlimited, and that the purchase money of such increased commerce would materially improve the condition of the native inhabitants, enable them to pay their taxes with ease, and to become customers for British manufactures. It was admitted, at any rate no one had ventured to deny it, that one great obstacle to increased cultivation lay in the absence of comprehensive irrigation works in situations where they could be established at a very trifling expenditure, and with a return at a high rate of interest, and still more in the want of means of conveyance either by railroad, or canal, or common roads. What the common roads of India were might be learned from the diagrams on the black board, copied from the *fac-simile* drawings of the late Mr. Mackay, the Manchester Cotton Commissioner. The Indian roads were tracks, marked out by cart-ruts, often as deep as the nave of the wretched carts, utterly impassible in the rainy season, and only available in summer at an absurd waste of power. Colonel Cotton was not content to point out the disease without suggesting the remedy, and his suggestions were backed by all the force of thirty years' experience in planning and executing the kind of works he recommended. He stated, and gave name, and date, and revenue returns, that proved that wherever the Indian government had expended capital in works of irrigation and of communication by land, by river, by canal, or by sea, not only had the rent-paying, tax-paying abilities of the natives been enormously increased, but a large percentage of profit had been reaped for the capital sunk. He (Mr. Sidney) had come prepared with a mass of evidence to the same effect, drawn from parliamentary documents of acknowledged authenticity; but it was unnecessary to detain the Society by accumulating proofs of the capabilities of India, wisely governed, and of the long years of neglect by the Indian government. It was no answer to Colonel Cotton's statements and conclusions, that one railway official should launch into a vivid description of railways planned and executed, and general laudation of the merits of a railway system; or that another should indulge in criticism, geographical and engineering, on points of detail, and which he was certainly less competent to decide than the author of the paper—the engineer of the Godavery Irrigation Works. It was no answer for the Deputy-Chairman of the East India Company to pit his fifty years' military experience against Colonel Cotton's thirty years' engineering experience, or for him to parade the expenditure on public works in a period of thirty years, which, large in millions, was small in comparison with the taxes paid by 150 million natives. It was no answer to the statement that Madras was without a port or a pier, to say that a Joint-Stock Company had tried to pass the Madras surf with a piled pier and failed. Had any eminent engineer been ever seriously consulted on the subject? But enough of these small cavils and detailed criticisms, which any minister in power could always find by the dozen, in order to discountenance, if he did not put down, an earnest practical reformer. The Society was not called upon to condemn Indian railways; far from it. He (Mr. Sidney) had no doubt that railroads, in more ways than one, would confer great benefits on our Indian empire, not the least by introducing a new class of scientific and practical men into that country. But the real question was whether a few hundred miles of railroads, executed and planned, were a sufficient substitute and atonement for the all but total absence of practicable roads through 30,000 miles of India. Whether a wise and liberal expenditure on public works, in deepening rivers, making cheap canals and cheap light railroads, would not amply repay the Indian government, both directly and indirectly. To these

questions the answers, as contained in Colonel Cotton's paper, were all one way. He (Mr. Sidney) earnestly called the attention of the Society to the condition of the Indian empire, over the future of which an enlightened public opinion in England, and England alone, had the power of exercising so beneficial an influence, for in India there was no public opinion. The government of Canada and Australia had virtually passed from our hands. They were colonized countries, and colonists soon learned to manage their own business without the drag-chain of Boards and Commissioners. But India was a conquered country, which could never be colonized, governed (until recently) by the traditions of conquerors, who, having found on entering into possession, an existing revenue, had never been pushed on to execute those works which had raised the colonists of the United States and Canada, in a less fertile soil, to their present flourishing condition. A parallel to the condition of India might be found near home—in Connaught, in Ireland, in the early part of the present century. There the landlords were the descendants of conquerors, and under the traditions of conquest, a rack rent, exacted from a miserable tenantry, pressed them down and detained them in the lowest state of degradation. There were no reproductive works, public or private; the fields were undrained and unfenced; the stock and the cultivator were alike without fitting shelter. The ragged tenant for his rent obtained leave to exist, and received, in times of famine, a remission of arrears of rent which it was impossible he could ever pay. A contrast was to be found in the English landlords, who spared the capital of their tenants by handing over their farms provided with the "works" necessary for production, and who met times of agricultural distress not by a mere abatement of rent, but by liberally investing money in drainage and improved farm buildings. The Irish landlord of the old sort (they were improved now) was a type of the traditionary Indian government, which took all it could from the Indian cultivator beyond a bare existence, and remitted or expended in times of famine sums of money sufficient, if wisely expended on roads, ports, and irrigation, to make famine impossible. For his own part he (Mr. Sidney) hoped better things of the future Indian government, and would have been glad to have treated past shortcomings as "bygones," had it not been for the tone and scarcely candid criticism of the Deputy-Chairman. He felt assured that the Society of Arts could not more usefully employ its just influence than in supporting the broad, sound, economical principles laid down in Colonel Cotton's admirable paper—principles which would substitute for the sordid, short-sighted economy which had too long characterised the internal administration of India, a wise liberality in the rapid execution of reproductive works, which would cover the country with a net work of communication, working upwards from the cheapest to the most perfect, and place within the reach of the industrious population the means of fertility in water stored, and the inducement to labour in the shape of access to market; such works would render the collection of the Indian revenue an easy task, and in England, by the profits of increased commerce, the exchange of our manufactures for the produce of Indian agriculture, render the burdens imposed by war comparatively insignificant.

The Chairman then rose and said, the time had now arrived when it was necessary to begin to draw these proceedings to a close. He had therefore now to propose a vote of thanks to Colonel Cotton for his very valuable paper. Whatever differences of opinion had been expressed that evening, there was no one present who would not cordially join in doing honour to the gallant gentleman who had brought this important subject before them. But it might be expected of him to offer a few remarks on this occasion, and he did so with considerable diffidence, because he could pretend to no practical experience on the subject, and he moreover spoke in the presence of gentlemen who were familiar with it both by experience and observation. He would offer one remark in reply to what had fallen from Colonel Sykes. That gentleman had attributed to Colonel Cotton the error of taking India for England, on principles applicable to England, but not applicable to India. He differed from his gallant friend upon this. He thought the only and sufficient defence of the paper was exactly the contrary, that, instead of the same principles being applicable, exactly opposite principles were applicable. In this country, if it were believed that a project would pay commercially, the money was readily found; if not, they waited until they thought it would. That was the way in which they dealt with things in England. But if that principle, which was the true principle of political economy, were applied to India, he very much feared it could not be carried out. It was simply because England was not India, because the same principles would not apply, because in India there is not the spirit of enterprise which exists in England, and they were obliged to begin at the wrong end, and look for the Government to make the country, instead of the country making itself. They were the landlords, as it were, of India; it was their estate, and the question was, whether they ought to be improving or neglectful landlords. India had been conquered at great expense, and at great loss of population, thereby occasioning a great discouragement to the industry of the country. They had acquired their possessions piece by piece, and they were conquered after a long period of civil commotion and brigandage. There were, therefore, allowances to be made for a government under such circumstances, and finding a country exhausted and depopulated, they did not plunge at once into the execution of very large public works; and, although he was by no means prepared to say that all had been done that might have been done, he said there was much allowance to be made in that respect, but he was prepared to say he considered the East India Company had by no means done its duty in the matter of public works. As the landlords of a great estate they had not done all that should have been done, and he did not think his gallant friend (Colonel Sykes) would say out of that room that £20,000,000, or one year's income, was a very great deal to have spent or projected to spend on public works in 30 years in a country like India. As far as the guarantee to the railways was concerned, he was not disposed to go into that question, because he thought the discussion upon that had been a little prejudiced by the desire on the one part to defend the course taken by the East India Company, and on the other part to defend the course taken by the advocates of railways in India; and although he was a member of the Government at the time this guarantee was proposed, for his own part he would not have given a shilling guarantee—not because he thought the guarantee was too high, but because a company under a guarantee was apt to lose a great deal of the stimulus to exertion, and was likely to be carried into an amount of extravagance and indolence that might not otherwise have occurred. With regard to irrigation, agreeing as he did with Colonel Cotton, as to the benefits of the system, even that, he thought, must be taken with some qualifications. They were not to lay it down as a rule that at every place they looked at it was worth their while as landlords to commence works of irrigation. The effect of the conquest had been, that the produce of the land had very considerably declined in value. It was not difficult to understand this. When the country was in a state of brigandage, that which escaped the hand of the spoiler fetched a higher price, whereas now the crop was used by those who grew it. The consequence was, the production was greater and the price was lowered. When there was a glut of produce it would be absurd to commence works of irrigation; that would only be to increase the producing power where the consuming power was wanted; and he therefore believed that the question of irrigation was to be taken not alone, but as subordinate to the

question of communication; for it was no use to increase the producing power of the country unless it could be carried to some profitable market. There was another element in the matter which was worthy of consideration, namely, our new conquests in Pegu, where it was said rice could be grown extraordinarily cheap and in vast quantities in the valley of the Irawaddy, and was said to be superior to the productions of Madras. But he was bound to say upon this point that the East India Company were doing all that could well be desired of them; because during the last year the Government of India sent out orders to spend as much money as was required for the public works, the only limit imposed being that the execution of those great works should not be put into unskilful hands, and that the expenditure should not take place until that had been secured. Another principle had been established, for the introduction of which they were indebted to Colonel Cotton, which was, that it was absurd to treat expenditure on public works in the same light as expenses that would never return anything—to consider the pay of a regiment the same as making a road or a dam,—and he repeated, for the establishment of that principle they were indebted to Colonel Cotton. With regard to communication in India, with all respect, he thought those railway gentlemen who had spoken against canals had taken too narrow a view of the case. He believed so vast were the resources of India, that plenty of employment could be found for any means of transport that could be suggested, and neither the railway directors nor the canal proprietors need look upon each other with jealousy. Railways were of great commercial use, but in a country like India, especially, they were of great political use. They had some 26,000 European troops in India, whose presence maintained the tranquillity of the country; and if, upon any emergency, it was necessary to summon those European troops to any particular quarter, they could, by means of the railways, be quickly called into action. An insurgent rajah might select the hot season for an outbreak, where they had but a small number of troops, and then they were obliged to concentrate their European forces at an amount of suffering and loss which could scarcely be conceived, and what our troops suffered in the Mooltan insurrection was scarcely to be told. It would tend to secure the permanency of our empire in India, if they had the means of conveying troops to any quarter of the country, without exacting from them those dreadful sacrifices, and would also invigorate the civil administration, by enabling the central power to investigate more closely the conduct of its officers in every department of the government. Colonel Cotton (continued the hon. chairman) was a man of whom this country, as well as India, had reason to be proud. He commenced, and he had carried out, the most gigantic plans of public improvements in India. It was to him we owed the noble work across the Coleroon, the Godavery, and the Kistnah; and it was to him also we owed what he believed to be the commencement of an entire revolution in the principles of Indian government. He had seen a document, signed by a member of the Council of Madras, which was not supposed to be particularly favourable to the mode of spending the public money of which Colonel Cotton had always been the consistent advocate, in which they said he had given them new views of their duties, and shown the duties of the Government in a light in which they had never seen them before—an admission honourable alike to the Government itself, and to the individual who extorted it from them. Colonel Cotton had begun a great work for India. He had turned the barren waste into a smiling garden, and carried the waters of fertility over the desert places, and he regarded him as a moral Columbus, who was opening out this vast country to our enterprise and energy, and giving that happiness to the people which they did not enjoy in the full measure which they ought under British rule.

The vote of thanks having been put from the chair, was passed by acclamation, when

Colonel Cotton said, in acknowledging the great honour of the vote of thanks, and the hearty way in which the chairman had proposed it, he could have wished to have replied to some things that had been said that evening, but at that late hour he must not detain them long. He would merely give one or two examples of the sort of answers he would offer. He must not even now forget the relative positions of the gallant colonel who had offered his remarks upon his (Colonel Cotton's) views, but still he must not hesitate distinctly to point out the real nature of his statements. The gallant colonel denied that the Upper Godavery was navigable. Now, he proposed to navigate the river from the Delta up to the centre of Berar, 450 feet above the level of the sea, in which part of its course it had a fall of a little more than 1 foot a mile. He met this, by telling the meeting the impracticability of the river near its sources, in the western ghauts, at a level of 1,500 feet above the sea, where it had a fall of many feet per mile. Now, what in the world had the impracticability of the river 1,000 feet above the level to which he proposed to navigate it, to do with what he spoke of. Again, the gallant colonel said he did not believe there was one Mahomedan work that we had allowed to go to ruin. He never used the word Mahomedan. He spoke of old native works; it was quite possible that not one *Mahomedan* work was in ruins, and that the works that had been neglected were the works of Hindoos. But it was notorious that there were hundreds, nay, thousands of native works now in every stage of decay. Numbers that were in a comparatively effective state when we took possession of them, and upon which the lands below them were wholly dependent for their value, were now in complete ruin, so that those lands were utterly valueless, and without a population. These two points would give an idea of the value of the words that were uttered, and dignified as answers to the statements he had made, and from these the meeting might judge how easily the rest that had been offered might be shown to be altogether unsubstantial, did time permit him to reply at length. He would also just refer to what a preceding speaker had said in reply to the gentleman (Mr. Nicholson) connected with the Bombay Railway. The former pointed out that the point from which he proposed to bring the Berar cotton to Bombay, a point 150 miles from that port, was not only not in Berar at all, but was actually 250 miles from the centre of the cotton tract in that district. He said he could convey it by rail from thence to Bombay for 13s. 4d., but he had to convey it 250 miles before he could put it on his railway at the point he mentioned. This was a specimen of a railway gentleman's attempts to set aside what he insisted upon, viz.:—that what India required was, that it should be pervaded by a system of communications for very cheap transit, in the shortest possible time, and that hence, with a navigable and improvable river now flowing from the cotton country 400 miles to the coast, it was a great mistake to spend £3,000,000 or £4,000,000 on a railway 400 miles long, with an ascent of 2,500 feet, and that would probably take 20 years to execute. He must just add, that a gentleman, a civil engineer, from the United States, who, from the great superabundance of speakers to-night, had not had an opportunity of stating it to the meeting, had mentioned to him, as a remarkable corroboration of one of his main positions, viz.,—that railways never could convey the main goods traffic of a country,—that it had been calculated that if the present traffic by the Erie Canal had to be transferred to the railway that runs parallel with it, it would require six lines of rails to be incessantly worked night and day to convey it; and, with respect to the comparative effects of speed and cost upon first-class passenger travelling, almost the whole of the passengers now go by the Hudson steamers from New York to Albany, 160 miles, in preference to the railway, on account of the less cost. He would not detain the meeting any longer than to again offer his sincere acknowledgments for the honour and compliments that had been paid him.

The Secretary announced that the Paper to be read at the meeting of Wednesday next, the 2nd of May, would be "On Juvenile Crime as it affects Commerce, and the best means of repressing it," by Mr. Jelinger Symons, B.A., one of her Majesty's Inspectors of Schools.

*** It having been represented, after the meeting, that there were still many gentlemen who were anxious to make some remarks on the subject of "Public Works for India," the Secretary is authorised to state that an Extraordinary Meeting has been fixed for Monday the 7th of May, at eight p.m., for the purpose of renewing the discussion.

## ARTISANS' VISIT TO PARIS.

In publishing the following prospectus, the Council makes the announcement for the information of parties interested, but is in no respect responsible for the carrying out the promises put forth.

Tha Council, however, has understood that some English workmen, at present in Paris, connected with the Exhibition, have availed themselves of the accommodation offered, and express themselves well satisfied.

PARIS EXHIBITION OF 1855.

ARTIZANS' RENDEZVOUS.

*Offices.*—Rue Drouot, No. 14, Paris.

With a view to facilitate the visit of the industrious classes to the Universal Exhibition, and to protect them from the exorbitant charges and impositions to which they would otherwise be liable, the Artisans' Rendezvous has made arrangements for providing board and lodging for *bona fide* members of those classes on the following

TERMS:

1st. Visitors will have to make their own arrangements in England for the journey to Paris. Information of the cheapest and best routes given at the London office.

2nd. The contract of the Paris office will only come into operation from the moment of the subscriber's arrival in Paris.

3rd. The subscribers will be lodged each in a separate room containing a single bed, with accommodation similar to that in the model lodging honses in London. They will be entitled to three meals a day, breakfast, lunch, and dinner or supper, *ad libitum*, liberally served, and comprising English and French fare, and also to the use of a common room, provided with English newspapers, maps, guides, and books of reference relating to Paris sights and amusements.

4th. Interpreter guides, in the proportion of one to each party of 25, will be placed at the disposal of subscribers, to accompany them to the Exhibition, conduct them to the sights of Paris, and make themselves generally useful to the subscribers.

5th. Subscribers in parties of not less than 25, if three days' notice be given to the London office, will be met, on their arrival at the railway station in Paris, by an agent of the Paris office, and will be at once conducted to their lodging.

6th. The charge for the above accommodation and advantages will be 5s. 6d. per day, including the registration fee, lodging, board, attendance and guides.—No gratuities will be allowed to servants.

7th. The above charge is exclusive of beer, wine, or spirits, which will have to be paid for apart as ordered; the price of beer being 3d. per bottle, and wine 7d. to 1s. per bottle.

8th. Intending visitors at the time of subscribing must fix the *minimum* number of days they propose to remain in Paris, and pay on account the registration fee of 6d. per day. The remainder of the subscription, at the rate of 5s. per day, is to be paid in advance, either at the London or Paris office, at the option of subscribers.

These regulations are indispensable, in order that accommodation may be prepared beforehand, and guaranteed to subscribers in succession.

9th. Any arrangement for extension of the visit beyond the number of days fixed at the time of subscribing must be made in Paris, and will depend upon the accommodation available. The subscriber must clearly understand that the Paris office is under no engagement to him beyond the number of days paid for in advance.

10th. Certificates will be issued by the London agent, on payment of the subscription, and be exchanged in Paris for the Artisans' Rendezvous ticket.

Subscribers may have their letters addressed, and apply for information generally, to the Rendezvous Office, No. 14, Rue Drouot, Paris.

Applications for further information to be made to the

PRINCIPAL OFFICE . . . 17, Cornhill, London.
Edinburgh.
Dublin.

W. H. J. TRAICE . . . . 35, Park-row, Leeds.

AND TO THE

Director of the "Chief Rendezvous" Office,
No. 14, RUE DROUOT, PARIS.

## CALCULATING MACHINE.

A calculating machine has lately been brought from Sweden into this country, by the inventors, Monsieur Scheutz, a Swedish gentleman, and his son. The machine is of that class known to mathematicians as a difference engine, its calculations being made on the principle of differences. The machine is adapted for calculating tables the law of whose formation is dependent on the addition of successive differences. It not only calculates the series of numbers, but it impresses each result on a piece of lead, from which a cliché in type metal is taken, thus producing a stereotype-plate, from which printed copies may be obtained, free from any error of composing, &c. To explain the working of the engine, and the mechanical contrivances by which its objects are effected, would be impossible without a series of elaborate diagrams and a very lengthened description, though it may be stated that the mechanism is peculiarly simple. The machine *calculates* to sixteen figures, but *prints* to eight only; and by a singularly ingenious, and at the same simple, contrivance, the eighth figure in the table is printed, not in all cases as calculated, but with a correction, when required, for the ninth and subsequent figures omitted in the table. Thus, wherever the ninth figure as calculated amounts to five or more, it is more accurate that the eighth or final figure in the table should be printed with the addition of one; this the machine accomplishes. By taking out certain wheels and inserting others, the machine can be readily caused to produce its results in £ s. d., degrees, minutes, and seconds, or any other series of subdivisions which may be thought desirable. In the series of successive additions of which the machine consists, the contrivance by which the carriage on arrival at ten is effected displays much ingenuity. The machine performs its operations, when once set to the law on which the required table depends, by simply turning a handle, without any further attention, the power required for the purpose being extremely small, not more than a child of ten years old could supply. The calculations are made, and the results impressed on the

lead at the rate of about 250 figures every ten minutes, the machine being worked slowly. It may be worked much faster, but in that case there might be danger from the momentum a rapid motion would generate in the wheels. It is said that the inventor has spent all his means in perfecting the instrument. It is to be hoped that some plan may be adopted by which the valuable powers of the machine may be rendered practically available for supplying the public with a perfect set of logarithmic and other tables, a desideratum long sought, and at the same time remunerate the inventor for his ingenuity and talent.

## Home Correspondence.

### THE DECIMAL SYSTEM OF COINAGE.

Sir,—I regretted not to be able to attend the late discussion of the Society on the subject of "Decimalising our Money Scale," and must trust to your kindness in allowing me to make a few observations in your Journal in support of those views of the subject that have obtained the appellation of the *pound and mil* scheme. I have seen no reason for changing my opinion of the extreme impolicy of interfering, in the way proposed by the advocates of the *penny and franc* plan, with the real poor man's unit, the *shilling*,—the measure of value in, perhaps, ninety-nine transactions in every hundred, of the tradesman; the proposed substitute for which, by a tenpenny coin, would involve us in making practical difficulties, without realising a perfect scheme of decimal accounting. In fact, according to some of its projectors, this would only be applicable in small affairs, whilst in large ones, in which the pound would be used, the decimal scale must of necessity be abandoned for some clumsy makeshift. The objection to change, so far as I have observed, in the public mind, is chiefly based on the groundless supposition of the necessity of an alarming influx of new money, to be accompanied by new ideas and standards of value. I have met these arguments by shewing that no novelties at all are required; that the present coins admit of perfect adaptation to decimal arithmetic, weeded of a few that may desirably be dispensed with. The following scale of circulating money will conveniently exhibit my views:—

| | | |
|---|---|---|
| Sovereign . . . | 1000 mils. | Gold. |
| Half-sovereign . . | 500 " | |
| Florin . . . . | 100 " | Silver. |
| Half-do., old shilling . | 50 " | |
| Quarter-do., old sixpence | 25 " | |
| Eighth-do., old threepence | $12\frac{1}{2}$ " | |
| Four mil, old penny . | 4 " | Copper. |
| Two mil, old half . . | 2 " | |
| One mil, old farthing . | 1 " | |

A question may remain as to the eighth of a florin, dividing as it does the mil, which in practice, I believe, would be unimportant; or if otherwise, we can well enough do without it, or any substitute, My scale proposes that the money of the old and new systems are to be identical, coin for coin, stamping excepted; and that no future money, either silver or copper, shall be issued unless stamped respectively, in conformity with prospective decimal arithmetic, in mils. I propose no present attempt at using them in any way but as heretofore, side by side with the old ones. The representatives of the existing copper money would be introduced bearing the marks 1, 2, and 4 mils, no notice of the new stamping being taken at the time of issue. Beyond this, nothing in size would mark any difference from those now passing current, of which they would form a part, circulating as farthings, halfpence, and pence. No innovation, partial or otherwise, is to take place in our mode of accounting; whilst in the mean time the ultimate period of transition would depend on the operations at the Mint, the changing process doubtless being spread over several years. Time in such a case is unimportant compared with certainty of success, and avoiding our intermediate state of perplexity between two conflicting systems. The old scale would continue in operation, whilst the masses would be learning their lessons from the new coins, and their relative value under the forthcoming scale, till the period should arrive when the final step might safely be taken of declaring by proclamation the future relations of one coin to another. This should be delayed till there was a preponderance of new over the old coinage, perhaps a considerable one, followed up by the introduction of decimal arithmetic at the public offices, in correspondence with the three denominations of coins—*pounds, florins, and mils.* It is not pretended that a vast process like this can be accomplished without some possible difficulties, unapparent to non-official eyes; but I think the mode of procedure thus contemplated would reduce them to their minimum: at all events they are not insurmountable, and the required extra effort would be a final one. The copper money alone appears to present room for controversy at its altered value under the new system. Probably the holders of this in large quatities are not very numerous, but ascertained loss up to a certain point ought to be met at the Treasury for a stated period, afterwards the dates upon the pieces would be distinctive. The imagined dissatisfation, of which so much has been foretold as likely to arise amongst the lower classes, at any change in the copper, I put down at nothing, believing that the amount of oppression falling in that quarter would be limited to the extra labour of counting 25 instead of 24, in change for a sixpence. The Chancellor of the Exchequer requires no assistance of mine; he will probably be wise enough to sit down quietly under a slightly diminished revenue. The claims for compensation in matters of diminished penny tolls, &c., might be anticipated at once, by a ten years' notice to such proprietors of the coming event; these must be satisfied with the grand arbitrator of all things—*Time.* Something approaching to alarm has been manifested at the mention of 20 years, as required to finally extinguish the present system of money. We have already talked out nearly 8 years, since Sir John Bowring's motion in Parliament, so luckily successful, for introducing the first step in decimalisation,—the tenth of a pound. Lord John Russell informs us that thirty years is about the average period required by John Bull to meditate over an improvement. The French were twice as long before they took a final leave of their old coins. Suppose, immediately on the passing of the Reform Act, we had commenced the process of changing our system, and had just now properly and finally completed it, the interval would not have appeared either very long or ill spent. Moreover, in estimating the relative advantages of the two modes of decimalising our money now dividing attention, mere time ought to weigh as dust in the balance, in comparison with considerations infinitely more important.

In my view it is a matter of indifference in what order the proposed change of money should come, or whether new silver or copper coins be issued in succession or simultaneously. This is a matter of Mint convenience, and of Birmingham contract arrangement. Erroneous ideas are afloat, and ought to be refuted, that the decimal system of accounting requires decimal modes of thinking and valuing, in *tenths*, or parts of tenths. This is a mere fallacy. The natural habits in all countries in common dealings induce the practice of continual *halving* and *quartering*, and nothing would more disgust the public than an interference with a *binary* division of the current coins as now existing. John Q. Adams took some pains in convincing the Americans that decimal book-keeping involved no necessity for using inconvenient or unusual money; that the questions were distinct, and that the coins ought, as far as possible, to be divisible binarily, to give facilities for ready counting—a point usually much lost sight of. Every banker knows this, and the remark made by one to me was, that no silver coin was admissible that was not

some aliquot part of a hundred mils. In consequence I omitted in my scale a 15-mil piece, which, I observe, forms a part in the one laid down by your correspondent Mr. Tripp. Neither would the *fifth* of a florin meet any requirement of the public. The Select Committee having, as I consider, made one false step, by recommending the introduction of a 10-mil piece (at once too small and too large for utility), naturally follow it up with its *half* and *double*; still, from necessity, retaining the indispensable quarter-florin; so that the public and cashiers would be plagued with these two coins, side by side, and almost undistinguishable. I may make an observation respecting the penny copper coin in its present form, as first introduced in the reign of George the Third. I confess I never had the same satisfied feeling respecting its value as a poor man's unit that many profess to entertain; although, as a matter of expediency, I have retained its representation in my scale. I rather agree with those who believe that it is too often employed in a way contrary to the interests of any class; that it is the daily medium of our change in small things, not intrinsically worth probably more than three farthings—the price too commonly being dependant on the *coin*, not the coin on the *price*. It may be imagined that, holding this opinion, I should not acquiesce in the introduction of a coin—*a five-mil piece*—exhibiting all the evils appertaining to the penny, with aggravation. Both coins could not co-exist, and employed as a substitute, one for the other, it would be discovered that, used singly, we got no increase of value for it. I am convinced that he is the best friend to the poor man who would give him the means to acquire a habit of reckoning with the smallest money. In a correspondence with Sir John Bowring on this and some other points, especially as regards any addition to our coins, I think our views became nearly identical. He thus expresses himself, in a communication to me, bearing date 5th October, 1853:—"In copper I would have only the 1 and 2 mil; 2 *gold*, 3 *silver*, and 2 *copper*, are the only coins I would retain."

HENRY TAYLOR.

London, 26th March, 1855.

## To Correspondents.

ERRATA.—In Mr. Good's letter on Decimal Coinage, in the last number, third paragraph, for "coin piece," read "4 coin piece." In postscript, last line but one, for "This expression,' read "This arrangement."

## MEETINGS FOR THE ENSUING WEEK.

MON. Zoological, 1 p.m. Anniversary.
Actuaries, 7.

TUES. Horticultural, 1 p.m. Anniversary.
Royal Inst., 2 p.m. Annual Meeting.
Civil Engineers, 8. Discussion on Mr. Barton's paper "On the Economic Distribution of Material in the sides or vertical portion of Wrought Iron Beams."
Linnæan, 8.
Pathological, 8.
Royal Inst. 3. Dr. Tyndall, "On Voltaic Electricity."

WED. Society of Arts, 8. Mr. Jelinger Symons, "On Juvenile Crime as it affects Commerce, and the best means of Repressing it."
Geological, 8. 1. Mr. E. Hull, "On the Physical Geography and the Pleistocene Phenomena of the Cottswold Hills." 2. "Notice of the occurrence of coal in the Gulf of Nicomedia." 3. Mr. R. Harkness, "On the Anthracite Schists of the Lower Silurians in the South of Scotland."

THURS. Royal Inst. 3. Mr. G. Scharf, jun., "On Christian Art."
Antiquaries, 8.
Photographic, 8.
Royal, 8½.

FRI. Botanical, 8.
Royal Inst., 8½. Dr. Gladstone, "On Gunpowder and its Substitutes."

SAT. Asiatic, 2.
Royal Inst., 3. Dr. Du Bois Reymond, "On Electro-Physiology."
Royal Botanic, 3¾.
Medical, 8.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 19th and 20th April*, 1855.

Par. No.
110. Local Acts (24. Newton and Oswestry Railway; 25. Folkestone Improvement; 26. Ayr Harbour; 27. Glasgow Corporation Waterworks)—Reports from the Admiralty.
150. Railway and Canal Bills Committee—3rd Report.
170. Committee of Selection—9th Report.
77. Bills—Testamentary Jurisdiction.
74. Bills—Edinburgh Lands.
81. Bills—Education of Pauper Children.
Transport of Stores, &c., to the East—Diagrams.
Prisons—19th Report of the Inspectors (Southern and Western District), Part 3.
Post Office—1st Report of the Postmaster-General.
Convict Discipline and Transportation (Australian Colonies) —Further Correspondence.

*Delivered on 21st and 23rd April*, 1855.

166. Public Income and Expenditure (Balance Sheet)—Account.
168. Deficiency Bills, &c.—Return.
173. Bullion, &c.—Account.
174. Land Force, &c. (India)—Abstract Return.
180. Probate, &c., Duty—Return.
181. Arctic Expeditions—Return.
182. Bank of England—Copy of Letter.
185. Supply, Expenditure, &c.—Return.
157. Civil Contingencies—Account and Estimate.
164. Governors of Colonies—Return.
169. Harbours of Refuge—Return.
184. British Museum—Accounts, Estimates, &c.
75. Bills—Passengers Act Amendment (amended).
82. Bills—Despatch of Business, Court of Chancery.
78. Bills—Poor Law (Scotland).
79. Bills—Sunday Trading (Metropolis).
80. Land and Assessed Taxes—Divisions.
National Vaccine Board—Report.

SESSION 1854.

493. Settlement and Removal—Supplement to Mr. Coode's Report.

*Delivered on 24th of April*, 1855.

178. Spirits, &c.—Return.
179. Spirits (Scotland)—Return.
187. Post-office Department (Packet Service)—Estimate.
83. Bill—Intestacy (Scotland) (amended).

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, April 20th*, 1855.]

*Dated 29th March*, 1855.

704. W. James, Crosby-hall Chambers—Screw bolts.

*Dated 30th March*, 1855.

710. G. H. and A. M. Babcock, Westerly, Rhode Island—Polychromatic printing presses.

*Dated 4th April*, 1855.

754. R. Hills and H. Monument, Caroline-place, City-road, and T. Miles, Queen-street, Finsbury—Corking bottles, jars, &c.

*Dated 5th April*, 1855.

736. T. Squire, Latchford—Removing hairs from hides and skins. (A communication.)
758. J. Carlhian, Paris, and F. J. Corbière, 27, Castle-street, Holborn—Soda water and aerated liquids. (A communication.)
760. J. Brazier, Wolverhampton—Revolving fire-arms.
762. D. Lane, Cork—Motive power by water.
764. A. Longbottom, Leeds—Preparing sand for casting. (A communication.)
766. P. Arrive, 7, Spencer-street, Gravesend—Safety valves.

*Dated 7th April*, 1855.

768. R. W. Waithman, Bentham-house, York—Lint.
770. A. Rollason, Birmingham—Photography.
772. R. Stones, Kingston-upon-Hull—Taps.
774. J. Aresti, Greek-street, Soho—Drawings on stone.
776. D. G. Jones, M.D., 14, Harrington-square—Farinaceous food.

*Dated 9th April*, 1855.

778. J. C. Kay, Bury—Pressure and vacuum gauges.
780. Lieut. E. O'Callaghan—Ordnance and projectiles.
782. W. Bull, Ramsey, Essex—Instrument for cutting vegetables.

*Dated 10th April*, 1855.

784. W. Ricketts and T. Bulley, Stepney—Table covers.
786. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Steam boilers. (A communication.)
788. J. H. Johnson, 47, Lincoln's-inn-fields—Combing wool. (A communication.)
790. L. Monzani, St. James's-terrace, Bermondsey—Folding stools and chairs.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

800. E. Pasquier, Reims, France—Machine for drying wool.—11th April, 1855.
806. S. Hjorth, Copenhagen—Magneto-electric battery—11th April, 1855.

807. S. Hjorth, Copenhagen—Electro-magnetic machine.—11th April, 1855.
808. S. Hjorth, Copenhagen—Electro-magnetic machine.—11th April, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed April 18th, 1855.*

2229. George Hamilton, 86, Great Tower-street—Improvements in obtaining soundings.
2233. Howard Ashton Holden, Birmingham—Improvements in roof lamps for railway or other carriages, and for parts used in connection with the same.
2235. Benjamin Nicoll, 42, Regent-circus, Piccadilly—Improvements in shirt-fronts.

*Sealed April 20th, 1855.*

2251. William Green, Howard-buildings, Brick-lane, St. Luke's, and Joseph Pickett, Duke-street, City—Improvements in treating or ornamenting textile materials or fabrics and paper, and in machinery or apparatus for effecting the same.
2252. Edward Abell, Lambeth—Improved instrument to assist the hand in writing.
2254. George Savage, Adderbury, Oxford—Improved singeing lamp.
2255. Abraham Gerard Brade, Paris—Improvements in the manufacture of plate and thread for gold and silver lace and bullion.
2266. Joseph Hopkinson, jun., Huddersfield—Improvements in steam-engine boilers and safety valves, and in apparatus for indicating the vacuum in steam-engine condensers in relation to the existing atmospheric pressure.
2278. Louis Vital Helin, 8, Rue des Douze Apotres, Brussels—Improvements in the manufacture of paper from straw.
2280. William Grindley Craig, Gorton, near Manchester—Improvements in the mode or method of consuming smoke, and in the machinery or apparatus employed therein.
2282. John Healey, John Foster, and John Lowe, Bolton-le-Moors—Improvements in machinery to be used for drawing, moulding, forming, and forging articles in metal.
2346. William Childs, jun., Brighton—Improvement in the manufacture of pipes and tubes.
2364. James Whitehead, Patricroft—Improvements in self-acting mules.
2394. Eugene Rimmel, 39, Gerrard-street, Soho—Improvements in combining matters to be employed in coating fabrics and leather, and for other uses in substitution of India rubber. (A communication.)
2414. George Bodley, Everhard-street East—Improvements in revolving cannon.
2536. Dominique Bazaine, Paris—Improved system of railway, applicable especially on common roads.
116. Jean Antoine François Victor Oudin, Mons, France—A new liquid for preventing sea sickness.
318. Alexander Sands, Liverpool—Improved fastening or detainer to be employed as a substitute for "clothes-pegs," or for other similar purposes.
340. William Blythe, Oswaldtwistle, and Emile Kopp, Accrington—Improvements in the manufacture of soda ash and sulphuric acid.
356. Andrew Henshaw Ward, jun., Massachusetts, U.S.—Improved loom temple. (A communication.)
388. George Noble, Sunderland—Improvements in the manufacture of fire bricks.
410. John Henry Johnson, 47, Lincoln's inn-fields—Improvements in fountain pens. (A communication.)

*Sealed April 24th, 1855.*

2142. Thomas Harris, Nanty Glo, Aberystruth—Separating the steam from the condensed water and mud in its transit from the boiler to the cylinder of a steam engine, stationary or locomotive.
2273. William Thomas Smith, New Hampstead-road, Kentish-town, and George Hill, of the City-road—Improvements in machinery or apparatus for winnowing, washing, sifting, or separating corn, gravel, minerals, and other materials.
2283. Joseph Eccles, Blackburn—Improvements in machinery for the manufacture of bricks.
2287. James Griffiths, Wolverhampton—Improvements in the mode or process of manufacturing certain kinds of iron, and in the machinery or apparatus used in such manufacture, part of which improvements are also applicable to machinery used in the manufacture of other descriptions of iron.
2289. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improved mode of operating trip hammers.
2291. Astley Paston Price, Margate—Improvements in the calcination and oxidation of certain metallic, mineral, and metallurgical compounds, and in the apparatus and means for effecting the same.
2292. William Ashton, Preston—Improvements in safety or escape valves.
2297. Edward Lindner, New York—Improvements in revolving breech fire-arms and magazine.
2298. Jean Pierre Savouré, 2, Catherine-street, Strand—An improved gold coin detector, applicable also for weighing postal communications.
2319. George Taylor, Holbeck, near Leeds—Improvements in mills for grinding corn and other substances.
2320. James and William Bradshaw, Blackburn—Improvements in time-pieces.
2331. Edouard Alexandre, Paris—Improvements in organ-pianos.
2353. Andrew Peddie How, Mark-lane—Improved machine for cutting metal rods and bars. (A communication.)
2360. John Blaikie, Glasgow—Improvements in the manufacture of driving belts, straps, and bands for machinery.
2381. David Tunks, Accrington—Improvements in watches, clocks, chronometers, time-pieces, and all other instruments for the measurement of time.
2385. James Niven, Keir, near Dunblane, Perthshire—The application of a new material to the manufacture of paper, and also of textile fabrics.
2396. William Kloen, Birmingham—Improved method of ornamenting and attaching labels, cards, window, and other bills.
2400. The Honourable William Edward Fitzmaurice, Hamilton-lodge, Kensington-gore—Improvements in bullets, shells, and other projectiles.
2426. Robert Wilson, Birmingham—Improved ornamental material or fabric.
2479. Henry Jules Duvivier and Henri Chaudet, 20, Rue de la Glacière, Paris—Improvements in treating gutta percha.
2541. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury, London—Improvements in the manufacture of palm-leaf hats and carcasses for hats. (A communication.)
2544. Henry Strong, Ramsgate—Improvements in the prevention of back smoke in chimneys.
2737. Peter Haworth, Manchester—Improved belt, band, or strap fastener.
2747. Ashton Stansfield and Josiah Greenwood, Todmorden—Improvements in power looms for weaving.
22. John Venables and Arthur Mann, Burslem—Improvements in producing raised figures or ornaments upon the surfaces of articles made of metal pottery and earthenware, glass, papier maché, and other materials.
23. John Venables and Arthur Mann, Burslem—Improvements in producing figures or ornaments in articles made of clay or plastic material.
61. Thomas Wilson, Birmingham—Improvements in the manufacture of bands used in the construction of small arms.
199. George Bell, 21, Cannon-street West, City—Improvements in constructing air springs.
233. John Smith and James Hollingworth, Langley Mills, Brancepeth—Improvements in treating certain fibrous materials for manufacturing paper.
243. William Taylor, 16, Oxford-terrace, Hyde-park—Improvements in cables for holding at anchor and towing ships and other floating bodies.
247. Alexander William Williamson, University College, Gower-street—Improvements in apparatus for feeding fires.
319. Louis Adolphe Ferdinand Besnard, Paris—Improved composition for fixing lithographs and engravings on canvass after being transposed or reproduced by a printing press.
337. James Nichol, Edinburgh—Improvements in bookbinding.
339. Francis Brown Blanchard, Maine, U.S.—A new and useful apparatus for generating motive power from heated air, steam, and the products of the combustion of coal or other fuel.
347. William Spence, 50, Chancery-lane—Improvements in substitutes for glass for ornamental purposes. (A communication.)
353. Fortunato Gaetano Pietro Maria Vittorio Maneglia, Turin and Genoa Railway—Improvements in railway carriages.
380. Thomas Organ and George Pitt, Birmingham—Improved dress fastening.
389. Paul Prince, Derby—Improvements in the patterns employed in making moulds for railway chairs.
397. Frederick William East, 214, Bermondsey-street, Southwark, and John Mills, William-street, Neat-street, Old Kent-road—Improvements in destroying the noxious vapours arising from boiling oil, bones, and other matters in the open air.
413. John Scott Russell, Mill-wall—Improvement in the construction of ships or vessels to facilitate the use of water as ballast.
421. Charles Henry Roberts, 3, Cornwall-road, Stamford-street, Lambeth—Improvement in the manufacture of rubbers for painters and others.
458. James Lewis, Abergavenny—Improvements in stench-traps.
467. Alfred Vincent Newton, 66, Chancery-lane—Improvements in the construction of printing presses.
479. Timothy Walker Carter, Massachusetts, U.S.—Improvements in repeating fire-arms. (A communication.)
501. Eugène Tardif, Bruxelles—Improved construction of numbering apparatus.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3709 | April. | Portable Camp Arm Chair ...................... | Edmund Brown Bishop Wren | 232, Tottenham Court Road. |

Journal of the Society of Arts.

*FRIDAY, MAY* 4, 1855.

## TWENTIETH ORDINARY MEETING.

Wednesday, May 2, 1855.

The Twentieth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 2nd inst., E. Carleton Tufnell, Esq., in the Chair.

The following Candidates were balloted for and duly elected :—

| | |
|---|---|
| Atherton, Charles | Hinks, John |
| Avery, John | Melton, Alfred |
| Boxer, Captain Edward Mounier, R.A. | Mondel, Joseph |
| Campbell, James | Temple, Hon. R. |

The following Institution has been taken into Union since the last announcement :—

389. Melbourne (Derbyshire) Mechanics' Institution.

The paper read was

## ON JUVENILE CRIME AS IT AFFECTS COMMERCE, AND THE BEST MEANS OF REPRESSING IT.

By Jelinger Symons, B.A., One of Her Majesty's Inspectors of Schools.

That public morals largely affect the welfare of industry and commerce will be readily admitted. The same reasons which determine us to select honest, sober, and trustful servants prompt the employers of labour, and make it their interest to moralise the working classes. Apart from actual losses by theft, the demoralisation of workmen causes a loss in the value of labour, which cannot be estimated at less than many millions per annum. Bodily inertness, carelessness, indolence, unskilfulness, and waste, are among the many results of lax morals, all of them preying upon and forming drawbacks to the productive power of the country, from which all social as well as industrial interests necessarily suffer. I believe it to be capable of demonstration, that this country loses far more every year by the vice of drunkenness alone, than the whole amount of the taxes. Though illustrations of a principle so obviously true are scarcely needed, I may refer to Switzerland, as a remarkable instance of the commercial prosperity which may be attained by the combined morality and skill of a people who seem to have been almost divested by nature of the physical elements which most of all minister to productive wealth. It may be said, that artistic and productive energies and success are dependent far more on industry than on morals; but I apprehend that as a general rule these are inseparably linked together, and that a workman, no matter in what handicraft, combining diligence and demoralisation as his characteristics, if such an one exists, is an individual anomaly, and not a specimen of a class large enough in the slightest degree to affect my position. It may be less obvious that this principle touches the immediate question I have ventured to submit to your attention this evening, namely, the treatment of juvenile criminals. But if demoralisation injures the vital powers of industry, and commerce suffers with them, commerce is clearly concerned in uprooting the sources of crime, and, therefore, in the reformation of juvenile criminals; for who are juvenile offenders but those who people the nursery and form the brood of future crime. I am speaking less now of the actual effect of crimes on commerce than of the widely extending contagion and demoralisation which result from the existence (especially in town communities) of a criminal class. Not only does that class deteriorate all who come within its contact and companionship, but the very frequency of crimes, and the minor violations of order and decency, render the neighbourhood familiar with their commission, which familiarity is itself demoralising, and so the circle spreads. And I may here remark that the contagious influence of bad morals and examples is never so effective or disastrous as among children.

Allow me in the next place to call your attention to the direct loss of property by one sort of crime, that which constitutes almost the entire criminality of the juvenile classes, namely, theft.

It is a well-known fact, frequently stated by the most experienced and best-informed witnesses, many of whom have recently deposed to it before the Committee of the House of Commons on this subject, that in most large towns there exists a distinct class of young persons and children regularly trained and educated in the art of depredation. Not only in London, but throughout the country, the craft of pocket-picking is taught, practised, and carried on, almost as systematically and artistically as any honest vocation; and the evidence abounds that our common gaols are often effective schools for the furtherance and education of all branches of the thieving profession. As an instance of the direct loss to capital employed in commerce, and especially in manufacture I may mention the bowl weft trade, which prevails so largely throughout the cotton districts both of Scotland, Ireland, and parts of the north of England. This weft is stolen in great measure by children, and not only is it a loss in the first instance to the owner, but his own stolen property enters the market, in the shape of cheap manufacture, to compete with him.

Many calculations have been made of the first loss sustained by thefts in large manufacturing towns—not a tithe of which, I need hardly say, are ever detected. I have but little faith in statistics of which the data are necessarily vague and hidden; but in order to give some slight idea of the magnitude of the system of depredation which is now going on among the juvenile classes alone, in large towns, I will mention that I have, through the aid of my friend Mr. William Rathbone, been supplied with a detailed statement as regards Liverpool, by Major Greig, commissioner of the police force. The gross results are, that in 1854 there were 1,035 committals of children for felony, of which 428 were by children under twelve years of age. The amount of property thus detected to have been stolen was £3,225, but Major Greig adds that the probable value of property also stolen, but for which the thieves have not been apprehended, is £5,314, making a total of £8,540 *known* to have been taken by juvenile offenders, of which £1,367 only has been recovered. Now, if a system of thieving be regularly carried on in Liverpool, or in any other town, by young thieves, who can make it so profitable a business as to afford a loss on their gains of £1,367, and are likewise willing to submit to 1,000 imprisonments per annum, we may deduce some notion, not only of the extent of the depredations committed, but of the depth and magnitude of the depravity engendered, to which these facts are but an outward index.

I have received some very interesting details from Leeds, Cheltenham, and other towns, not certainly developing so extreme a case as I believe Liverpool presents, but still affording ample ground for the only point I am now endeavouring to establish, namely, how largely property suffers and morals are depraved by the extent of juvenile delinquency. I may mention that the criminal calendars forwarded to me disclose a fact I have everywhere (and in regard to all ages) found to be the case—namely, that the criminal class are not the least instructed class. I observe that those children committed who can neither read nor write, last year, did not exceed 28 per cent. of the whole number in the calendars I have examined.

I trust I have now adduced ample reasons why juvenile crime sufficiently affects commercial welfare, to entitle the vital question of its prevention to a place within the sphere of subjects which this Society may properly and usefully discuss.

There is one preliminary branch of the question which may, I deem it, be usefully eliminated from our inquiry, namely, the necessity of a new system of reformatory treatment for young offenders: but that seems to be almost the only point on which public opinion has pronounced a decisive fiat.

It has, indeed, been amply discussed and fully settled, that not only do juvenile delinquents require reformation, but that gaols, so far from effecting it, harden the offender, if they do not confirm him in crime. But beyond this lies a troubled sea of controverted theories and conflicting experiences, over which this Society may possibly pilot philanthropy into a safe and practical haven. It is with some hope of such a result that I have ventured to invite its calm attention to what appears to me to be the chief points at issue. I have, for long past, taken a very lively interest in this subject. My practice in criminal courts, and acquaintance with the moral economy of education, and, lately, my visits to nearly every reformatory establishment in England, have necessarily led me to form conclusions, which I will not affect to conceal, on the mooted branches of the subject. At the same time, I rejoice that the unimportance of my individual opinion will leave you perfectly free to form, and, I trust, to express, your own judgments, without the possibility of being biased by the utterance of mine, it being highly desirable that this great question should be debated without prejudice, and its merits sifted with fairness and freedom

The premises being settled and the object one of common assent, the remaining questions relate solely to the best practical means of effecting juvenile reformation, with due regard to the interests of society.

There appear to me to be two elements in the requisite process, namely, punishment of the offence and reformation of the offender; yet this is so far from an admitted axiom, that one of these two positions is warmly contested; for there are those who deem the punishment of his crime no necessary part of the treatment of the juvenile criminal, and who hold that the only appliance required is reformation.

The opinion has been broadly stated, that a child up to the age of thirteen or fourteen should receive no retributive correction, even for grave offences; that the only justifiable punishments are, in the first place, those which the restraints of moral conduct naturally inflict on persons suddenly removed from a life of dissolute freedom, and such as might be administered for offences committed under the process of reformation. It is assumed that the child offends whilst free "without discernment," and that the punishment with which the law visits juvenile crimes is arbitrary, and neither deterrent nor reformatory, and that it is awarded without knowledge of the culprit's antecedents, or of the neglect and temptations which induced his delinquency.

If this doctrine be tenable, it is difficult to resist the conclusion, that children, as a general principle, should be held irresponsible for their acts, and, being exempted from the penalties of the law, may thieve, burn, or kill with impunity, the sole result of such conduct being, that, if convicted, they shall be subjected only to the restraints of a reformatory discipline, where kind treatment, and the supply of every want, are alloyed by no other punishment for fresh offences whilst undergoing it, than such as are equally visited on every child under good parental care, whose antecedents are free from crime. It is scarcely necessary to comment on the effect and antisocial evils of a doctrine thus at variance with all law, human and divine, and the experience and practice of mankind in all ages. It is an amiable rather than a humane mistake—one probably engendered by the fact, that legal penalties are not always punishments, especially to the class in question. The theory on which the error ostensibly proceeds is, however, this, that children are morally entitled to exemption from punishment because they are without discernment. But if so, it is difficult, in the first place, to understand why this principle should cease to protect them from correction the moment they cross the threshold of a reformatory institution, in which they are said to be punished for faults committed there. The antecedent adversities and non-discernment which exonerate them from the crime which sent them there, ought, in consistency, to atone for the minor indiscretion of violating conventional rules, or sinning against a discipline they have never learnt to obey.

The assumption that all children under 16 offend without discernment, appears to have been arbitrarily established in France, and unhesitatingly adopted by the philanthropy which has reproduced it here. But is it so? Is the class of children who swell our criminal calendar without discernment? I have taken opportunities, not only of gathering the opinions of those best acquainted with this class, but also of closely questioning many of their number at Kingswood, Red Hill, Stoke, Hardwicke, and Parkhurst, and I can vouch that a more singularly shrewd and intelligent body of youths are rarely met with in the course even of long experience in testing the mental capacities of children, and this is the opinion of nearly all who are familiar with young criminals, not only here, but abroad.

Nor is their intelligence merely natural. It is also more or less cultivated. The senior chaplain at Parkhurst, the Rev. H. Smith, in one of his last reports, speaking of the new arrivals there in January, 1853, says, "120 out of 160 had had the privilege of instruction in National, British, and other day schools, for periods ranging from three months to ten years. * * * The large majority of these new boys that have been educated, as it is called, in day schools, corresponds with my experience in former years, and is certainly a significant fact. It shows that three-fourths of our prisoners are not from the lowest class, for the parents of 120 out of 160 were able to pay for their children's schooling." There is, then, every reason for believing that the mental discernment of these youths, instead of being dormant, is extremely active.

If it be advanced that though the intellect of this class has been educated, yet its moral sense has not been developed, such an argument against the punishment of crime must have still more weight in favour of the exemption of adult offenders, who, in the days of their childhood, had far less means of improving their discernment and learning their duties, and whose age and long practice of crime will scarcely have quickened their moral sensibilities. If, therefore, the State is bound to forego the correction of juvenile criminals, so it is that of adult criminals, and the social equity of punishment is a mistake, and penal justice at an end. On the other hand, it may be justly conceded that the proper end of punishment is not the retribution of so much pain for so much guilt, but the prevention of crime no less by its deterring influence on others than by the reformation of the offenders.

The reformatory effect of punishment depends on its justice, and on the impression of its justice on the mind of the recipient. The child is quite as susceptible of conviction that his punishment is just, as the adult, and generally more so. The greatest care should be taken not to evoke resentment by punishment, but, as far as can be, to harmonise chastisement with contrition; at any rate, to avoid hardening the recipient and inducing defiance. If this be done, (and there is ample practical proof that it may be done), the sharp correction of crime is compatible with the kindliest influences of reformation. They know little of the heart of a child who have yet to learn that the punishment which teaches him that sin is a bitter thing, and the law has its terrors, may be so applied

and tempered as to humble his stubborn will and pride, open the avenues to his heart, and ensure a conviction of ill-deserving, and an earnest of amendment far more impressive and enduring, than the mere appliances of indulgent treatment, prefaced by the evil lesson that crime may go unpunished.

The experiences of every Christian parent will confirm the assertion that the just, though sharp punishment of sin is perfectly consistent with the tenderest affection and the fullest fruition of kindly influences in the heart of a child. The sole question is, what shall the punishment be for the class in question?

With a view of solving this very difficult problem it was that I resorted to the plan of consulting themselves. I have lately, privately and apart from any witness, conversed with several of these youths, all of them convicted of crime, most of them steeped in it, and long familiarised with the associates, accompaniments, habits, feelings, incidents, fears, and hopes of criminal life. They varied in age from 11 to 19; they belonged to all stages of the reformatory process, from those with whom it had yet to begin its work to those who, to all appearance, were permanently reformed. They came from nearly all quarters of the kingdom, and were spoken to at reformatory institutions widely distant, and, perhaps, almost as widely differing in system from each other. A long experience in the work of taking and testing evidence, corroborated by the opinion of those who best knew my informants, has at least satisfied me that they gave free vent to their own impressions, and spoke the truth alike in spirit and substance. A perfect absence of reserve was readily obtained by a complete disclosure of the real object of inquiry, namely, that of learning the various facts requisite for planning how best to deal with their own class hereafter, but without any reference to themselves individually. Here are some of the notes, made at the time, of the gist of my conversations:—

1st Question. *Is a criminal life a happy one?*—There was no difference of opinion on this point; all said it was not. These were verbatim answers—"It keeps you always anxious." "You never feels yourself safe." "I had generally plenty of tin, and lots of grub and girls, and all that, but then you may be caught out any time, and don't know who mayn't crack (betray) on you." "It keeps you always restless." 2nd Question. *Does the fear of punishment and getting into trouble prevent lads from committing crimes, and what do they fear most?*—The answers differed slightly. This is a fair *résumé*:—"More or less it does, but it depends a great deal on how often a lad has been in gaol." This was the verbatim evidence of a young lad who is one of the cleverest pickers of pockets in England. "I have been in five gaols, Derby, Knutsford, Worcester, Stafford, and in Liverpool six times. The oftener you go the *hardener* you are. I was flogged once; that was nothing, I wouldn't mind that no time. The worst thing you ever have is being shut up by yourself; but that ain't so bad when you have books, or anything you can play with. I was often put in a solitary cell for things I done when I was in the gaol—swearing I'd fling the can at the man's head, and such like. Once or twice they locked me in a solitary cell, and only let me out to wash for five minutes in the day. I had no bed. It's solitary confinement that frightens lads the most. I think if lads outside knowed what nice places there is (meaning the institution he was in), and how well you're treated, they would be often thieving and doing things to get sent here. A boy came here with another not long ago, to see E. N., and he went back to Birmingham and stole a head of cabbage, on purpose to get sent here, but he wasn't: the beak wouldn't do it. I can't say whether I'll be honest myself when I leaves here yet; I think most of them will though."

With two exceptions, every witness declared that flogging did not deter the commission of crime, and that it was confinement which was the most dreaded. One of these said he merely spoke of himself, as he had suffered intensely from being over-flogged. All said that it hardened them and never improved them. A great majority thought imprisonment, as now administered, produced very slight deterrent effect *after it was repeated twice or thrice*, for that it seldom proved half so bad as they anticipated. Their opinions varied slightly on this point with the discipline of the gaols they had been in. One said he would as leif go to C. Gaol as stay out; it was no punishment, they had lots of fun, were all together, and had plenty to eat." All thought the more solitary the confinement the greater the dread, and the greater the punishment. Another, at the same institution, said, "I think many would commit offences to come to places like these, if they were commonly known in the country. Flogging does nobody any good; kind treatment is the best way to reform lads. It would punish me most if I was confined in a solitary cell. I was transported for picking a woman's pocket of £25 10s., but I was sent here instead, almost directly. I was not punished for it. When I was thieving I was bullied and always in fear, There is no detention here, we stay just because we like it." Another, a very remarkably sensitive and clever lad, of a peculiar temper, and of a more advanced age, said, "he would rather have a flogging than three days in a cell alone; thinks kindness the best discipline, and that reformatory places like these give boys a taste for a better style of life than they knew of before; believes gaols the worst places for them. He learned more thieving tricks in W. Gaol than he ever learned out of it." Of one lad at Parkhurst, who appeared thoroughly reformed, and extremely intelligent, I asked what punishment he would deem most advisable for deterring crime? He replied, "*A sharp, short, solitary confinement.* If it is too long, they would get so far used to it as not to care for it again. The longer any imprisonment continues the less you care for it." This opinion, though not so directly elicited from any of the others, was borne out by all that fell from them.

Not a single lad deprecated punishments for crimes, and the readiness with which they condemned flogging rendered their silence as to other punishments, where they were silent, sufficiently significant of its utility. It is also worthy of note that none of them pleaded that want of discernment as an excuse for their offences which is so groundlessly pleaded for them. As an instance of the *keenness* of their "discernment," I may mention the following conversation with a boy who had just come to one of these reformatories a few days before:—

"Do you know what the eighth commandment says?"

"It says you mustn't steal."

"Have you stolen?"

"Yes; many a time."

"Why is it against the interest of us all that thieving should be allowed to go on?"

"It is against the will of God."

"Yes; but I mean why isn't it good for us in this life."

"I don't know."

"Don't you like to keep what belongs to you?"

"Yes; to be sure."

"Then, don't you see that if stealing is allowed, what belongs to you would'nt be safe, and that is against every-body's interest?"

"No it isn't; for them as steals will be sharp enough to keep what they have got."

"Did you never have anything stolen from you?"

"Yes; once I did though—but only once."

Superintendents of private reformatories have lamented to me that the absence of any power of detention limits their power of enforcing labour and discipline, leaving both in a great measure to the pleasure of a class of children remarkable for their inaptitude for the one, and their impatience of the other. They stay so long only as they are pleased to stay. Their endurance is dependent on their contentment; and their acquiescence in rules or regulations in some reformatories is procured by humouring their tastes, rather than by controlling their will or correcting their faults.

A superintendent of labour in one of these schools told me that it would be impossible to apportion rewards to work done, for those who get the smallest share would be irritated, and refuse to go on working, even if they remained at all in the establishment. The captivating license of nomadic life and lawless freedom awaits them without, and to it they return the moment the irksomeness of the restraints exceed the *agrémens* of their new abode.

Allow me now briefly to sum up the practical results of this state of things, wherever it is permitted to obtain. So far from awarding to voluntary crime its legitimate punishment, or impressing practically on the minds of these young delinquents that the verdict of guilty, just passed against them, has a fearful meaning and a certain sequel of suffering—they are taught not only that no punishment is due to them, but that, in proportion to the magnitude of their offending is their chance of escaping from it, into the agreeable refuges which these reformatories extend only to the worst class of offenders. So far from the discipline of the place being a corrective to the moral leprosies, abnormal habits, and lawless license which characterise its inmates, in one signal instance the total absence of all system or method, or of any other restraints or rules than those made by the lads themselves, has been vauntingly avowed as the leading principle of the establishment and the great secret of its reformatory power. It was impossible to take the most cursory view of Saltley and the aspect of its inmates, without perceiving how prejudicially this principle was carried into operation. It is a fact, that until the fruits of such a practice became too glaring to be tolerated, not only was pocket-money given to these lads, but they were on certain days of the week permitted to go unattended and uncontrolled into large neighbouring towns and there visit their old associates in crime, apparently in the charitable hope that they would act as missionaries to allure others from their vicious courses.

It needs not the anecdote of the boy who stole the head of cabbage, to prove the imminent danger that such reformatories, if multiplied in the country, would entirely deprive society of the deterring effect of punishment, prove a positive inducement to juvenile crime, and, moreover, to crimes of a very grave nature. It was just as well-known to the boy who told me the anecdote, as it was to myself, that he owed his own escape and refuge to the frequency and gravity of his crimes, and that the imitator had failed through the smallness of his offence. I cannot but fear that these places will, if they should spring up largely under the recent statute, become far greater promoters of juvenile delinquency than the gaol system—bad as it is—which they seek to supersede. That act requires merely a preliminary detention of 14 days in prison. This, to a child who is comparatively innocent and young in crime, inflicts a useless degradation and a wanton loss of self-respect, which the judge has no discretionary power to remit; to a hardened offender it is a mere farce. The good done by such institutions as I have described, seems to consist chiefly in bringing these children into contact with civilisation, and surrounding them with sympathies and kindness, giving them a practical insight into a new world, as it were, to which they never previously aspired, because alike ignorant of its comforts and its advantages; and it is by a liberal supply of these that they are induced to submit to the irksomeness of comparative order, cleanliness, and instruction.

I must specially except the Philanthropic, Miss Carpenter's school, and Messrs. Bengough and Baker's school, at Hardwicke, Gloucestershire, from the charge of want of discipline, or neglect of proper punishment after the children are admitted. Previously they have no power to inflict it, nor will children submit, voluntarily, to a probationary test, like the adult offenders at the excellent establishment of Mr. Nash, at Westminster. In each of the above-named reformatories, though the principle of penal discipline, as a result of the offence of which the youths have been convicted, does not, and indeed cannot, be inflicted, it is but justice to say that owing to the practical good sense and actual experience of each of the founders of these most praiseworthy establishments, habitual industry, good discipline, and tolerably sharp punishments for offences committed in the institution, are in each case as far as possible enforced.

At Parkhurst prison there is a preliminary probationary stage, which is quasi-penal. I say quasi-penal, because there is no other correctional discipline than that which consists in being confined to cells with books for somewhat less than two hours, chiefly during meal times, the rest of the day being spent in school and exercise, together with the other boys in the same ward. This continues for four months. After this they pass immediately into the industrial wards, where nearly the whole day is occupied in useful industrial labour. They dine, work, and have short intervals for recreation together. Spade husbandry, cattle tending, brick making, baking, carpentering, painting, blacksmith's work, flax dressing, tailoring, shoemaking and washing, constitute the employments, in which they are instructed by skilled persons. Warders constantly superintend them. The chaplains pray with and address them collectively for half an hour every morning, and speak to them individually occasionally. Each prisoner has instruction in school about nine hours in the week (which is too little), and every evening the most deserving lads are allowed to read or write, or converse together in the school-room, for one hour before evening prayers. Each boy has access to the chaplain at pleasure. Punishments are administered also for offences committed in the establishment, with the sanction of the governor, and rewards are given chiefly by means of good conduct and labour marks, which are credited in money earnings to each inmate. Order, neatness, regularity, cleanliness, and obedience, are enforced under a quiet, but exact discipline. The system of industrial training is one of the most perfect in England. It is the life spring of the whole process of reformation. The governor and the chaplains attribute much of the success which attends the institution, to this element. It is cercertainly peculiarly adapted to the correction of those abnormal and desultory habits which are the great charm and characteristic of vagabond and criminal life. Nothing will thoroughly eradicate this bane, short of systematic labour. Compulsory and habitual industry is indispensable to the cure of a disease in which idleness is incarnate, and of which it is often the root.

In my conversation with the youths whom I examined at Parkhurst, I found that they attributed much of the improvement in their own character to the ministrations of the chaplains, and to the kindly interest taken in their welfare by the governor, as well as to the instruction they received in the school. It is a favourable feature that they, one and all, highly appreciated the education they received, and desired its extension. They all expressed a belief that a large majority of the total number (575) were steadfastly resolved to abandon their old ways, and earn an honest livelihood,—of whom a minority only desired to emigrate, and this it appeared chiefly from the fears that their reformation would be doubted, and their facilities of welfare circumscribed in England. All agreed that there was no punishment, after the probationary stage, but that which resulted from misconduct in the establishment, and that the severest was confinement in the cells. Since the introduction of rewards the punishments have diminished. Each boy sleeps in a separate cell, which I regard as a most essential measure, though it is effected at Parkhurst only.

There are ample evidences that both at Parkhurst, at Red-hill, and at the better conducted private reformatories, genuine cases of reformation are by no means uncommon, after deducting numerous ones of feigned and transient penitence. The mere effect of kindness which the mesmerism of personal influence carries right to the heart,

and the magic talisman of hard work, produces some change for the better, even in the least hopeful cases.

It is not within the scope of this paper to comment further on the merits or defects of particular establishments, nor do I propose to indicate more than the general conclusions as to remedial measures, which my present means of judging have enabled me to form.

The difficulty which besets this part of the subject is apparent to none more than to those who best understand it. Were it possible to convey a catholic representation of the various facts and scenes which have been presented to those who have investigated the practical bearings of the question, I should gladly avoid drawing a single inference from them; as, however, the statement of such premises is necessarily fragmentary and imperfect, I feel bound to express my belief in the following conclusions:—

1. That the generality of reformatory institutions which neither punish nor imprison offenders, must be more or less defective in discipline, and so indulgent to the tastes of the inmates as to answer few of the behests of public justice, while they afford direct inducements to the commission of crime, of which there is already practical experience.

2. That no general measure as a substitute for the present system of punishing juvenile crime will do justice either to society or to the offender, which does not provide a due prefatory period of punishment for the offences of which they are convicted, to be apportioned to the antecedents, character, and criminality of the recipient, and which the Act of 17 and 18 Vict. c. 80, entirely fails to do.

3. That this punishment should at first consist of entirely separate confinement more or less prolonged, and more or less accompanied by means of mental occupation, according to the nature of his offence and the disposition of the child, to be shortened at the discretion of the officers of the institution.

4. That there should be, in all cases of grave offences, gradations of penal discipline, the latter stage attended by school instruction and short intervals of recreation and exercise in companionship, preparatory to the greater liberty of the purely reformatory sections. The object is to connect in the mind of the patient increasing comforts and benefits with progressive improvements of heart and conduct.

5. That the subsequent discipline should consist of systematised instructional and compulsory labour, chiefly in spade husbandry and useful trades, and that the labour should be as hard as may comport with health, together with plain and very practical instruction for at least two hours daily in elementary knowledge.

6. That religious instruction and reformatory influences should be sedulously brought to bear on the prisoners during the whole of their terms, by the services and close personal ministry of clergymen whose hearts are in the work, assisted by laymen in a lower rank of life, more nearly approaching to that of the prisoners themselves, and having a real sympathy with them, who should be specially trained for the purpose, and qualified to secure their confidence and affection.

7. That the power of detention should extend over the whole period of the sentence, subject to its suspension, and the restoration of the offender to liberty, at the pleasure of the Secretary of the Home Department, on the recommendation of the governor. Short sentences are, however, usually worse than useless.

8. That any continuous misconduct should be punished by a return to either stage of the penal wards, as occasion might require, and a proportionate prolongation of the original sentence.

9. That signal good conduct and reformation should be rewarded by the occasional enjoyment of liberty, under proper regulations and other privileges, preparatory to its entire restoration.

10. That according to the opinion of Colonel Jebb, 300 or 350 inmates are sufficient for one establishment, and that, as I stated to the committee of the House of Commons in 1852, it would be advisable, in the first instance, to establish fifteen of these institutions experimentally, in the most populous counties, accommodating an aggregate of 5000 offenders.

11. That the penal and reformatory stages should be combined in the same institution; first, because it appears desirable that the same officers, and especially the chaplain, should be thoroughly acquainted with all the phases of character which each patient presents, and superintend the entire process of his reformation, beginning with the correctional discipline which is a part of and inseparable from it, and because it would be difficult to restore penal discipline for short periods, if the means of reimposing it were at a distance.

12. If this be conceded, the expediency may be well considered of giving power to magistrates to commit *before trial* to the separate confinement of the penal stage under modified discipline, in order to avoid wholly the contamination of those common gaols where no means of segregation exist, and the inevitable loss of caste and character.

Great exception is taken by some philanthropists to what is termed "the military element," as it exists, for example, at Parkhurst. Judging not merely by that institution, but by the workhouses governed by non-commissioned officers, it may be advanced that if order, neatness, punctuality, and discipline are essential to reformation, these are seldom so well attained as under judicious military superintendance; and whilst assuredly coercion and fear are no necessary parts of such an administration, the fullest exercise of kindness and sympathy is perfectly consistent with it.

The general principles of reformatory discipline are admirably set forth in recent essays and letters published by Mr. M. D. Hill, Mr. Barwick Baker, and the Rev. Sidney Turner.

Having now treated of the salient points which present themselves to those who practically study juvenile crime, with a view to ascertain the discipline, alike moral and physical, best adapted to transform the tares into wheat, and relieve society from its chief canker, it remains only to add a few remarks on the proper parties to administer the remedy.

If the preceding views be substantially correct, it seems to be almost a necessary consequence that the treatment of juvenile offenders belongs to the state. They fall by law into the hands of the law, and all usage and reason seem to indicate that by it they should be dealt with.

In the first place, can penal justice be either legally or advantageously delegated to private hands? Is it not an integral function of law, which should, *primâ fácie*, be exercised under its own sanction? The grounds on which this constitutional principle is founded seem almost self-evident. If punishment and detention are necessary parts of the treatment of juvenile offenders, the state should administer these integral portions of its executive jurisprudence.

Private reformatory establishments, great as are their prospective and possible mischiefs, have certainly done some good service to the cause. Their tentative utility must not be overlooked, as affording both positive and negative examples. Their mistakes and failures are available beacons. They have also given useful proof of the vast power of sympathetic and individual action in the work of reformation—a point excellently developed by Miss Carpenter, of Bristol, both practically in her establishments and theoretically in her able books. But this is a principle of which private establishments possess no monopoly. It can be carried into operation in a government establishment as well as in a private "reformatory." As far as the past experience of society has gone, without any disparagement of the priceless value of individual benevolence, I believe that the kindly and parental influence in question is even more effectively accomplished

by paid than by unpaid agency. I need only cite the zealous offices of the clergy in their various spheres of reformatory labour, and also (in a humbler walk) those of City missionaries and Scripture readers as evidence of this position. It is a mistake to accredit effective philanthrophy solely to voluntary effort, and deny it to those who apply their hearts and devote their time and talent to the work, simply because they live by their labour and make it their vocation. A labour of love is not necessarily unpaid or always beneficially uncontrolled.

The primary barrier to the committal of public offenders to private hands, as I have indicated, is the impropriety of entrusting to irresponsible persons the powers requisite for the due administration of penal justice, and yet it is the express object of the recent statute to shift the whole work on local benevolence, without even adequate powers to those who may undertake it. The ill effect of the absence of such powers has been forcibly exemplified in the evils named, and in the frequent failure of the reformatory efforts which have been made, by the absconding of the offenders. But even if these very grave objections to such a system had no weight, the very nature of private benevolence seems to forbid the State from delegating its trust to it. Nothing can be more admirable than the devotion of private wealth, and the time and zeal of educated persons, to the uplifting of the outcasts of society, but, unfortunately, such virtues are not necessarily permanent, nor always judicious. As applied to the work of reforming criminals, they partake not the less of the character of chance charities and fortuitous philanthropy, because they are now pursued with the zest usually attending novel humanities and fashionable charity. But these impulses are notoriously ephemeral and intermittent, and the voluntary institutions to which they have already given birth are equally so (as recent collapses exemplify); and if so, they cannot with any reasonable prudence, be entrusted with a national work of vast social moment, which eminently needs permanence and uniformity of system. Let that system be ever so well matured, its operation could not be secured by any less methodical administration than government can alone perpetuate.

The State, and the State alone, has the power to supply this essential condition of successful reformatory institutions, and also to administer the equally essential preliminary and deterring punishment of crime, which is a no less vital element of public justice than a social necessity.

I confess that I distrust private aptitude for the due conduct of a work which ought not to be subjected to the varieties of experimental benevolence. The belief that juvenile offenders are errant angels, whose reformation requires little else than fondling, is alarmingly prevalent. It is a mistake which one or two of our most practical managers began with, but which a few months actual experience has in each case dispelled. Perhaps no vocation requires a more peculiar set of qualifications, both natural and acquired, than that of the head of a successful reformatory. It will take two years to train even a well-disposed man fully for it; and yet reformatories are being established as if masters for them could be raised like mushrooms; and I have just seen a circular issued by the Berks magistrates, evincing so singular an appreciation of the requirements of the work, as to offer 14 shillings a week and rations for a superintendent,—a salary scarcely exceeding what they give their grooms.

It has been said, that private reformatories for the young offender avoid the "ban of the prison." I apprehend that the ban to be removed is the ban of crime, and that it is a great mistake, and, moreover, a mischievous one, to stigmatise the remedy rather than the disease. Society, under the present system, wisely discredits his reformation, and fears the offender; *fœnum habet in cornu; longè fuge*. But it is the belief that he is criminal still which attaches the ban to him. If prison *schools* effect reformation, no ban belongs to *them*; on the contrary, they will be a passport to the future welfare of the inmates.

I cannot refrain from commenting on the cruel injury which results to *them*, by the unjust disparagement of institutions which really reclaim them. Their future restoration to society and independence depends mainly on the public credit of the establishment which, in sending forth its patient, endorses a bill of health for his restoration to society. If this be dishonoured, his chances of well doing, however real his reformation, are seriously damaged. This is no problematical injury. I have seen a letter from a late Parkhurst inmate, who was making every effort to obtain a livelihood, and complained bitterly of the cold distrust which repulsed his efforts. It may be well worth the consideration of her Majesty's Government how far such cases may be met with increased facilities, under due regulations, for emigration. Such a resource would, in many cases, be thankfully accepted, not only as a means of escaping the odium of present prejudices, but also avoiding the temptations of old associations.

The funds whereby prison schools should be maintained would be probably provided partly by the state, by local rates, and by forced contributions from the parents of the offenders, as I long ago recommended, and as has been provided by the recent act.

The cost of the buildings and the salaries should be defrayed by the Consolidated Fund, and the maintenance of the offenders, as far as it exceeds the produce of their labour, by the county, union, or district where the offence was committed. This expense would prove so extremely insignificant in amount, when charged on the rateable value of property assessed either on the county or on the poor-rates, that it would be scarcely appreciable, it being considered that the maintenance of the same offenders in the gaols must be deducted from the outlay. The expense would arise mainly from the greater number of youths whom an efficient system of reformation would probably induce the magistrate to commit.

The pounds, shillings, and pence view of the subject, when we are dealing with the repression of public crime and the elevation of popular morals, is so utterly unworthy of consideration, that it is humiliating to remember that English idiosyncrasies still compel us to descend to it. When the enormous amount of property now lost by juvenile plunder and the generation of thieves thus reared is remembered, the greatest present economy in reformation is the largest future loss,—a fact which pennywise ratepayers should not omit from the calculations which damp their philanthropy, and often shut out from their view even the worldly wisdom of pound savings in prospect.

The principle of making the parent contribute, whose neglect of the moral welfare of his child has in some measure caused his crime, seems to be universally recommended, no less by reason, equity, and social policy, than by the common assent and approval of those who have studied the subject. The difficulty of enforcing such payment where the parents are known, would only be greater than that of recovering the maintenance of bastard children from their fathers by similar powers, where the parents are destitute; it is, however, in many cases otherwise, for the parents are often well off, and it is in these cases that the principle would apply with most benefit.

The great proportion of criminal children whose parents are tramps, or who have no fixed residence, will always render the operation of this wholesome check on crime, fragmentary and partial.

Private benevolence may find another field for its invaluable offices in the treatment and training of that larger class of outcast children who swarm in our towns, and having neither fallen into destitution nor committed detected crimes, are outside the gaol and the workhouse, though constantly hovering on the verge of both.

Many of these are criminal; some have been already imprisoned; others equally, and often still more guilty, have escaped detection. A portion are simply vicious.

A large section are on the threshold of destitution—some of whom, it is fair to assume, are not yet actually criminal, and successfully resist the inevitable temptations of their position. Each of these groups in some measure merges into the other, and partakes of its characteristics. Their prevailing moral lineaments are more easily ascertained. Most of them are ill-disciplined, dirty, idle, and sensual. They have been termed "the City Arabs." But inasmuch as the great majority live in towns, and are not migratory, the term by no means aptly designates them, except as relates to their averseness to settled and continuous labour. So far from the bulk of them being of nomadic habits, they infest the towns of their birth with remarkable tenacity, and prowl with the adhesiveness of cats in the same purlieus and alleys; whilst the very name of "Arab" suggests the idea of activity, incessant and prolonged travel, open-air life, and habitual avoidance of all urban haunts and mural abodes. The special class to whom this singular misnomer is given are born and bred in the crowded hovels and penned-in alleys of the densest parts of our large towns—roam chiefly in the gutters, and wallow faithfully in the same stagnant dirt, moral and physical, day by day, and year by year. They constitute a sort of fungus population, vegetating in the dampest, densest, and darkest parts of all large places, and form the great nurseries of crime, penury, and disease.

At first sight, seeing the affinity which exists between one, at least, of the sections of this class, and that of criminals under sentence, and between the more destitute and less criminal section and that of the children in workhouses, the question is naturally suggested whether each might not be wholly drafted into district schools for prisoners and paupers? I incline to think not. In the first place it would involve a dangerous and unconstitutional infringement on the right of personal liberty to subject even a child to detention on mere suspicion of crime. Legislation has never in modern times so far superseded the sanctions of the law, and disregarded the boundaries of penal justice. I am aware that this was once done by a *coup-de-main* at Aberdeen, but its illegality is admitted by those who did it. The chances of injustice under such a system would far outweigh the convenience to the public, and the good which would possibly result in many cases, where the punishment did no moral wrong. A portion, however, of the class in question, can be sent to the prison schools, whenever they are established, without illegality, and without any change in the law. Many of these children are frequently detected in various offences, especially in petty thefts and trespasses, and acts of overt vagabondage, which are now habitually overlooked, owing in great degree to the natural unwillingness to submit young children to the contamination of a common gaol; and secondly, from the want of a public prosecutor, and the consequent trouble and expense of instituting prosecutions. One section, therefore, of the great vagrant horde will fall naturally into the prison school.

The semi-pauper class forms another section. Those who are the children of persons in receipt of relief alone amount to 258,000, though some of these will doubtless go to district pauper schools. But the impossibility is obvious of including all these children—at least three times as numerous as those in workhouses—in such district schools without an entire revolution in the principle as well as system of the poor laws. A parental government would probably hesitate thus to enlarge the exhibition of public dependence, and the evil necessity of institutional charity. Nevertheless, a judiciously selected portion of these children placed with reference to the workhouse, as the out-door criminal children are to the gaol, may be absorbed by the district labour schools.

If these premises are sound, it follows that the treatment of a portion—but of a small portion only—of the criminal and the impoverished sections of the great body still at large, may be provided for by the two new institutions of penal and labour schools, already contemplated by Her Majesty's government. Such children may be regarded as the waifs and strays of the two classes already under legal custody, who belong equally to the charge of the state.

I would beg, however, to express the conviction, that further than this, the direct interposition of the government need not extend. I am of opinion that it cannot beneficially do so.

A large class remains, whose industrial and moral education is adequately met by no existing appliance. There must, moreover, always be social and moral necessities for which a government can properly make no provision. There are limits even to its executive benevolence, assigned no less by reason than usage. Nor is it perhaps desirable that it should be otherwise. If we were to venture to indicate a boundary line to state interposition, it would be that the state should directly minister to such philanthropic requirements only as could not be equally well effected by private effort. It is on all grounds beneficial to enlarge, foster, and encourage the activity of individual benevolence in the removal of social evils; and the establishment and success, though at present partial and imperfect, of ragged industrial schools, appears not only to illustrate this position, but to indicate one of the best means whereby the large residue of the dangerous class of children may be effectually reached, and to a great extent reclaimed. In order to ascertain what probable proportion of the necessitous section reside in towns where ragged schools are commonly placed, information has been collected from the chief unions in the west of England. The disparities of proportion are remarkable, but the aggregate result shows that no less than 40·8 per cent. of out-door pauper children live in towns.

At Gloucester, a ragged industrial school was commenced with thirty pupils, in 1850. It now numbers above 100, and an investigation having been made last year, no less than 55 per cent. were found to be the children of out-door paupers, and the rest are all, more or less, of the poorest class.

Experience has amply proved the great and signal power these schools possess in the work of reformation. Habits of reckless insubordination, utter disregard of all moral control, personal filth, heathen ignorance, and the mother of them all, inveterate laziness, disappear under strict judicious discipline, plain practical instruction, and regular labour, with a degree of success and rapidity which repeated scrutiny has convinced me is really sound and enduring. Even where the reformation is not complete, an insight has been given into the comforts of comparative decency, and the dignity and profit of labour, which renders dirt, sin, and indolence generally less attractive, if not actually distasteful, for the future. This seems to be the fitting sphere of individual exertion, and the efforts of the highest order of philanthropy, nor can there be a more fruitful field for its exercise.

I have now glanced at the main features of a great social topic which the moral necessities of the people, no less than the progress of broad Christian sympathies, are pressing on the attention of the times. For the nonce, the war, and the absorbing importance of foreign events, have set aside the consideration of home reforms. When these, however, happily resume their natural predominance, I think no public question will require earlier or more effective settlement than the treatment of juvenile offenders, on a system sufficiently matured and organised to reform the criminal, whilst it protects society by the due punishment of crime.

## DISCUSSION.

The Chairman said, the subject was of such importance and general interest that it required no suggestions from him to invite the observations of those who had previously paid attention to the subject, and several gentlemen present had almost made it the study of their lives. As he had no doubt the observations

would be rather lengthy, it would perhaps be advisable that they should principally direct their attention to the main point as to the object of punishment, whether to punish the offender or seek his reformation. That was the point to which Mr. Symons had referred in the first part of his paper—and was the main one on which there was a division of opinion in the country. He had an opinion of his own, but before he expressed it he wished to hear the observations of others more competent than he pretended to be.

Dr. Waddilove said, although he was not included within the class of persons respecting whom the chairman had stated that they had made this subject the study of their lives, and although he made no professions of a practical acquaintance with the question, yet he spoke of it with perhaps an interest not inferior to that felt by any around him. He could not but think, that although this subject had been largely considered by eminent persons, statesmen, legists, charitable ladies, and benevolent individuals, and also by persons similarly situated to the learned gentleman who had read the paper, still he thought they had not struck at the root of the evil. The chairman, it seemed, wished to confine their attention to the two questions, the punishment of the offender and his reformation. He (Dr. Waddilove) thought that those who had given their attention to juvenile delinquency had not struck at the root of the evil, they had not grappled with the cause, but had rather dealt with the effect. They would treat children guilty of some petty theft as criminal offenders, and would turn them over to the hands of justice to be dealt with, and would send them either to a prison or a reformatory school; and as their moral principles were presumed to be vitiated they were placed under a course of severe discipline, with a view to make them fit members of society—to eradicate, in fact, the taint with which it was assumed they were infected. He was one of those who thought that they went somewhat too far in so doing. He thought, instead of those reformatory schools they should establish what were called schools of industry; and that children under a certain age, if they had no occupation, or were not at school, should be placed at an industrial school, where they might have occupation and instruction, where they might be taught some trade, might be trained to become soldiers or sailors, or find employment in some shape or other. Where a child was not put to school by its parents, or had no ostensible means of occupation, it was the duty of the state then to take charge of that child. Some persons might say that would be an infringement on the liberty of the subject; but in reply to that he would say, one of the definitions of liberty was that a man has a right to do what he pleases with his own, provided he does not thereby injure his neighbour. But if a child had become, or was likely to become, a thief, in consequence of the manner of life it was leading, by the neglect or design of its parent, the parent inflicted an injury on society, and forfeited at once his right over that child; and in such a case he held it to be the duty of the state to interfere. He was not going into the details how this was to be done, but he merely threw it out as a suggestion of his own mind upon the question. There were hundreds and thousands of children in this metropolis wandering about without occupation of any kind, and without any care or supervision on the part of their parents; and he thought it was the duty, as well as the interest, of the state, to interfere and do its utmost to prevent them becoming criminals; whereas, the principle of the system treated of in the paper before them was that they were to wait until a crime was committed, and then they were to send the child of tender years to undergo punishment and a harsh course of discipline in a reformatory school, differing but little from a gaol. The child was to be treated as a criminal before it had become morally such. In the last session of parliament an act was passed for Scotland, by which a power was given of apprehending any child found wandering about the streets or begging. The child was to be taken before a magistrate, who might send it to an institution similar to the industrial schools he had alluded to, unless security could be found for its good behaviour; that was an approach towards the course of action he would suggest, but he would go further. The child under that act must be taken before a magistrate, not, perhaps, as an actual offender, but still brought within the machinery of the law, and made the subject of a judicial inquiry, whereas, he would maintain that there should be no such process, that children found begging or wandering about the streets, or those whose parents did not give them honest employment or instruction, and those who had no parents, should, without further inquiry, be sent to an industrial school, or put to some course of occupation to redeem them from the habits they were contracting, which would almost inevitably lead to crime. Before the State could deal with them under the existing law, they must have committed some crime. That, he thought, was the error of the present system. Children of persons in the better classes of society would sometimes pilfer, and how were they dealt with? They were not at once handed over to the policeman. Why act differently with the children of the poor? Ascertain to a certainty that the child is morally and all but incorrigibly bad before you place him in one of those reformatory schools. The Earl of Shaftesbury, whose name they must all revere, last session introduced a bill called the Juvenile Mendicancy Bill. His lordship, in some degree, advocated the principle which he (Dr. Waddilove) was now urging, but for some reason or other that bill did not pass. There was another point to which he would refer. He could not but think that in all these reformatory systems, and in dealing with juvenile delinquents as a class, they dealt rather too harshly with the child. They knew it for a fact, that last year no fewer than 7000 children—that was, persons under 17 years of age—were convicted of theft, and of that 7000, the large number of 1200 were stated to be under 12 years of age. Conceive a child under 12 years brought up to answer a criminal charge. What would a man do in his own family in such a case. Would he turn the child over to the civil power? The would-be reformers of juvenile offenders, and the inspectors of reformatory institutions, looked upon all children as criminals; it was part of their province to exercise hardship and punishment. He thought they ought at all times to temper justice with humanity. He thought persons had not grappled with the cause of juvenile crime, but had rather dealt with the effect; therefore, he hoped, in all future steps that were taken in this matter, they would look to the source of the evil, in order that they might be enabled effectually to arrest its progress.

The Chairman said he was reluctant to interrupt the observations of the learned gentleman who had addressed them, but he wished to remind him that the present question was not how to prevent crime, but how to deal with the offender when the crime was committed. He might, perhaps, agree with Dr. Waddilove as to the conclusion he came to, but that was not the question which they had to discuss, but it was, supposing the crime to have been committed, what should be done with the children.

Dr. Waddilove referred to the title of the paper in explanation.

Mr. Power (Recorder of Ipswich) thought that his friend Mr. Symons had, in the paper before them, put the case of those whose opinions he represented in as strong a light as he could, and he (Mr. Power) had the misfortune to differ with almost every proposition which his friend had laid down,—not that he arrogated to himself any extraordinary philanthropic pretensions, but that he thought the justice of the case was opposed to the views which his friend represented. In the first place, with whom were they dealing? With children. It was all very well for his friend, as generally for those advocating his views, to select them as near as possible to 16 years of

age, and as having the character and responsibility of adults, but they had the fact before them that large numbers of those convicted of crime were not just under the age of 16 years—just trembling on the verge of manhood—but that many of those in our gaols were children of the most tender age—children of 8, 9, and 10 years of age; and he said, to administer to them what his friend called sharp, stinging punishment, to put such a child into a solitary cell, which any one who was acquainted with the anatomy of the human frame and constitution, would tell him was opposed to the very nature of the child, to do that was to visit upon the child a vindictive punishment, that could answer no good end,—that would not deter him from committing other offences, that would not deter others similiarly situated from committing offences, and could have no good tendency towards reforming the child himself. Mr. Sheriff Watson, of Aberdeen, had sent him a communication which showed the cause of juvenile crime as far as it was possible for any statement to show it. In the bill which had been referred to by Dr. Waddilove, by some omission, either in the wording of the act or in consequence of the interpretation put upon it by the Lord Advocate, the industrial free schools of Aberdeen were excluded from its operation. Some years ago a Poor Law Bill for Scotland was passed, and between 1850 and the present date, owing to the interpretation put upon that bill by some of the sheriffs, who are judicial officers in Scotland, it was determined that widows and other single women having one or two children should no longer have the right to out-door relief. They must either go into the poor-house or receive no relief at all. The consequence of this had been a great increase of vagrancy. It was thought by sending them to the industrial schools of Aberdeen this might be put a stop to, but, in consequence of the interpretation put upon Dunlop's Act by the Lord Advocate, that could not be done, and what was the consequence? Vagrancy had increased in Aberdeen threefold, and whilst, in 1850, the number of children under 12 years of age convicted of crime and sent to prison, was only 8; in 1854 it amounted to 49. To tell him that a child was to be subjected to a sharp stinging punishment—to be put into solitary confinement, because, first, by the interpretation of the laws they had made the child a vagrant, and then, because the act did not allow the child to be sent to an industrial school, he was sent out to beg, and from begging got to stealing; to tell him that a child so educated and so subjected to circumstances should be visited by a sharp punishment, in a solitary cell, was, he thought, to manifest an obliviousness of that justice which ought ever to prevail between man and man. Would such a punishment upon the child stop vagrancy or put an end to crime? What good could it answer except in the gratification they—grave men—received from the knowledge that a child of 9, 10, or 11 years of age was expiating his crime—his terrible crime—in solitary confinement, and on bread and water diet!

Mr. Symons—I did not say stinging punishment, which seems to imply flogging. I said a short and sharp punishment.

Mr. Power would, for his own part, rather have a child whipped than sent into solitary confinement. His friend had quoted two or three instances, no doubt perfectly true, in which solitary confinement was viewed with horror by children. And why? Because it was antagonistic to the child's nature. In a child of from 10 to 14 years of age, at the very time that he was gathering his information for future good or evil in life from all that was passing around him, to place such a child in a solitary cell, was doubtless painful and abhorrent to the child himself; but to tell him that it was a punishment which could have a good effect upon the child, was to tell him that which was opposed to his reason, and he believed would be scouted by all those who knew anything of what was the organisation of the human frame. It was impossible, in the limits within which his observations must be necessarily confined, to follow his friend Mr. Symons through all his points, and he would therefore simply confine himself to a notice of two or three of those points. He had alluded to Parkhurst. He (Mr. Power) had been at Parkhurst, and also at Saltley, and comparing Parkhurst, with all its train of officers, with the reformatory treatment practised on a smaller scale at Saltley, his judgment was all in favour of Saltley. To Parkhurst—(and he did not wish in any way to libel that institution, but he wished to speak the truth of the matter)—to Parkhurst he paid a pains-taking visit. He saw 13 or 14 boys in a field idling round a warder. To tell him that the hearts of the boys were in the work was impossible. Any one could see that it was compulsory labour, the warder buttoned up to the chin in a regimental coat looking on—there was not the least heartiness in the work—the sentinel with fixed bayonet passing up and down the while. He would ask Mr. Symons this question—if Parkhurst were joined on to the main land, how many of those boys would remain there upon the work? All would run away. And as to reforming people against their wills, they might as well try to stop the motion of the earth; and the man who did not know that, was a very tyro in the reformatory treatment of criminals. The first thing to be done, was to get the boy's interest in his own reformation, otherwise they might try for ever to reform him, and they would not succeed. They might have the warder to superintend the boys, and (with all respect he mentioned it) the chaplain to teach them what their true duty was, but they did it in vain unless they gained the first step of awakening an interest in the mind of the boy in his own reformation. But his friend had said he would have this sharp stinging punishment administered in the same place where the reformatory treatment took place. He would like to see his friend governor of such an institution, and his friend, having administered his sharp punishment, might say, "Now, you have seen my harsh face, I will now turn to you a smiling countenance and try to reform you." He might try a long while, but he would not succeed. Any one who had had anything to do with reforming children, know that they had to meet a boy in his abnormal condition. The hand of society, he believed, had been against him; he had been dodging the policeman all his life, and he thought he had more right to complain against the policeman than society had a right to complain against him. The first thing was to get the boy to think that there was some sympathy for him, and by that means to inspire in him trust and confidence. They must make him believe that they were his friends, and then the work of reformation might be said to begin to take effect. But his friend said—"You fondle the boy." Had any one in this meeting tried to get rid of a habit which they were desirous to get rid of? If so, they had learned whether it was an easy task or not. With regard to some of the boys at Saltley, he could point to the terrific punishment they had gone through in their own self-reformation, far greater than solitary confinement or any other punishment they could administer. They might imagine a boy accustomed all his life to a roving and predatory life, with all the excitement attending it, escaping more often than detected. He gave that up in the reformatory school; his mode of life was different; he had to learn habits of order and cleanliness, and to learn to entertain a regard for others, instead of always being in a state of antagonism to the rest of society. In all this he was going through a real punishment, far more severe to him than any arbitrary punishment that could be inflicted on him, and, therefore, when his friend said those holding opposite views to himself on this subject were anxious to do away with all punishment, he did not represent them rightly. All he said was, it was unjust and useless to pass these vindictive, arbitrary punishments upon children. He now came to the last point he would mention. His friend had spoken of 15 of these contemplated reformatory establishments to accommodate 350 children each. He (Mr. Power) should like to see the staff which his

friend would appoint over these 15 establishments with 350 children; for after all, they, like Parkhurst, would be neither more nor less than prisons; they would be so many gaols, though called by another name. They must have the high stone wall, with the spikes at the top; they must have warders to enforce outward discipline, and they would turn out some of the children, as some of the ticket of leave men were turned out—reformed outwardly, it was true—hypocritically reformed, it was true, because there was a reward in view for outward performance of the requirements made of them in those establishments, but as to any reformation of the heart, there would be none. They would incur the expense of fitting up these 15 establishments with their staffs, but as to reforming the criminals thereby, that would be a problem as unsolved as it was now. They might turn them out improved in their appearance and general outward bearing, but with regard to reformation in the heart, it would be a complete failure.

Mr. ELLIOTT was pleased that in the paper read by Mr. Symmonds, a humane and healthy principle was at least acknowledged; the courage of the author was admirable in resisting the effeminate and diseased sentimentality which was too common on all matters of criminal jurisprudence. Juvenile offenders must be treated as all offenders should be: they had broken the law; they had injured their neighbour, and satisfaction must be had; that was, they must be hurt, they must be treated in a manner that would deter others ready to fall into crime; that was, they must be hurt so that the ideas of pain might be instantly associated with crime in the minds of all evil-doers. Mr. Symonds had manfully acknowledged this, when he said their pain must be sharp and short, but only of that kind which belonged to disagreeable confinement. He would have been glad if the truth had been still more boldly declared, and if the sort of punishment, pain giving, which punishment was, had been real sensible corporal pain, which everybody could understand, and until we had fallen into effeminate habits, all were ready to apply, from the days of Solomon, who said, "Spare the rod, and spoil the child;" to say nothing of the example of a greater than Solomon, "Who made a scourge of small cords, and drove ill-doers out of the Lord's Temple." The very instructive evidence was adduced by Mr. Symonds, of a young thief who said, "He did not care for flogging a bit;" that was only so much braggadocia, not to be believed; pain was pain, and people did care for pain, and, therefore, they did care for being flogged; to say boys or men did not care for pain, the pain of flogging, is just as absurd as to say, round was square, a cube was a sphere, hot was cold, or any other absurdity. Keeping in mind that you punished for satisfaction, and for example, you also punished for reformation, to prevent the ill-doer repeating his offence; and how best could you do that? by so treating him that he would say, "The pleasure of theft is not so great as to outweigh the pain of the punishment; a stolen apple and a flogging, is worse altogether than an apple bought with the produce of work, and, therefore, I will steal no more, but work." A very powerful, energetic young man said, "He was, when a boy, a sad fellow to rob orchards; he was flogged for it, but he sometimes robbed orchards still." "Well, but if you had not been flogged?" "Why, then I should have robbed orchards much more." Criminal children should have parental discipline for offences; the police should take them to their parents, who should punish them; but if their parents be depraved, who live, as was sometimes the case, on the thefts of their children, and who taught them crime by precept and example, then the summary jurisdiction of the magistrate and the police must take the place of the unnatural parent, and punish them, that was pain them, that was flog them. The present mode of treating young offenders was costly and mischeivous; it rewarded crime, and, therefore, encouraged it and taught it. It placed offenders in prisons, reformatory asylums, really palaces compared with their own homes, where they were well fed, cleaned, nursed and doctored, kept warm in light and nice apartments; they were visited by ladies and gentlemen, made much of, and altogether treated in a way that was a scandal on the honest industrious man of humble life, who was not half so well respected, cared for, clothed and comforted, neither he nor his children. To the mind of multitudes, crime in this country was rendered, by the follies of the effeminate humanitarians, the antecedent of improved comfort, sympathy, and enjoyment. The poor labourer, who saw that his boy could only by his hard industry and heroic self-denial grow up to the endurance of hunger and hard work like himself, would be apt to say, "My child is delicate, and cannot work as I have done. I should like to give him a trade; that I cannot do by hard work, but I see that those who steal and destroy fences and do mischief are taken care of by the gentry; and in addition to all bodily comfort, good shoes, and caps, they get a good deal of learning, and are taught a trade, that of blacksmith, tailor, &c. Surely hard honest work must be the shameful thing, seeing how it suffers and is neglected, and theft must be a good thing, seeing how genteel people, especially our clergymen, make much of thieves, and comfort and reward them; my boy shall turn thief." This certainly was the teaching now-a-days, and still more was it, when to all this we added the fact, that the money value of a young thief was much more than that of a whole labourer's family. At the lowest he cost £25 a year (or probable double) to reform, or make-believe reform, while the whole year's income of a labourer, wife, and two young children was often just the same. There seem but one means by which, after punishment, these young persons could improve their manners, and that was now-a-days entirely repudiated, so pleasant was the company of depraved persons to the humanitarians—transportation. Send them abroad, into the wild and fertile and unappropriated regions of the Cape, Canada, or Australia. Reform of the offenders depended on food and raiment coming as the direct and instant result of work, and in those countries they so came, labour being so much required. Reform depended also on certain healthy bodily conditions; here we sent children back to the hot, close, pestiferous air, of crowded rooms and cities, where diseased tendencies are fostered; the wild, violent bodily labours of the colonies, in purest air, changed the nature of the blood, nourished the brain with healthiest materials, carried off the natural bodily fatigue, the otherwise diseased nervous energy; health rendered labour pleasant; and if anywhere a bad boy could be turned out a good one, it was in the healthy natural occupations of colonial pastoral life. The example of our own country proved this, seeing how much less crime there was in the rural districts, notwithstanding that every rural prison was converted into a school for the reward of crime; the healthy pursuits of the field rendered a man proof against the temptations of the humanitarians, and this was quite proved by the very decided and rapid improvement which was effected, not, it was true, in every instance exactly, among our transported convicts. One of the happiest notions for the improvement of bad children, was that of the late Lieut. Brenton, who formed a receptacle for them at Hackney-wick, taught them a little garden culture, and sent them to the Cape of Good Hope, where, though with some failures, and though in the hands sometimes of hard masters, the majority of these children were speedily changed into honest workers. Lieut. Brenton was hunted down by the newspapers, his beneficent scheme was destroyed, and he, good fellow that he was, sunk under the persecution and died. Since then the humanitarians had, without restraint, converted the country into one vast crime preserve, and, as a consequence, crime, and especially juvenile crime, had abundantly increased.

Mr. SLANEY regarded this as a subject of deep interest to society at large, and one which should be treated with the greatest calmness and consideration. He had heard, with some regret, the extreme differences that appeared to exist between the gentlemen who had addressed them

that evening—differences, however, which a little calmness and coolness might in some measure remove. They had heard advocates on the one side of what was called the harsh treatment, and on the other side of what was called the kind treatment. But he would ask them, whether, amidst the multitudes of these juvenile criminals, they did not find persons of every gradation of mind, intelligence, and disposition, so that they might apply to some or other of them both these treatments; and, therefore, it might be useful, upon the ductile, the gentle, and the impressible mind of some, to apply the milder form of treatment; and, on the other hand, with some of harsher temperament, of older years, and more hardened by custom, to such it might be necessary to apply a more stern and rigorous treatment in bringing them to believe that it was to their advantage to be amenable to the laws of society. By some such process they might consider that the treatment spoken of on both sides might be combined, applying it with judgment to the different classes of minds of which he had spoken. For his own part, he was inclined to aid, not the vindictive side, but rather the indulgent side. When he came to see what were the causes of these effects—when he came to consider whether the fault was in the children themselves, or in the circumstances that surrounded them—whether it had not arisen mainly from various examples set before them by the parents, and from circumstances of temptation which, perhaps, few could have resisted, or it might be from the neglect or supineness of the government even under which they live. It had happened to him to have visited the haunts of vice and ignorance, of sickness and of suffering, where he had seen such temptations placed before the minds of children by bad examples around them, and such influences acting upon their infantile minds, that he ventured to say, while he did not excuse their crime, it was almost a matter of necessity that they should become the little criminals which they subsequently turned out to be. During the time that he had the honour of acting upon the Commission of the Health of Towns, he recollected visiting a miserable court, in one of the large provincial towns, accompanied by an intelligent police officer, and after seeing the dreadful dirt and filth in which the inhabitants lived, and in which their children had been imbued in all that was physical and moral around them, he asked the officer who accompanied him whether he did not find those people very much debased. He replied, "Yes sir, I have transported every one in this court twice over." Then ought they not to feel for those juvenile offenders, who had around them such powerful incentives to evil. They were, it seemed, debarred from considering what appeared to him the most important element in the case, viz., the consideration of how they should prevent the numbers of juvenile criminals being continually filled up by fresh persons coming into the criminal class. If that were the case, the whole question of the necessity of an improved education, including industrial education, religious education, and all that acted upon the juvenile mind from its earliest dawning, would be debarred from the present debate. Besides that, there was another wide field which ought to be considered, and that was the physical situation of these unfortunate people, because if they had them confined within the narrow precincts of an obscure alley, in towns inundated with fœtid vapours, and all the evils they had seen in the close abodes of the humbler of the working-classes, he defied them—with all the education they could give, and with the best of schools—he would defy them, if they returned into those abodes of misery, to raise them from the condition by which they were surrounded. To return to the subject more immediately before them, it appeared to him, it was by a combination, on the one hand, of the stern principles to those hardened by crime; and, on the other hand, by the mild and lenient, and considerate treatment to those whose minds were ductile, and open to impression; it was by a due commingling of these two methods that they could hope to accomplish the great object of reclaiming juvenile criminals; but it seemed to him of greater consequence to prevent, if possible, the continued increase of this unhappy class by making use of the proper means to prevent that increase.

Captain O'Brien said, as he was one of the official persons alluded to who, as Visiting Director of Parkhurst Prison, might be supposed to be prejudiced in favour of a penal system, so, on the other hand, as one of the Committee of Mr. Nash's Reformatory in Westminster, he might, with equal justice, be accused of having a strong leaning towards reformatories; but in fact he had, so to speak, a prejudice in favour of both. His experience led him to the conclusion that bad, vicious, wicked lads should be subjected to strict discipline, and when they did that which was deserving of punishment, they should receive one, short, sharp, and decisive. But, then, to subject a little boy who really had not discernment, who was guilty only of some petty delinquency, to the same penal coercion as the other class of offenders, would be cruel and useless. An absolute and unbending rule could not be laid down for all. As regarded serious offences and wicked boys, he preferred the course pursued at Parkhurst. As regarded the comparatively innocent boys, he preferred the reformatory methods. Subject to this exception, he coincided with what had been so clearly laid down by the intelligent author in the able paper which had been read. He must, however, advert to certain statements that had been made to the injury of Parkhurst. It had been said that the education at Parkhurst was not carried far enough. It was quite true that there they did not attempt to educate the boys highly—for instance, they did not go into cubic equations—but they were taught to read, and to write, and to cypher, to an extent that would be useful to them when liberated. It was a mistake to over-educate. Then it had been said that the boys were idle at their work, and had no heart in it. To this he would answer that this was not the case generally, though a single gang might have been standing still when a particular individual was looking on. It was objected to the warders that they wore their coats buttoned up, instead of digging with the boys. He (Captain O'Brien) was glad to hear it, as, if the warder had been engaged at hard labour himself, it was quite impossible he could superintend the conduct of the prisoners in his gang. It was also asserted that the prisoners would assuredly run away if there were not sentries with loaded firelocks hard by to shoot them if they attempted it. The reply to this assertion was, that for nearly two years no sentries whatever came upon the premises, or in any way acted as a guard upon the boys. Such were among the allegations made; they were groundless, and showed the animus which prevailed against the establishment, which he believed to be conducted by the local authorities—he meant the governor, the chaplains, and the subordinate staff—with firmness, kindness, discretion, and efficiency. To return, however, to the more general question before the meeting, he would recommend the perusal of the evidence taken before Mr. Baines's Committee of the House of Commons, which sat in 1851 and 1852, and though there would be found great diversity of opinion in that evidence upon matters of small detail, but little diversity would appear, among those who were practically conversant with the whole subject, upon questions of principle.

Mr. W. A. Shields (Master of the Peckham Birkbeck Schools), as one engaged in education, wished to make a remark or two upon what had fallen from various speakers with regard to the punishment of juvenile criminals. They had had those children brought before them as incorrigibles, and one gentlemen called for a sharp, stinging punishment, and another insisted upon a mild treatment. He took it that it was not a fact that the bulk of these children under 12 years of age could fairly be called incorrigibles, which no human means could turn or correct. It was different to dealing with a man hardened in crime. He (Mr Shields) was opposed to

vindictive punishment, considering, as he did, that the true object of punishment was to prevent the repetition of the offence. He thought no one could for a moment justify the application of vindictive punishment to children in the sense in which that term was generally understood. He would call attention to another point. Not long ago the notion prevailed very much that it was impossible to conduct schools without this sharp punishment, but gentlemen connected with the Society of Arts, and who knew what was going on with regard to education, were aware that notion was fast dying away; and should they say that these little children, whose greatest crime was the neglect in which they found them, were not to be touched by the same kind of training as they bestowed upon their own children. If the son of parents who were of the class termed respectable were guilty of any irregularity in his employer's counting-house, it was more often than otherwise the case that, instead of handing over the offender to a policeman, he was transferred to the wholesome reformatory influence of home; but if, on going from this meeting, they found the hand of a young culprit in their pocket, they would not know what it was their duty to do in such a case. They must look at the source of the crime, and against this it was that the appliances must be brought to bear; and he thought he was within the question when he said he believed that in the reformatory teachings of these young criminals it must be brought to bear; that they must be met, not with the warder with his coat buttoned up, but with the warder with his coat off, and, if needs be, with his shirt sleeves tucked up—men who would exhibit to these young criminals the dignity and the pleasure of labour, and of existing by that labour. Then, again, he thought intellectual education was another step to that end. Give them a little education, it was said—that meant by a man of little skill in education, and no more. He (Mr. Shields) did not want that they should be instructed in cubic-equations, but he wished, when it was perceived that the intellect of a boy had been unnaturally whetted, that a proper direction should be given to that intellect—that he should be taught that his notions of his duty towards society at large were mistaken notions. If they left that out they would still find in the juvenile offender a fear of the buttoned-up warder, and of the buttoned-up policeman. There was a great difference between the man who was honest because he liked honest courses, and the man who was honest because he feared their friend's vindictive punishment. As one engaged in education he had no hesitation in saying that to produce the higher result was the sure one. But they wanted men in prisons who understood education, and who would lay themselves out for the work, and would carry it on with all the kindness that they felt it desirable to exercise. Let them not be afraid of too much kindness to young offenders, and, above all, let them not appear amongst the advocates of the application of vindictive punishment to those whose errors might have arisen from the want of a training in the way in which they should go, and whose continuance in wrong doing had been because there was no helping hand to save them from that course.

Lord Lyttelton said, having received from the Council of the Society an invitation to be present and to take part in this discussion, he was unwilling that it should close without offering a few words, although of course he was speaking under the disadvantage that he was unable to attend until about a quarter of an hour previously, and therefore did not hear the reading of the paper or a great part of the discussion that had followed upon it. At the same time, he had the advantage of a rather familiar acquaintance with Mr. Jelinger Symons, and, like most public men, he had read a great deal upon this subject. There was much to read about it, probably as much documentary evidence upon the subject as there could be any necessity for; and he had also some practical acquaintance with it, although it was very little. He felt, with Mr. Slaney, that it was much to be regretted that there should be strong-felt differences of opinion upon first and essential principles, but such discussions as these were calculated to be of great service in bringing men's minds together on first principles, because all over the country this treatment of young offenders was at the present moment being more and more attended to. One thing, however, he was pleased with—that was, that whatever was done in these days was an improvement upon what had gone before, and he was not aware of anything having been done in this matter from which more good than harm had not resulted. But there was still a difference of opinion upon some of the main principles of the question, and, as he understood the difference, perhaps he might say the chief difference was that which had been treated of this evening, viz:—how far the punative or the reformatory principle should be kept in view. He agreed with Mr. Slaney, that in point of fact both were capable of being combined together in a certain manner; and as far as the enunciation of the general principle went he agreed with Mr. Slaney, and he (Lord Lyttelton) ventured to differ from Mr. Power on that point, inasmuch as he had understood that gentleman to say that the general principle he laid down was this—that young criminals, whatever that term might mean, were not to be punished at all, that punishment was not to enter into their treatment. As far as his (Lord Lyttelton's opinion went, as an abstract principle he thought it was based upon fallacy. He remembered Mr. Power at Birmingham laying this down on this intelligible ground—that these young criminals had not sinned against society, but that society had sinned against them; but if that were the ground of action, he (Lord Lyttelton) thought it was going a little too far. It was an ancient principle of the English law that a little child—not only the class of children, but a little child—should be apprehended and brought before a magistrate for an offence of which he might be judged *incapacitate* on the ground of tenderness of years, but it could not be put upon the ground that the crime of that child was not to be imputed to it because of the fault of the education of the child. That certainly was not the principle of the English law, because, if so, it might go on during the whole of life, that that child during its whole life had never had a fair chance of knowing what crime was; but nobody, he thought, would maintain that an individual was to be treated in that light throughout the whole of his life, and he did not see how they were to escape from the application of it to children that crime was to be punished, nor did he see how the matter was to be treated differently in the one case to the other. In some cases punishment might be dispensed with, and in other cases the quality of the punishment might require to be varied, but he agreed with Mr. Symons upon this point, whilst he differed with Mr. Power and other gentlemen who had spoken. But what he looked upon as the practical argument on this subject was that the differences of opinion might, after all, be in the theoretic and abstract way of stating the question, rather than in the application of it. He believed it might be found that there was more agreement upon that point than they were at present disposed to think was the case. Those who were acquainted with the voluminous evidence that had been given on this subject, and he might mention, in particular, the evidence of a great authority on this subject, Mr. M. D. Hill, of Birmingham, would remember that this had been frequently stated, that it was in itself a punishment to a child who had been brought up all his life in lawless habits, to be taken to one of the reformatory institutions, where he was obliged to conform to habits of regularity and order, and to pursue a system of hard labour only. In this view, therefore, those who differed in the abstract principle might agree. In the reformatory institutions the young criminals might be brought to abandon their bad courses and take to good ones, and the application of the punative principle would, perhaps, form the best application of the reformatory

principle. That was, perhaps, the manner in which the question could be best treated; at the same time he could lay down no positive rule for its application, as it might be a matter left within the discretion of the managers of reformatory institutions. But if the broad principle was to be argued, he certainly held to that which had always been a received principle, viz., that crime, where it was crime, whether of one age or another, was to be visited with punishment.

Mr. Power—I beg to say that I have no objection to any amount of punishment, so long as it is directed to the reformation of the offender. What I oppose is vindictive punishment, which has not reference to the reformation of the offender, but merely as some atonement to society, which he has offended.

Mr. Muntz, M.P., remarked, that this was an important question, and also a difficult one, and he doubted very much whether any one man was competent to give a correct opinion upon it, unless he had had great experience in the management of men and boys, and had had a family of his own. The difference consisted between organisation and education, and he thought in dealing with this question, sufficient consideration had not been given to organisation. He had for fifty years superintended a large body of workmen and children, and for nearly forty years he had superintended a large family of his own; and his opinion was, that the treatment of all the parties must be regulated according to their individual organisation. If they attempted to treat a body of men or children all upon the same principle, they would fail in their object, because what would do in one case would not do in another. He had had people in his employ from boyhood to manhood, and had hardly had occasion to find a fault with them, whilst on the other hand he had had people whom nothing would make do right; and, therefore, if it were a question of education, why did not the same truth applied to one produce the same effects when applied to all? Even in the domestic circle of a man's own family the same remark applied, as it was frequently found, that although a whole family might be educated upon the same system and upon the same principles, yet the effects of that education were differently manifested in different organisations. With some people flogging would only tend to increase the evil, whilst there were others of whom it might be said their brains could only be reached through their skins. He therefore cautioned the meeting and the country not to attempt to go upon the principle of treating all those young criminals in the same way, in the hope of reformatory results. If they did, they would signally fail in their object, and, instead of making them good members of society, they would only make them confirmed thieves.

The Chairman said, whatever differences of opinion might prevail on this subject in the various phases in which it had been presented to their notice, he felt assured that on one point at least they would be perfectly unanimous, viz., in according to Mr. Symons a cordial vote of thanks for his very able paper.

Mr. Symons, having acknowledged the compliment paid him, said, his friend Mr. Power had expressed his views with more force than he had ever heard him before. One remark made by that gentleman was important. He imagined that punishment was regarded as some atonement on the part of the child towards society. That was a mistake which he hoped no one would carry away; that was not the object; the object was in some degree the reformation of the offender, but in a higher degree the protection of society. He thought society ought to be protected from juvenile as well as from adult offenders. A very great deal had been said by Mr. Slaney, Mr. Muntz, and other gentlemen, as to diverse treatment of diverse children of different capacities, and feelings, and degrees of crime. He agreed with that, but he stated in his paper that the very institutions such as he had recommended, formed upon the model of Parkhurst, but in some respects improved, would admit of that apportionment of punishment, and of corrective and reformatory discipline according to the character and the crime of the children. If these establishments did not effect that they would fail in one of the great objects of their institution. One word with regard to what had fallen from Lord Lyttelton. He agreed with his lordship in the views he had expressed, which were entirely in accordance with his own up to a certain point; but when his lordship said that under any circumstances it would be sufficient punishment that a child should be taken from his dissolute habits, and placed under a discipline which should prevent the indulgence of these habits, he (Mr. Symons) dissented from that proposition, although he need not say there was no one whose opinions he more respected, or were entitled to greater weight than were those of his lordship. It was no more than they would do with their own children, if they took them from a course of undue freedom; but society in the case of young criminals required a punishment *dehors* that restraint to which a child would be subject under the parental roof.

The Secretary announced that there would be a *Special* Meeting on the evening of Monday next, the 7th instant, for the purpose of resuming the discussion upon Colonel Cotton's paper, "On Public Works for India." Also, that on Wednesday next, the 9th inst., the paper to be read would be, "On the Manufacture of Steel as carried on in this and other Countries," by Mr. Charles Sanderson, of Sheffield.

*** The Secretary is requested to state that it has been found impossible to accede to the request made at the meeting that an extra evening should be appointed for the further discussion of the question of "Juvenile Offenders."

## Home Correspondence.

### RAILWAYS AND CANALS IN INDIA.

Sir,—Seldom has the arena of the Society of Arts presented a more important subject than that treated of by the paper and discussion of Wednesday last, and not often has a subject been more earnestly discussed. The very expression of Colonel Cotton's face betokened a man loving truth, beneficent as well as benevolent, and if not

* In a note to the Secretary, Mr. W. Bridges Adams, who was unable to address the meeting, remarks that Mr. Muntz was undoubtedly right in asserting that different natures required different modes of treatment, but his illustration, that some of his own family were guided as by a silken thread, while others required thrashing to keep them in order, did not prove Mr. Muntz a thorough-going philosopher. It only proved that, like the owners of niggers in Uncle Sam's republic, he was anxious to exercise his power to make the weaker being do his bidding and "be good" after his fashion. The boy had native aptitudes for something which Mr. Muntz had not the acute perception to discover. The acid tried hard to unite with lime by its own affinities, but Mr. Muntz determined it should be kept in contact with silex, in a condition of constant repulsion. Probably the boy had strong physical energy, which would have found more relief in the factory than in the school. The American schoolmaster, when the impatient pupil day after day would whittle the forms and desks to pieces, gave vent to his ruling passion by setting him to chop firewood in the cellar for an hour, when, his high-pressure steam being blown off, he settled down quietly as an A-B-C-darian. Stephen Gerard, the Philadelphia millionaire, always liked quarrelsome people for clerks, on account of their energy, but he put them to work in separate offices, and said they were his best men.

thoroughly benescient, still many-sided if not all sided, and erring only from an intensity of desire to do good.

In this earnestness he has set up an opposition of canals *v.* railroads, as though the advent of railways would absorb the whole amount of money seeking for employment, and leave no capital for the canals. It has been said of the citizens of the United States, that they consider liberty to be like a quartern loaf—if any one else gets a slice, there will be less left for themselves. Colonel Cotton's reasoning would seem to be of the same fashion. He regards railroads with fear, as a most expensive luxury, preventing the extension of works of large utility—canals—having reference both to irrigation and transport.

Canals are but another word for rivers, placed in new channels. Why is the new channel needed? The river, as its name imports, is a river, or cutter, of the earth's surface, which is riven by it. By sudden floods of rain or of melted snows, it rushes down declivities in straight lines, till it meets with obstacles, in the shape of rocks or of hard ground, or till it makes obstacles by piling up and depositing its debris along its course, when it bursts its bank to right or left, and becomes sinuous. Thus it is that rivers take curved courses, make deeps and shallows along these courses, and finally make deltas on the ocean margin. The tendency of the water is to level the ground by raising it, and, then escaping, to make a new level, very like the artificial process of making a railway embankment. If the course of the river were straightened, and the shallows deepened, the same process would be renewed if the river were constantly subject to alternate flood and drought and if a canal were cut, the same result would take place, unless it could be kept out of the reach of floods.

The first thing in all cases to be done in a warm climate like India—and without which material wealth cannot exist, and navigable canals and railways would be alike useless—the first thing is to procure water wherewith to irrigate the land. Sun, water, and earth or sand, are the three elements of vegetable wealth, and without these in conjunction, a tropical climate is ever a desert. In the mountain-girdled hot valley of Aconcagua, in Chilé, the finest wheat the world produces is a result of irrigation from the artificially-conducted melted snows, and, what is remarkable, a rainy season, *i.e.*, in a fortnight's rain, the rain produced mildewed ears and a bad crop. I do not know if such be a result in India, but there can be no doubt that irrigation, as the means of producing food and other crops, comes before canal navigation as the means of transporting crops. And it is probable that if the means existed of lifting the water from the river directly on to the dry land, there is enough of the latter to absorb the whole of the former, in the dry season, for useful consumption.

But if there be water enough left for the purposes of navigation, of course it can be used, though the first object of the canal should be irrigation.

Colonel Cotton assumes that railways in India are to cost £10,000 per single mile. They may be made to cost that, or more, but it is an undoubted fact that a mile of permanent way—really permanent—and of the best materials, can, at the present prices of iron, and at the present high freights, be landed in India for about £2,400, and complete permanent way, such as the commonest labourer of India can lay down in the levelled ground, without chance of error, including extras for sidings, crossings, &c. If we take £1,000 per mile for rolling stock that will only amount to £3,400; and if canals are made, earthwork must be done, and huts made, and boats built, and reservoirs provided, and even then the navigation will not be brought alongside peoples doors, and gardens, and fields, as may be the case with the railway; and, therefore, Colonel Cotton proposes, in addition to the canal, "to lay down light railways by thousands of miles in all the populous parts of India, which can be done without any difficulty." This brings us to the question of what is a railway, and what a light railway?

A railway is, or should be, two straight parallel lines of iron, so strong vertically and laterally that they will not alter their form, either temporarily or permanently, under the pressure of the rolling loads, provided those loads be not calculated to crush or laminate the iron. The structure of the rail, moreover, should be such as not to offer mischievous leverage, or facilitate displacement by the side blows of the wheels, *i. e.*, the tread of the wheels should be as little as possible elevated above the bearing surface, while the depth of the rail should descend into the ground, as the keel of a ship does, to hold it firm and prevent its rocking or going to leeward; and the joints of the rails should be so arranged as to make the strength equal and continuous throughout the whole line. Complying with these conditions there will be a railway in the proper sense of the term—lacking these conditions the whole thing will be a misnomer.

Whether light or heavy, the same conditions must exist. If rails deflect, vertically or laterally, under an engine, the power will be wasted, and the maintenance costly. If it be an animal power railway, and the rails deflect under too heavy waggons, the same mischievous results will occur. The datum waggon should first be constructed as lightly as may be consistent with strength and with the minimum of friction at the axles and the circumference of the wheels. The load the horse can take up the worst gradient should then be ascertained, and the strength of the rail settled accordingly. If it be desired to run the same waggon on the road and on the rail, the wheel should be made with two tyres, and a groove between for the edge rail to lie in. And if light railway-trucks be used, the wheels should all separately revolve on their axles: and, moreover, efficient springs should be applied, or light rails will very soon be out of order. It is desirable not to have any timber at all on such railways. If rails are laid on cross-timber sleepers, either the sleepers must be buried in the ground, when considerable labour will be incurred, or they will be rapidly destroyed by the cattle tripping over them. If timber be used at all, it should be merely in detached blocks, and not as part of structure—merely as a ballast of wood, where other suitable material is difficult to get. The railway, light though it be, must be as perfect in all its parts as the heavy one, or the desirable result of reducing wheel traction by railway to the minimum, will not be attained. If timber is to be sent from England it will be a bulky substance, and costly in freight; if it is to be manufactured in India, skilled labour will be expensive. To answer the purpose required the railway must be of few parts, easily put together without blunder, and capable of firm fixing. And it will not do to use any turntables, or points, or crossings, such as are used on locomotive lines, where skilled labour exists for repairs. The proper kind of crossing, or turn-out from one line to another, is a flat pavement, or boarded floor or platform, whereon the rails finish with sharp points, so that the wheels may be easily entered. Light four-wheeled spring trucks, run on to the pavement, may, by lifting one end of them, be easily turned round; but if the levels are to be disregarded, the question of breaks on descending inclines will require attention.

I can quite agree with Colonel Cotton that one chief end to be had in view is the increasing wealth and comfort of the Indian population, but it is doubtful if this end can be attained quickly by civilising downwards. If, for example, travelling and locomotion were very much more tedious and costly than it now is, the number of intelligent travellers and settlers would be proportionately reduced. And it is only by increasing facilities that the numbers of intelligent people can be made to increase. And to enable these intelligent people to travel, and to carry troops to put down outbreaks, there is no means to compare with the railway. And time is a large element in the amount of human happiness and energy. It is doubtful what Colonel Cotton means by "high speed," ten, twenty, fifty, or seventy miles per hour. Ten miles

is high speed compared with a bullock waggon. The question resolves itself into one of cost. If sixty miles per hour could be attained with no more cost than the transit by oxen there would be little objection to it. Now high-speed cost is relative, not positive. Light engines and trains can travel quite as fast as heavy ones, and do no damage. The damage is the speed and weight together, and with light weights there is no damage.

Man does not live by bread alone. The bucolic state, the bucolic condition of plenteous food, tethered to a fixed spot will not constitute even Indian happiness. To be secured against starvation is doubtless a considerable good, but abundance of corn is no more a final end than abundance of potatoes. A leavening of wealthy people, surrounded by beauty and pleasant appliances, teaches poor men to aspire, and makes them long to traffic in their common superfluities. And the very life of commerce is rapid transit—if not for goods—for passengers. Rightly made, the interest on the outlay for 5000 miles of railway would not much exceed a million per annum to be paid by the people of India, and amply repaid to them in the shape of work and traffic, which otherwise would not exist. The comparison of the steam-boat traffic of the Hudson river with the rail traffic of the New York and Albany, is not to the point. A large and ever full river, with powerful fast steamers may be cheaper, and certainly is pleasanter, than the railway cars of the Union, but the comparison would not hold good with the railway and the miserable slow boats in the Erie, or dreary canal, a mode of travelling at four cents per mile, meals included, which Englishmen, at least, do not like a second time; and from Glasgow to Greenock, with a river like a canal, and in some other instances, the rail will not let the river traffic live. The locomotive engine returned from Cuba, and put into the steam-boat, in order to rival the locomotive ashore, which the wiseacre manager deemed the secret of the speed, settled that question.

It is doubtful if one evening more will be sufficient to carry out all the important points of this great subject.

I am, Sir,
Yours faithfully,
W. BRIDGES ADAMS.

1, Adam-street, Adelphi,
April 28, 1855.

The question of the Ghaut ascents I will discuss at a future time.

## Proceedings of Institutions.

Hampton.—A concert was given on Thursday evening, April 12th, in one of the rooms of the Hampton Endowed Schools, by permission of the trustees, by Mr. L. W. Wüstemann, organist, in aid of the funds of the Literary Society. The concert was very numerously attended. The performers were, with but few exceptions, inhabitants of Hampton and the neighbourhood, pupils of Mr. Wüstemann. Mr. F. Wüstemann performed on the flute. Mr. L. W. Wüstemann's daughter, aged 13, played a fantasia on the pianoforte, in a very pleasing manner. The solo songs of Madame Schürer and Mr. L. Wüstemann were much applauded. The president, T. H. Holbreton, Esq., tendered the thanks of the society to Mr. Wüstemann, which having been responded to, the meeting separated.

## To Correspondents.

### DISCUSSION ON COLONEL COTTON'S PAPER "ON PUBLIC WORKS FOR INDIA."

The remarks made by Colonel Sykes on this subject were not fully given in last week's number of the Journal. The concluding portion of his address was as follows:—

Colonel Sykes (in continuation) said, Colleges for the instruction of civil engineers were established under the different governments. Great sums of money had been, and were now being, laid out upon public works in India. Amongst other sums authorised during late years (and they must bear in mind that it was only about 26 years since railways were first established in England, and they were now only in 1855) there had been a guarantee given of 5 per cent. upon £10,000,000 of money for railways in Bengal, and he fancied it would be well for some of the gentlemen present, if they could get that guarantee upon their railway property in this country. With the lines already in progress, and those sanctioned for Madras, Bombay, and Scinde, the government guarantee extended over an amount of £17,000,000; that, he thought, was tolerably liberal, more liberal than he should have been inclined to be. Then, again, within the short period of two years, a sum of £150,000 had been laid out upon the establishment of the electric telegraph in India. That telegraph had been completed in a marvellous manner, connecting the three presidencies of India, so that the governor-general, when at Neilgherries, had an unbroken and instantaneous communication with all the presidencies of India. The next great work was the Ganges canal, for the purposes of irrigation; upon that work £1,800,000 had been expended, and it was now in operation for the irrigation of the country. With regard to the Punjaub, canals had been begun there, but it must be remembered that we had only had possession of that territory four or five years; nevertheless, £500,000 was being expended upon canals for irrigation. Then there were the works of irrigation upon the Kistnah river, to which £150,000 had been allotted; and £150,000 had been spent for irrigation from the Godavery, £50,000 for the Cauvery, and there was a bridge proposed over the Hoogly, at Calcutta, at the cost of £400,000. Again, the trigonometrical survey, which was of the highest importance to India, had been effected at a cost of £ 00,000, so that the total outlay within a short time, had been £20,700,000, and yet Colonel Cotton had said in his paper that "nothing had really been done towards the two great objects, viz., of irrigation, and opening out the resources of India." He would ask whether that was a fair statement to make, and whether it was borne out by the facts? He had marked other points for notice, but he had already occupied too much of their time, and would therefore close with thanking the meeting for their obliging attention.

## MEETINGS FOR THE ENSUING WEEK.

Mon. Royal Inst., 2. General Monthly Meeting.
Society of Arts, 8. *Special.* Discussion on Colonel Cotton's paper, "On Public Works for India."
Architects, 8.
Chemical, 8.
Entomological, 8.
Tues. Horticultural, 3.
Royal Inst. 3. Dr. Tyndall, "On Voltaic Electricity."
Syro-Egyptian, 7½. 1. Mr. Samuel Sharpe, "Notes on Syria." 2. Mr. Harle, "On Nergal."
Civil Engineers, 8. Discussion on Mr. Barton's paper "On the Economic Distribution of Material in the sides or vertical portion of Wrought Iron Beams."
Med and Chirurg., 8½.
Zoological, 9.
Wed. Literary Fund, 3.
Royal Soc. Literature, 4½.
Society of Arts, 8. Mr. Charles Sanderson, "On the Manufacture of Steel as carried on in this and other Countries."
Graphic, 8.
Ethnological, 8½.
Thurs. Royal Inst. 3. Mr. G. Scharf, jun., "On Christian Art."
Antiquaries, 8.
Royal, 8½.
Fri. Astronomical, 8.
Philological, 8.
Royal Inst., 8½. Mr. Henry Bradbury, "On Nature Printing."
Sat. Royal Inst., 3. Dr. Du Bois Reymond, "On Electro-Physiology."
Royal Botanic, 3¾.
Medical, 8.

## PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.
*Delivered on 25th of April*, 1855.

Par. No.
138. Superannuations (Public Offices)—Account.
176. Immigrants and Liberated Africans—Return.
192. Exchequer Bonds—Account.
186. Agents of Transports—Return.
84. Bills—Loan.
85. Bills—Stamp Duties (Drafts on Bankers).
86. Bills—Income Tax.
88. Bills—Customs Duties.
Australian Colonies (Alterations in the Constitutions)—Further Papers.
County Courts—First Report of the Commissioners.

*Delivered on 26th of April*, 1855.
140. Civil Service Estimates—Classes 3 and 5.
193. Committee of Selection—Tenth Report.
87. Bill—Spirit Duties (Scotland and Ireland).

*Delivered on 27th of April*, 1855.
140. Civil Service Estimates—Class 4.
167. Education—Tabular Statement of Expenditure.
183. East India—Copy of Letter.
188. River Barrow—Report.
191. Spirits—Returns.

*Delivered on 28th and 30th April*, 1855.
125 (1). Metropolitan Water Companies (Lambeth Company)—Report.
172. Poor Relief (Scotland)—Return.
176. Weights and Measures—Abstract of Report of the Commissioners.
189. Tithe Rent Charge (Ireland)—Abstract of Return.
175. Metropolitan Commission of Sewers—Account.
194. Oak Bark (Alice Holt Forest)—Return.
196. Turnpike Trusts (Ireland)—Copy of Commission.
198. Hampton Court and Kew Gardens—Return.
90. Bills—Public Libraries and Museums (as amended by the Committee, and on Re-commitment).
91. Bills—Church Rates Abolition (No. 2).
89. Bills—Metropolitan Buildings.
Colonial Possessions—Reports.
Prisons—20th Report of the Inspectors (Scotland). Part 4.
Turnpike Trusts—3rd Report by the Secretary of State.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, April 27th*, 1855.]

*Dated 6th March*, 1855.
496. P. M. Parsons, Duke-street, Adelphi—Fire-arms and projectiles.

*Dated 7th March*, 1855.
506. J. H. Johnson, 47, Lincoln's-inn-fields—Hard india-rubber. (A communication.)

*Dated 14th March*, 1855.
572. E. V. Gardner, 24, Norfolk-street, Middlesex Hospital—Smoke prevention and economy of fuel.

*Dated 26th March*, 1855.
657. J. B. Dechanet and A. D. Sisco, Paris—Metallic tubes and pipes.
659. J. Gedge, 4, Wellington-street South—Gloves. (A communication.)
661. J. Britten, Birmingham—Chimney sweeping machine.
663. J. Mc Kinnel, Glasgow—Ventilation.
665. W. Bartlett, Birmingham—Ventilators.
669. O. R. Burnham, New York—Projectiles.
671. J. Marland, Leeds—Preparing, sizing, and warping yarn.
673. J. Shaw and J. Fielding, Lees, and L. Harrop, Oldham—Spinning machinery.

*Dated 27th March*, 1855.
675. J. Gedge, 4, Wellington-street South—Transferring designs to fabrics or to paper. (A communication.)
677. C. Goodyear, Paris—Moulding india-rubber and gutta-percha. (A communication.)
679. A. Turner, Leicester—Elastic fabrics.

*Dated 11th April*, 1855.
792. J. Edge, Bolton-le-Moors—Steam engines.
794. C. Blunt, Wanstead, and Dr. J. J. W. Watson, Wandsworth—Artificial fuel.
796. J. Alderman, Denmark-street—Adjustable couches, chairs, &c.
798. F. S. Hemming, Birkenhead—Buildings.
802. G. F. Wilson, C. A. Hanson, and J. J. Wallis, Vauxhall—Camp candles and candle lamps.
804. G. F. Wilson and G. Payne, Vauxhall—Ornamenting glass.

*Dated 12th April*, 1855.
810. F. Wilhelmy, Paris—Border paddles for steam-boat wheels.
812. W. Terry, Birmingham—Breech-loading fire-arms.
814. J. Lalernan, Lille—Combing flax. (A communication.)

*Dated 13th April*, 1855.
816. J. Templeton, Glasgow—Pile fabrics.
818. J. Revell, Dukinfield—Propelling vessels.
820. J. Jarman, Masborough—Horse shoes.
822. T. Hill, Walsall—Nails. (A communication.)

*Dated 14th April*, 1855.
824. J. Denoual, Jersey—Enveloping medicinal preparations with soluble substances.
826. W. Gossage, Widnes—Soap.
828. W. Reid, Holehouse Neilston, Renfrew—Finishing textile fabrics.
830. G. J. Sculfort, Mauberge—Screw-wrenches.

*Dated 16th April*, 1855.
832. R. M. Ordish, Copenhagen—Permanent way.
834. H. Holmes, M.D., Clifton road, Maida-vale—Treating the human body by gases, vapours, and electricity.
836. J. Cowley, Quennington Mills, Gloucestershire, and D. P. Sullivan, Stockwell—Paper.
838. W. Bull, Lupus-street, Pimlico—Axle bearings and axles.

*Dated 17th April*, 1855.
840. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Nails, bolts, rivets, &c. (A communication.)
842. R. Milligan, Harden, Bingley—Wool, mohair, or alpaca fabrics.
844. C. Crapelet, Montmartre—Tompion for cannon and other fire-arms.
846. P. Levy, Edinburgh—Wrapper.
848. C. Foster, Warrington—Railway signals.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.
893. H. Schoofs, St. Gilles, near Brussels—Making, fixing, or attaching artificial teeth, gums, and palates.—21st April, 1855.
909. H. J. Iliffe and J. Newman, Birmingham—Manufacture of covered buttons.—23rd April, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed April 27th*, 1855.
2302. Oliver Maggs, Bourton, Dorset—Improvements in portable steam engines.
2303. Gustave Hermann Lille, Amelia-villas, De Beauvoir-grove, Kingsland—A new material for the manufacture of paper.
2321. James Rae, 1, Alpha-road, New-cross—Improvements in machinery or apparatus for assisting in propelling vessels.
2332. Nathaniel Topp, John Holt, and John Partington, Farnworth—Improvements in hand mules for spinning.
2333. Isidore Alexandre Moineau, and Jean Gustave Lemasson, Paris—Improvements in elastic mattresses and seats.
2354. William Henry Woodhouse, Parliament-street—An improved meter for water and other liquids.
2670. Auguste François Joseph Favrel, Paris—A new machine for beating precious metals, applicable to leather and to forging.
313. Edward Sparkhall, 142, Cheapside—Improvements in the exhibition of pictorial representations of various subjects.
472. William Hunt, Tipton—Improvements in utilizing certain compounds produced in the process of galvanizing iron, and in the application of the same and similar compounds to certain useful purposes.

*Sealed May 1st*, 1855.
2338. John Adcock, Marlborough-road, Dalston—The novel application of the stem or stalk of the tobacco leaf for various useful purposes.
2343. Joseph Betteley, Liverpool—Improvements in the construction and manufacture of iron knees, and the application thereof for ship's fastenings.
2345. James Wallace, junior, Glasgow—Improvements in zincographic and lithographic printing.
2352. Edward Hogg, Charles-street, Gateshead—Improvements in shot and shell.
2393. John Wain, Greenacres-moor, Oldham—Improvements in certain machines for spinning and doubling cotton and other fibrous substances of the kinds commonly known as mules and turners.
2495. John Simon Holland, Woolwich—Improvements in large and small fire-arms, and in the preparation of their charges.
2646. Edward Strong, Carstairs—Improvements in removing and replacing the wheels and axles of locomotive engines and other rolling stock of railways.
2763. Bernard Hughes, 3½ Donegal-place, Belfast—The better and more effectual heating of bakers' ovens.
361. John Oxley, Beverley—Improvements in machinery for making wheels, or the various parts of which wheels are composed.
381. George Nasmyth, Kennington—Improvements in preserving animal and vegetable matters.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3710 | April. 26. | Portable Camp Bedstead | John Southgate. | 76, Watling-street. |
| 3711 | " | Improved Apparatus for Freezing or Iceing Creams, &c. | George Epitaux and Levi Stead. | 3, Pall mall. 97, Norton-street. |

Journal of the Society of Arts.

*FRIDAY, MAY* 11, 1855.

## EXTRA-ORDINARY MEETING.

### Monday, May 7, 1855.

An Extra-Ordinary Meeting was held on Monday evening, the 7th instant, for the purpose of resuming the discussion upon Colonel Cotton's paper, "On Public Works for India." Edwin Chadwick, Esq., C.B., presided, in the absence of Robert Lowe, Esq., M.P., who took the chair on the last occasion, but was unable in this instance to do so, owing to his parliamentary duties.

The Secretary stated that he had just received a telegraphic message from Mr. John Bourne, of Greenock, to the effect that a letter he had written on the subject before the meeting had been omitted to be posted; but that he concurred in Colonel Cotton's views as to Indian river navigation. [This letter has since come to hand, and will be found printed *in extenso* at page 449.]

The Chairman then called upon Mr. W. Bridges Adams to open the discussion, when that gentleman read an abstract of the following paper:—

## CANALS AND RAILWAYS IN INDIA.

By W. Bridges Adams.

In every subject under discussion the first object should be to settle the terms of the discussion. The terms of the present discussion have not been settled, and thence probably has arisen much of the variance of opinion. India is a term meaning almost every variety of soil, climate, and circumstances, from the snows of the Himalaya to the hot swamps of the Hooghly. We might as well dispute of the whole continent of America, and determine that everything good for the Gulf of Mexico is also good for Cape Horn. To assert, as Colonel Cotton would appear to do, that no railways should be made till all canal power were exhausted, would simply be to say that mankind in India should only dwell along the navigable streams, or streams to be made navigable, or capable of being worked by very ordinary appliances. To assert, on the other hand, that no water conveyance shall be used, because railways are a convenient means of transport, would be an absurdity. To assert, also, that no railway ought to be made where water transit exists in a similar direction, would be to determine on a great waste of very valuable time amongst the most intellectual members of the community—a process fatal to the general progress of the masses. In all times and ages rapid transit—rapid as compared with the general movement of the community—has been found a necessity of government and progress. The ancient Peruvians, lacking the means of mechanical and animal locomotion, established a communication of human runners, at posts a few miles apart, in order to convey messages rapidly. Modern Indians are used as beasts of burden to convey their ruling classes at the rapid rate of four miles an hour, because they find it a necessity to travel faster than bullock waggons, through districts where water transit exists not, and horses cannot be maintained. It might be said that people ought not to travel at a cost of cruelty, but they do, and they will in failure of non-cruel methods; and amongst the national cruelties that have been abolished by the advent of railways, that of the cruelty to post-horses is not one of the least; a cruelty, be it remembered, not of the poor, but of the rich; a cruelty not of the race-course or of the hunting-field, but of the road; a cruelty in which the legislator, returning from his duties to his estate in the country, indulged in as prominently as other men, when giving an extra half-crown to the post-boy to induce him to give an extra spurring to the bleeding ribs of the jaded post-horse.

Fast travelling must be, to induce civilization, even at the cost of stinted rations to the poor, who have to do the work at the outset. Not destructive fast travelling for whims, but travelling as fast as can be accomplished without greatly enhanced cost.

It is no argument against the construction of canals in India, as proposed by Colonel Cotton, that railroads in Europe and America have been constructed along the same tracks as canals and rivers. The construction of a railway does not prove that a canal is useless; on the contrary, it may happen that the canal and railway mutually help each other. A large transit of goods implies a large transit of passengers, and *vice versa*; and while canals are well adapted for heavy goods, they are too slow for light goods. There may happen circumstances in which the canal is practicable, and the railroad is not, as in swamps, but on the other hand the railroad is practicable in a vast number of cases where the canal is not, as in districts of little water and on very undulating ground.

A mechanical difference in the construction of the canal and the railway is this, the former must be a series of direct levels, with sudden drops, in the form of locks, whereas the latter may be a gradual incline. It is obvious that the incline does not increase the cost in making the line, whatever may be the case in working it. But locks and their maintenance do very seriously increase the cost, both of making and working.

Navigable canals are made because rivers will not run straight or level. Brindley, in his evidence before the legislature, said roundly, that "Providence made rivers to feed canals;" but the great Earl of Bridgwater, looking further, said the only fear he had for his canal revenues, was the possible contingency of "those ——— execrable —railways."

Canals belong to peculiar localities, such as Holland, where the water is in abundance, and it is almost needful to dig ditches to make dry land. In such districts a canal does not become a mischievous monopoly; but in England, which is by no means a dry climate, the canals were a monopoly, for there was only a given quantity of water, and it was all owned, and could not be increased by manufacture. That also might come to pass in India.

The railway came and beat down the monopoly. Iron is not limited, like water, and wherever a railway proprietary charge large fares upon an extravagant capital or a spendthrift working expenditure, there, infallibly, in due time, will parallel lines of rail be laid down. The only way in which a practical railway monopoly could be accomplished in England, would be to purchase two strips of land, east and west and north and south, in the form of a cross, and charge black mail to every one passing over it, as the barons did in the olden time, when there were no Acts of Parliament to make individual advantage give way to the public good.

Rivers and canals for navigation have been chiefly successful in temperate and cold climates, notwithstanding the difficulties of frost. The Hudson, which drains a large extent of lake district, is a case in point. It is only in such climates that the constant supply of water can be kept up. The Erie canal is the artificial drainage from the Erie lake to the Hudson, and this is carried over the valley of the Mohawk in a long wooden trough, upon tressels of great height, with a kind of wooden mantle-shelf on one side for a towing-path, the water pouring out at every joint in miniature Niagaras, showing that it is a raw material in great abundance. In hot climates,

canals are chiefly made for purposes of irrigation; and where, in such climates large navigable rivers serve the purposes of transport, it is only because population has not sufficiently thickened to use up all the water for irrigation, or because the rivers run in such deep channels as to prevent it, forming, as it were, large sluices. The River Plate is one of those draining a large district, but so little used for irrigation, that the wide steppes of the Pampas, which could be made to absorb it all, are, in the absence of a rainy year, a dry desert, in which the cattle die by thousands around the last muddy water-holes.

We have long been accustomed to read of voyages on the Nile; yet now there is a railway alongside it, and there is useful land enough to use up probably the whole of the water, were there means to lift it up; yet this river Nile, like the Indus, is not, and probably never has been, navigable to the sea. The Mahmoudieh canal, leading into Alexandria, is the artificial substitute for the impracticable channels of the Delta.

The Mississippi, like other great rivers, makes and unmakes islands, closes its channels capriciously, and opens new rivers along its course. It is ever bringing down detritus and making deposits where it lists, incessantly raising its channel and heaping up obstacles which oblige it to run over its banks, unless helped by human labour, which has now enabled ships to float above the roofs of the houses in New Orleans. The Ganges makes sport of the islands at its mouth in the same manner.

Whenever we find a river constantly keeping up a delta or a bar, we may take it for granted that the supply of water varies. The Thames has no delta, but it is carefully banked in and dredged when needful. In the rivers of hot countries, the rainy season brings down a torrent which heaps up materials serving to pond up the water when the rain ceases; and these bars are the impediments to navigation in the dry season. Removing the bars, the navigation would be open, but only till the water had all run out, which would be very rapidly. These bars, in fact, constitute a series of natural locks, between which the water lies at a level. These natural ocks Colonel Cotton would convert into artificial locks to be effective for navigation, but it would be necessary to run the stream into an artificial channel, to be out of the way of floods which would destroy the work of art. The canal is a pond without a current, and one of the troubles of ponds is, that they are apt to fill up with sediments. Moreover, these channels, if narrow, will only admit of towing, which needs a towing path and animal power. If propelled by steam the banks wash away, as is found in the Clyde, which is practically a navigable canal below Glasgow; and does not subserve the public want of speed as does the railway. And it is only in fine weather that the lowest possible fares will induce people to travel by water on the smooth Thames to Gravesend, and even then they return by rail at night to town.

Canals must make sinuous courses to keep the levels, much more so than railways, and thus increased distance is added to slow transit. And time is money, even to the labouring man, who has to eat every day, even though he were to travel for nothing. What workman goes to Birmingham from London by canal? It is a mere jest to allude to it.

Rivers, to be constant, must be dependent on some process of nature for storing up water. In Chilé and Peru the Andes perform the office by storing up the snow; but the rivers are little more than a hundred miles in length. In the Upper Ganges, the Himalaya range performs the same office. Mont Blanc and other mountain regions supply the Rhone, which was formerly a navigable river all the year round, while the snows were sheltered beneath the pine forests, and melted gradually. The pine forests being cut down, the Rhone is now an alternate mountain torrent and a non-navigable stream during great part of the year. The proof of this is, that within a few years past Lyons has been subject to periodical inundations which have washed down dwellings and stores constructed of unburned bricks. It is obvious that such buildings would not have been erected if they had originally been in risk of melting down like barley-sugar. The large American lakes which are drained by the St. Lawrence, and to which the limestone range of Niagara forms a bar, are fed by the rains and melting snows, and it is stated that their depth is decreasing by the constant felling of timber to supply the numerous steamboats, which exposes the snow to melt, and the water to evaporate. In Ireland the great bogs form a kind of natural springs, from which the water gradually oozes to supply the rivers. Other rivers are supplied by mountain caverns with large inlets and small outlets. In countries of continuous rain the rivers may be continuous without any of these resources.

In hot countries jungles may supply shelter for the water-courses, to prevent evaporation, but such must ever be a pestilential country, like the west coast of Africa.

Leaving the problematical question of navigable canals, we come to the question of irrigable canals. Of *their* value and permanent utility, if India is to make progress, there can be no doubt. Colonel Cotton cannot well over-rate them in this particular. My own belief is that in proportion as irrigation extends, population will thicken, and that ultimately it will be found that the whole of the water can be advantageously absorbed to render the dry land fruitful. In hot countries the roots of the plants appear to be the best absorbents. Rain is not favourable to ripening vegetation. But the process of irrigating land by open channels is a costly one. Along the channels there is a thick and tangled growth of weeds, requiring a constant expenditure of labour to keep down. In the beautiful plain of Valencia, in Spain, the whole water of the river falls short of the necessities of the cultivators, and leaves much good land useless, and generates a perrenial strife amongst the peasantry, which rises into an occasional tumult, with loss of life, and has to be put down by the soldiery. There is a proverb about the water:—

> "Una mitad al cielo,
> Otra mitad al suelo."
>
> "One half to heaven,
> The other half to earth."

Probably of all the water that springs from the mountain, one-third is absorbed by the sun, and another third by the porous channel, to grow weeds, while only one-third reaches the cultivated land.

In hot Spanish countries, with irrigation, it is customary to plant the acequias or irrigation channels with trees, to prevent evaporation. But there is yet wanting a cheap and efficient mode of conducting irrigation water under ground, and when that takes place it will be the most valuable gift that modern science can bestow on India, saving human labour, and preventing the waste of water. The water must be filtered before it enters the channels, to prevent deposit, and the channels must be easily accessible, to clear out obstacles. If Colonel Cotton will set himself to work to solve this problem, he will be a still greater benefactor to India than he has yet been.

One chief objection that Colonel Cotton makes to railways is, that by their cost and outlay they will prevent the canalisation of the Indian rivers, which would be much cheaper per mile. Yet he says, that navigable canals are insufficient, and proposes as an adjunct light railways, the cost of which he does not tell us, though he asserts that the ordinary lines will cost £10,000 per mile. Now, a railway consists essentially of permanent way and rolling stock. These are the two items which cannot be done without, any more than the bridges and levelling. All else, expensive stations, &c., is a question of choice. The permanent way and rolling stock will not exceed £3400 per mile, and earthworks and bridges, at £1600 more, would only make up £5000 per mile. Horse railways, wholly of iron, to work into this as branches, could be constructed at between £500 and

£600 per mile, and by a horse railway, I mean a very permanent horse railway, and not a toy—horse railways that can be laid down by unskilled Indian labourers, after being shown how the first pair of rails go together. I go still further. There are districts where even railways to track light waggons by hand would be desirable, as in Welsh slate quarries, and they also should be constructed wholly of iron, for reasons obvious enough to those who have had to grub up thorny roots to boil their kettle.

I have for many years past been an advocate, in print and out of print, of light railways for steam power, of horse railways, and of portable railways. In the *Times* of January, 1850, and in the *Spectator* of February, 1850, these plans will be found favourably reviewed.*

The question of railways might be nearly an exact science, but it is far from that yet. Railways divide into two branches, tram ways, or trammel ways, in which the guiding power is on the rail, and railways proper, in which the guide is on the wheel. A commoner division is that of steam locomotion and animal locomotion, the structure varying with the loads to be borne. The railway is better than the trammel way, for several reasons, as it keeps clearer from dirt and obstacles, and engenders less friction. The mechanical principles which should govern the construction are the same in all cases.

As the object of a railway is to lessen the obstructions to the movement of rolling wheels, we may consider the rail and wheel as man and wife, not to be treated apart, for as a bad wife may make a miserable husband, so a bad wheel may spoil a rail, or *vice versa.*

The first thing to desire in a railway is that it should be as nearly as possible a horizontal plain, straight, and parallel between the rails.

Secondly. The rails should be virtually inflexible under the rolling loads. In making a girder bridge over a stream it is necessary that the depth of the girder should bear such a proportion to the length and load that it will not deflect in the opening. A rail is, or should be, a girder, likewise non-deflecting, and if the support below it be a yielding material, or solid discontinuous supports, the rail must be deep enough not to bend between the supports, or upon the unfirm material, or the result will be a line constantly out of repair, needing what is called maintenance of way and increasing resistance to traction. The pressure ought to be equally distributed, by the absence of flexure, and this can only be done by depth.

Thirdly. The rails should be laterally inflexible, or great friction will ensue by the rocking of the engine and carriages. They should be laterally straight, or a continuous sinuous movement will take place.

Fourthly. The junctions of the rails should be so arranged that while allowing for expansion and contraction the strength of resistance, both vertically and laterally, should be as great at all the joints as at the intermediate portions.

Fifthly. An efficient connection should exist between the two opposite rails, to keep them parallel.

Sixthly. The surface of the rails beneath the wheels should be so hard and tough that they will neither crush nor laminate beneath the rolling loads.

Seventhly. The bearing surface of the rails or supports on the ballast, should be of such area that the rolling loads will not disturb it.

Eighthly. The height of the wheel surface above the bearing surface on the ballast, should be the minimum, while the bearing surface is the maximum.

Ninthly. The rail should bed into the ground, to keep it steady laterally, and prevent rocking.

Tenthly. The depth of the rail below the bearing surface of the ground should be so much in excess of the rise above the ground, as to constitute a suspensive principle, in opposition to the principle of a prop, which is the common mode of structure. Where only light loads are required, the prop plan may be used for convenience, but it is not the form of greatest permanence.

Eleventhly. In maintaining the line of way, care must be taken to provide good drainage for wet weather, and easy means of watering in dry weather.

The construction of any railway, great or small, and its mechanical fitness may be tested by these rules. Various modes of construction may be used, but all should be firm without loose jolting, and though timber sleepers have their advantages, no doubt greater permanence may be attained by an iron structure. Cast iron, if in sufficient masses, will do, but wrought iron is the best, and to absorb mischievous vibration, loose timber blocks, analogous to wood-paving, and not structural, may be applied as a portion of the ballast at a cheap rate.

In laying the rails of permanent way, the upper or wearing surfaces are placed at an angle with the horizon of about one in twenty, in order to keep them parallel with the coned peripheries of the wheels.

Railway wheels are a peculiar structure, found only on railways and for common roads in the very rudest countries. They are not wheels in the proper sense of the word, the two wheels being keyed fast on a shaft analogous to a garden roller. The result is, that if they be of equal diameter, they have a constant tendency to move in a straight line; if of different diameters, they have a constant tendency to move in a curved line. To compensate for this evil, the peripheries are made in a coned form, of smallest diameter outside. This is said to compensate for curves, by the tendency of the centrifugal force to throw the outer wheels on their largest diameters, and the inner wheels on their smallest diameters, corresponding to the varying lengths of rail, *i.e.*, the wheels are supposed to move sideways. If they do this, they, of course, take the carriage with them. But the curves on a railway are not mere large curves, but an incessant series of small curves, varying with the position of the rail, the tread of the wheel being sometimes on the inner and sometimes on the outer side of the rail, and the glint which may be seen on the surfaces of the rails, is a sure indication that rubbing and burnishing, as well as rolling, is taking place; in short, even upon a straight line, if the cone of the wheel accurately fits the pitch of the rail, a constant grind must take place by the varying diameter. The wheels are really friction wheels, till by rubbing they diminish their bearing to something like a knife edge. How far this conical bearing is an advantage to the engine driving-wheels in giving adhesion, and how far it is an evil, can only be proved by trial against cylindrical wheels and level rails. The probability is that it is an evil.

That it would be an advantage to have cylindrical wheels for mere bearing-wheels there can be little doubt, for the purpose of running on a straight line; but the cylindrical wheels would be a disadvantage on a curved line, unless one were of smaller diameter than another, corresponding to the curve.

* "A pamphlet just published, entitled, the 'Iron Ways,' will be read with satisfaction by proprietors of railway shares, for its hopeful anticipations of what may be effected towards a restoration of profits by the adoption of light and frequent trains. It also contains a number of suggestions on the general development of traffic, which, in point of ingenuity and completeness, as well as in the faith they exhibit in the extent to which the public would avail themselves of increased facilities, resemble the original Post-office plans of Mr. Rowland Hill."—From the *Times*, Jan. 25th, 1850, Money Article.

"Redemption of the Railway System. — The author shows how the railway world can be rescued from its difficulties, and how the extension of a more manageable railway system, by its minuter ramifications into the very farms, would reconcile farming with free trade, as it would make transit easy both for produce and locomotive farming apparatus, and would thus bring a full manufacturing power and activity into the heart of agriculture. But although the view is put forth by a practical man, its reasoning is so clear, and its method of attaining the proposed end is so direct, that railway folks will pronounce it unpractical.' "—From the *Spectator*, Feb. 9th, 1850.

But permitting each wheel to revolve independently of the other, will solve this difficulty. Not with a fixed axle, as that would involve risk in case of heating. But with the axle revolving in the carriage boxes, and the two wheels revolving on the axle, there will be not merely a complete removal of curve friction, but a far greater degree of safety, inasmuch as if the axle heats, the wheels will revolve, and if a wheel heats the axle will continue to revolve. In ordinary practice the wheels will not revolve, as the friction of the axle will be less, but each wheel will revolve just so much as will compensate for the curves and irregularities, and the torsion of the axles will cease.

To illustrate these movements there is on the table a box representing a waggon frame and four sets of model wheels. One set are keyed fast on the axles, and are of equal diameter, one of them being shown as a disc wheel. These wheels, if placed beneath the waggon body, will move forward in a straight line.

A second set have the wheels keyed fast on the axle, with larger diameters on one side than the other, in the proportion of 18 to 15. These wheels, placed under the waggon-body, will, by reason of their varying diameters, roll on one side, while they sledge on the other, creating great friction.

A third set are of equal diameters, and all revolve loosely on their axles. These will run with the minimum of friction, either on straight lines or curves, and without regard to varying irregularities of the rails.

A third set are of equal diameters, and all revolve loosely on their axles. If they be placed under the waggon-body they will run nearly as freely as if of equal diameters.

But if the first set of wheels, of equal diameters, and fast on the shafts, be placed under a waggon body, so that the axles are not parallel to each other, the resistance will be very largely increased. In this case, also, the loose wheels will materially diminish friction and facilitate movement.

If, again, the two wheels on a side be not in the same plane, as when a blow sets the framing out of square, that also will generate friction, and retard the carriage. In this case, also, the loose wheels greatly facilitate movement.

In all cases the boss or centre of lever wheels should be as long as half the diameter, to prevent wear.

It has been alleged that loose wheels involve risk of getting off the line, by their free movement at points and elsewhere. This is only saying, in other words, that the more perfect the construction of the sledge, the less chance there is of the carriage moving freely. If curves be too sharp they should be provided with guard rails. But the simplest answer is, that loose wheels have run, and still continue to run, in France, where "they manage these matters better," both under engines and carriages.

With loose wheels accuracy of diameter is not required, and with fast wheels, however accurate they may be made at first—though they commonly are not accurate—they rapidly become inaccurate in wear.

Apart from the mechanical fitness of loose wheels there is an important commercial question. Of all forms of matter relative to packing and transport, railway wheels fixed fast on the axles is the very worst. It measures more with less bulk than any other known form, save empty packing-cases. With the wheels loose from the axles they may be packed in a small space, and they will be less liable to damage.

Between the wheels and the load should be placed efficient springs in all cases; but this is not a present question.

It is a common remark by persons of not very logical minds, that a thing is very well in theory but will not do in practice. If this mean anything, it is that the theory is a false one. A man putting forth a false theory may do so either honestly or ignorantly, and in neither case ought he to be implicitly trusted; but precisely the same remark applies to those who refuse to admit a true theory, or who suffer a true theory to fall dead for want of application. To the clear perceptive mind the true theory is as true and certain as the demonstration by practice.

To illustrate the theory of rails which I have set forth the large model on the table represents a rail of girder form, deep and wide, to give vertical and horizontal strength. The top of the rail is elevated less than three inches above the bearing on the ballast, while the width is 13 inches, or a proportion of about 26 to 5 in favour of steadiness. The total depth of the rail is 7 inches, and of this 4½ inches serve as a keel, to give additional steadiness by holding laterally in the ballast. The tie bars keep the gauge. The packing is very accessible, and the rail is really reversible. The rails and side brackets break joint mutually, and the manufacture is easily producible, and any part can be replaced without much waste. There are but four parts or types, and the commonest labourers can lay them down without error, while the whole is of wrought iron, and there is no timber to rot, and no mechanical work to do on the ground.

There are three other models—one of a bracket joint for a double head rail, increasing the mechanical efficiency and decreasing the cost. A second model of a similar joint for a mid-ribbed rail, to give lateral stiffness and resistance. The third is a girder rail and joint to be applied to cross sleepers or to detached blocks. This rail is very stiff, both vertically and laterally. All these are applicable to locomotive lines.

The bridge rail and joint with the tie bar are applied for laying down on the surface of the ground, or for cross sleepers. The rail is rolled with two lower ribs forming angles, over which the sides are drawn close by the bolts, clipping both rails and tie bar as firmly as a vice. The rail is thus deepened vertically, and rendered stiffer. The gauge is shown as 2 feet 6 inches. The rail is adapted to lay down without sleepers on the surface of the ground, and may be easily widened by longer tie bars. There is no timber or sleeper needed, and the rails may be moved at a moment's notice. The firmness of the joints makes the rails practically continuous bars. This rail is perfectly well adapted for horse traction, burying the joints in the ground, and leaving the rails to bear on the surface, or placing detached blocks of wood below them. The waggon wheels are to be cast sheaves, from 15 to 18 inches in diameter, and a single spring connecting the ends of the axles together on each side. The waggons will carry a load of 30 cwt.; or a lighter rail, on the same principle, may be used to carry 15 cwt. This same rail and joint increased one-half in size, and placed on cross timbers, would make the strongest, firmest, and cheapest of ordinary lines of way. Used without sleepers it would be found the simplest application for army and fortification lines, perfectly manageable by ordinary soldiery, and also for mineral and for agricultural lines, where horses are used.

This bridge rail joint has now been in successful use upwards of six months on one line, and is about to be laid down on four others. The bracket-joints are laying down on four lines.

Models are shown of these brackets full size, as applicable both to joint and intermediate sleepers. Mechanically this arrangement makes the rails much firmer, as they are lowered two inches on the sleeper; the undersides are not damaged by resting on chairs, so that they are really reversible; there are no pegs to get loose, and the weight of metal is considerably reduced as compared with the chair system.

An apology may be due for the prolixity of this detail, but upon the specific question of wheels and rails depends the result of profit or loss in railway transit.

And this brings me to a very important consideration of the question at issue. Colonel Cotton compares canals as they are, with railways as they are. But there is a manifest distinction. Canals, during the lapse of time

from their advent to the present day, appear to have exhausted the fertility of the human mind as to their perfectibility. The only further move is to convert the external haulage of the boats to an internal propulsion. But this needs a size of canal not yet contemplated. But railroads proper have, as yet, only existed 25 years, and are far from having yet attained their possible perfection. I am not going, after the fashion of Brother Jonathan, "to draw a bill on futurity and cash it at sight," but I appeal to any competent and unprejudiced observer who is familiar with the items on railways of "maintenance of way and rolling stock," whether reasons have not been pointed out why there is hope for a very material diminution in cost and working expenses. With this proximate and more perfect result, then, must Colonel Cotton compare the water transit he advocates. We are a "practical" people, so practical that we have changed the very meaning of the word theorem, and made it to signify a fallacy, so that a man must forego the gift of speech and demonstrate in materials like deaf and dumb people, ere he can gain credence. He must not set up for a critic till he is prepared with something better than the thing he criticises. For this reason only have I loaded the table with models, which seem almost an insult to common sense, as embodying the merest truisms.

There is yet another question. The canal only follows the course of all the earliest settlements, the streams, and leaves untouched the hidden wealth of the yet desert. The railway opens up mineral and other wealth. It will, if rightly used, form a line of new streets and villages. It will bring squatters from all parts to its borders, just as the opening of the Erie canal gathered together what are called "forwarding merchants" from all parts of the Union. Yet another thing. The line of the river is very commonly unhealthy by its locality. The line of the rail will, probably, be much more healthy. The very rushing of the trains sets the stagnant air in motion.

In discussing whether a canal or railway is best, the discussion must, therefore, not wander all over India, like a desultory tribe of broken men, but must be confined logically and specifically to each given river in succession. Let us know the conditions of the river as to its amount of water at all seasons, the gradients of its bed—the obstacles in its course—soil and climate, and we can deal with the question as a calculation, whether it is desirable to make a railway or not in preference to, or in conjunction with, the rivers. All generalising, save as to theory, or laying down principles, is useless, when the question is one of fact, and of specific fact. It is as vague as the celebrated proposition. "Given the height of the monument, what is the depth of the Baltic sea?" or, to put it into an American axiom, "It is about as big as a piece of chalk."

Cotton is the staple subject. Let us know in how many localities, and of what extent, cotton grows; and, what is also very much to the purpose, in how many and what sized localities it may be made to grow along the course of the railways *in esse* and *in posse*. Whatever be the amount, there is no doubt that railways can carry it, if not on one line of rails, on two or more. With good gradients, a well-constructed engine, and waggons not damaging to the road, may transport from 100 to 150 tons nett at a rate of 15 to 20 miles per hour; and 24 trains a day might follow each other in succession without casualties: in round numbers, a million and a quarter tons per annum. But in such case only one uniform rate of speed could be permitted.

But the real cost of transit on Indian railways cannot be ascertained till a mechanically perfect system shall be adopted, and the fuel procured and manufactured on the spot, and water used in the boilers distilled by the sun, and returned in the form of rain to the Company's tanks, unimpregnated with earthy matters that destroy the boilers and impede the production of steam. Nor can the railway be properly maintained till provision shall be made for watering the road in dry weather as well as draining it during rain.

I must conclude by quoting the opinion of a very competent authority—Colonel Kennedy—on this question of canals and railways, in his work published in Calcutta, arriving at similar conclusions.

"Whilst deploring that the characteristic energy of Englishmen, which has produced such marvellous results at home, should as yet have made so little progress in the physical improvement of India, there is still one small consolation. If India has been deprived of the benefits which energy has conferred upon England, she may now profit by the experience of England, and may save a vast amount of that progressive investment of wealth, which the results we now enjoy in England have cost. There, no fewer than four successive investments have occurred to effect nearly the same object, each, in its turn, superseding and rendering almost useless that which preceded it. We have had—

"First. The defective roads of intercourse of our forefathers, crossing hill and dale, and accessible only to back-loads, or lightly-laden carriages.

"Secondly. The more civilized and profitable carriage roads of the present generation, which set the former aside.

"Thirdly. The network of canals for carriage of merchandise.

"Fourthly and Lastly. The railways of the present day, capable of doing the work of all, and with much greater profit and economy, if the errors at their introduction had been avoided.

"The position of India at this moment, therefore, enables her to save the three first progressive classes of investment, and to effect at once the 4th and perfect class.

"The national character of England, as well as the interests of about 150 millions of people, calls for an exertion both of judgment and energy in reference to this subject. It requires that the grievous impediments should be removed which affect Indian travellers of all classes, and which limit their progress to three miles an hour, in traversing the level and burning plains of this country, even in the neighbourhood of the great capital of India, and in the nineteenth century.

"The sound application of our English experience should enable us to avoid the waste that has been above referred to. It should warn us against constructing canals or the transport of merchandise, where the lines are fitted for railways. It should induce us, in opening ordinary roads in lines that are eligible for railways, to lay out all levels, curves, and fences on a principle that will admit of their future conversion to the more perfect purpose of railways without loss or waste.

"A chief head of expenditure in the construction of ordinary roads, in the plains of India, consists in the metalling. A similar class of expenditure is required for railways, called, in the phraseology of the craft, ballasting. Thus we see that without, in any way, impairing the object in view, when constructing an ordinary road, it may be suited for conversion at any time to a railway.

"In selecting the position, we have only to ascertain that we have got the right general mercantile line, which should be equally our object if we looked to nothing beyond an ordinary road. In 'laying out and forming,' we have to regard the curves and levels with great accuracy, which produces neither difficulty nor cost, in a level country like that now under consideration. We should place the fences at a sufficient distance to admit, in future, of a double line of rails; and we have to lay down our metalling along one side of the enclosed line, which will afford, for the present, a perfect horse-carriage road, and will provide a ballasted bed, all ready for laying down a *single* railway track, at any moment that we can muster the required courage and energy to scare away the phantom which is now scaring us from adopting, at once, the complete and perfect measure required.

"In the observations I have made as regards canals, I should be sorry to be misunderstood, as I believe a certain class of canals, for the purposes of irrigation alone, is quite as essential a desideratum, as is the question of railways in India.

"The canal principle for irrigation should be looked to as affording the power to increase our produce, and should be carried to the utmost extent that the economising of water can require, so that our rivers may be made to distribute their waters, and exert their fertilising powers upon the earth, before flowing to the sea. If this principle were adopted, we should not find the devastating and mischievous effects at present produced in the low inundated districts, by what are considered ungovernable rivers. But commencing as near to their sources as requisite, the waters would be, at proper intervals,

abstracted and carried into distant districts, that are now parched and unproductive, there to create plenty; and the rivers, on reaching the lower plains, instead of impeding the construction of useful works, and destroying large tracts of valuable land, &c., would be found manageable, and merely furnishing those indispensable supplies of moisture which the culture of the earth requires.

"To accomplish this desirable result on the great scale required in India, however, the principle of canals for the transport of merchandise must be separated entirely from that of irrigation canals.

"A canal for mercantile operations is a very costly structure.

"A canal for merely conducting water, as a means of irrigation, is, on the contrary, a very cheap work.

"The revenue of India could not ramify irrigation to the extent required, either to fertilise the arid districts or to economise her enormous waters by the instrumentality of navigation canals, with all their costly locks, &c.

"By means of irrigation conduits, however, I have no doubt that the vast results I speak of might be accomplished fully, and at comparatively a very small outlay indeed.

"Canal construction, therefore, I feel convinced, should be limited to the principle of irrigation—irrigation conduits, with a view to the fertilisation of the soil, and the increase of Indian produce. For the interchange of that produce, and for all other public objects of locomotion, the most efficient and economical means will be found in a judicious application of railway construction.

## DISCUSSION.

Mr. Hyde CLARKE trusted that the important subject that Colonel Cotton had brought before the Society would not be continued as a discussion between the advocates of the East India Company on one side and its opponents on the other, nor between the advocates of railways and the advocates of other means of internal communication. If the subject be rightly viewed, if we looked at it under its moral aspect, if we looked at it with regard to the development of the resources of India, we must be convinced that its resources were ample, if properly directed, to carry out every means of internal improvement— it could scarcely even be a question whether railways should be undertaken in the first instance, or canals of irrigation, canals of navigation, tramways or other roads—whatever mode be adopted, it must result, as had been shown by the evidence which Colonel Cotton laid before the meeting, in the increase of the physical and material resources, and consequently, in the means of giving a reproductive return on the future works. It was to the moral results, therefore, that he conceived we must in the first instance look, rather than to the pecuniary results, and if we measured those results upon the basis which Colonel Cotton had given us, if we looked to the saving of life which was the result of any improved means of communication, to the extension of produce and the increase of resources, we must be convinced that we should have in that development the means of carrying out all the other branches of our undertaking. It seemed to him that the cause which Colonel Cotton had taken up, had been to some extent damaged by the comparison which he attempted to draw between canals and railways. He (Mr. Clarke) did not wish to examine it as a partisan of railways, or as an opponent of canals, because he was convinced on the one side, with Colonel Cotton, that canals, both of irrigation and navigation, were essential for the welfare of India, and on the other side he was convinced that rapid railway communication was one of the most essential means for creating a great moral reform in India. But looking at it under the commercial aspect, in which Colonel Cotton had chosen to examine it, it seemed that a very great fallacy lurked in the comparison which the gallant Colonel had attempted to form. He had taken the simple figure of the fare or cost of carriage by water, and he had compared it with the cost by railway, and the view which he had attempted to give had been that the simple cost of conveyance was the whole cost which arose on the article of production in its transit from the place of origin to the place of consumption—but when we formed a comparison between a river or a canal for instance, and a railway, we had other elements of calculation to take into account, and more particularly, where a railway was concerned, we must take the saving of time in its various bearings as a very important element. And if we took the great valley of the Ganges, through which the greatest line of railway was in progress, we should find that the mere saying of interest on the original cost of the article, formed a very appreciable item in comparison between the two modes of communication—but a comparison between railways and water communication became practically incapable of exact parallelism, because the railway could carry what the river could not. Take for instance, various articles of production which do not admit of a long water voyage. It was evident that while they were restricted to water navigation, those articles could only be consumed within a small circle; for instance, all those articles which, in our own experience, were perishable, such as butter, fruit, vegetables, and all those various articles which could only be consumed in the neighbouring market-town, were now carried to every part of the country—nay, he might say, to almost every part of Europe. The moment you enabled an article to be consumed, you created the means by which it could pay for its transit. Enormous as was the traffic of the great valley of the Ganges, it was nothing in comparison with what it would be if railway communication were introduced. Numerous articles which were now left to perish in the place of their production would be carried to distant places, and would of themselves constitute important articles of traffic—but even with regard to great articles of traffic, notwithstanding what the gallant Colonel had told us, there was scarcely one of them, however low-priced, that would not pay the expense of railway transit—and he was not speaking without some consideration of the subject—because, though we were told that railways were only projected for India five years ago, yet he remembered, himself, that he was, ten years ago, asked to investigate this question of the capability of railways to compete with canal navigation, by three gentlemen—Mr. Macdonald Stephenson, who founded the Bengal system, Mr. Heath, who founded the Madras system, and Mr. John Chapman, who founded the Bombay system.* Now, on looking into all the elements, taking into consideration the cost of the article at the place of its production and at its place of consumption, it was evident that the difference between the two prices was made up, not simply by the cost of transit on the Ganges, but likewise by the interest that was saved or lost on the other side, by the circumstance that the article could be brought to market under any conditions, and the fact that it could be carried to market in safety. Now, with regard to cotton the gallant Colonel must be perfectly aware that under the present imperfect modes of communication, cotton was subject to deterioration and loss in the course of its transit; so that though we might start with a cargo of cotton of a certain nominal weight, we should find, before we got it to market, a great quantity had disappeared, in one form or another. If carried by beasts of burden, the very animals consumed it if they could get at it; it was subject to injury on the river; it was exposed to theft on the road—whereas, in carrying it by railway, it was brought expeditiously to market, without injury, and therefore there was a greater gross return than there was in carrying the same article by an apparently cheaper mode of transit on the river, or on the canal. But there were likewise commercial considerations which would preponderate with the merchant, and would induce him to give a preference to the quick mode of transit. The mere fact that an article could be brought rapidly to the port of shipment would determine the question, whether it should be conveyed at all; it did not become a question whether it should be conveyed by

* Practical and Theoretical Considerations on the Development of Traffic in India. Weale, 1845.

road, or by the Ganges, or by a railway, but whether it could be carried from the port of shipment to the market at the right season, or whether it could be carried at all. Therefore, instead of limiting ourselves to taking the cost of conveyance on the river Ganges, and the penny a mile on the railway, we must take into consideration the whole of those varied circumstances which influenced the producer and the merchant in determining whether they should deal in the article at all—but if we were to limit ourselves to this pecuniary investigation, and to determine whether or no we should give India a particular class of communication, because we thought rivers or canals were cheaper, we should evidently exclude that far higher consideration, the effect which a railway system would have on the development of intercourse among the Europeans and natives of that great country. If we only looked to what the electric telegraph had done to the present moment, chiefly for political interests, but which it would in a short time effect for commercial interests—we must acknowledge that a great lever had been applied to the moral organisation of India which would realise the greatest results. But when you could give the Europeans of India a means of communication with every part of the peninsula, you would thereby increase vastly their moral power. Government had been in the habit of looking at it with the view that it would enable them to use a smaller body of troops, because they could be readily moved from one garrison to another, and to the place where their action might be needed. But if we looked at it with regard to the moral garrison of India, that was, the English officials and the English residents in the country, we should see that the railway would extend their influence to a far greater degree than at present. We had been told by some of our Indian friends of the great loss of time incurred in travelling from one station to another. That loss of time and money must be measured by the loss to the natives of India. If the European community which, after all, was the great centre of civilisation in India, could be made more effective in its action, we might be assured that it would so leaven and excite the native community, that we should have the means of carrying out not merely the projects of the gallant colonel, but those of the railway gentlemen who had advocated their respective schemes during this discussion. But there was one very important economical consideration connected with the effect of the railway system in India. It was one which we might appreciate to a small extent by its effect in this country. If we looked at what was going on in the market towns, but still more sensibly in the western parts of Ireland, we should find complaints of the rise of prices of common articles of consumption. and also the necessaries and luxuries of life, originating in the fact that those articles were carried off to the great manufacturing towns and the metropolis, and we must observe that the effect was not the obtaining an average price between the low price which subsisted in the distant towns, and the high price which prevailed in the great towns, but it was a general raising of prices throughout the country. Now that was a result which we should certainly achieve in India, from the moment we could apply, not simply the ordinary means of communication, but good and effective railway communication throughout India. And see in what way this raising of prices would act upon the condition of the population—see how it acted in the west of Ireland. By the mere fact that you raised in their markets the cost of their articles of production, the agriculturists of Ireland were more easily enabled to purchase improved agricultural implements, and to exchange their products with the rest of the country. So long as the west of Ireland was in that condition that meat was 3d. and 4d. a pound, and the wages of day labourers 4d. and 5d. a day, they were not able to obtain a good exchange for their produce; but now that you had raised the value of their productions and the wages of the labourer, you had obtained great consumers for the manufactures of this country, and that was one great result which you would obtain in India and upon a far greater scale, because you had to deal there with upwards of 140,000,000 of people.* He would not detain the meeting longer in enlarging upon these points, because there were many gentlemen who could speak upon this subject much more ably than he could, but he had had an opportunity of considering many of these questions in connection with railways and telegraphs in India practically, and he should regret if a discussion so important degenerated into one between the advocates of particular modes of communication.

Sir Frederick Abbott remarked, this was the second time this very important and interesting subject had been under discussion before the Society, yet, he was sorry to say, they appeared to be just as far as ever from the point which they wished to arrive at. Col. Cotton had laid before them a very remarkable paper, in which he appeared to regard the increase of the means of internal communication in India as the great desideratum for benefiting that country, and, as far as he (Sir Frederick Abbott) understood it, Col. Cotton had laid down two propositions, in which all his views appeared to be condensed. First. That it was necessary for the welfare of India that they should pervade every district with a system of cheap communication and transit for goods; and second, that water was the only mode of transit that could be given to India with any sort of advantage.

Col. Cotton—As the main lines of communication.

Sir Frederick Abbott would refer to the gallant gentleman's sixth proposition, wherein he stated, "Nothing but canal or river communication can provide India with sufficiently cheap transit for its long distances and the small value of its main articles of transport."

Col. Cotton—As the basis of communication.

Sir Frederick Abbott—That meant that the trunk communication must be by water—flowing rivers or canals—which, in both cases, would require to be navigated by steam-boats of large capacity. Then he understood the lateral communications might be minor canals or railways, or by the ordinary country roads, made traversable from end to end by bridges. Up to this point the discussion reminded him of the proposition which Charles the Second put to the Royal Society of London in its early days, viz:—"Why a fish out of the water weighed more than a fish in the water?" They set to work to reason the subject, but never thought of putting the proposition to the test to see whether it was the case or not; and so it was with the present system—they had not tried to prove Col. Cotton's system to be correct. He thought the only mode to be pursued in endeavouring to come to a satisfactory conclusion on the subject, was to ask the gallant Colonel to answer questions that might be put to him as to the feasibility of the system of communication which he proposed, and if that proposition were acceded to by the chairman and the meeting, he thought they might arrive at something like a proper view of the case.

The Chairman was sure Col. Cotton would be happy to answer any questions put to him.

Col. Cotton—Quite so; any question whatever.

Sir Frederick Abbott—Then he would ask Colonel Cotton whether it was intended that the system should be applied to the whole of India, or whether it regarded merely the peninsula of India, and not the plain districts?

Col. Cotton—Upon this I have said, "All the districts, certainly, could not be improved in exactly the same way as Rajahmundry, because it is a delta, and has peculiar advantages both for irrigation and water communication, but they ought all to be improved on the same principle; thas is, *every advantage should be taken of the peculiar natural facilities of each district*, to supply it as quickly as possible with these two grand requisites—irrigation and cheap transit."

* The railway and canal being simply a result of labour, the construction of public works in India becomes no longer a complicated question of capital, but a simple application of local resources.

Sir Frederick Abbott said, then he would ask where was the river that could be made navigable for steam-boats of large capacity, to any extent? Then take the case of canals—either flowing or still-water. A still-water canal, in a tropical climate, would become clogged with weeds, or fœtid; therefore they must, in a country like India, resort to flowing canals; and when the action of the steam-boat wave was superadded to the erosive action of the moving water, the soft, sandy soil would never be able to retain the proper form of bed. These were some of the difficulties that had occurred to him with regard to Col. Cotton's plan, which could not be applied to the whole of India, but must be taken as applying to a particular part, and not to the whole country. He would ask Col. Cotton whether he applied his plan to any particular part?

Col. Cotton said, there were at present two large rivers navigable during the whole year round, the Indus and the Ganges; and had 10,000*l*., or 1000*l*., or even 100*l*. per mile been expended upon improving the other rivers of India, most important results would have been effected.

Sir Frederick Abbott—The Government is ready to do so if a favourable plan is laid before them. A celebrated engineer was sent out to make a project for improving the navigation of the Ganges.

Col. Cotton—I have been writing with all my might for the last twenty or thirty years to press upon Government plans for the improvement of India by means of public works, but I have almost invariably been snubbed, and I never got an opportunity of speaking out upon the subject till I did it here, and now I am ready to answer any question that may be put to me.

Sir Frederick Abbott would ask Colonel Cotton how he would control such rivers as wandered through wide beds of unfathomable quicksand, and make them navigable for steamers of large capacity.

Colonel Cotton had laid down a plan in the works that he had published. There were different ways for different rivers; but the main point was to do first what could be done in the beds, and the next thing was to store up water so as to increase the supply in the dry season.

Sir F. Abbott—"Store up the water of the Ganges!" Was there anyone here who had stood on the banks of the Ganges—

Mr. Davis objected to this catechetical style, and moved that this cross-questioning should cease.

The Chairman remarked that to pursue a system of cross-examination would be at variance with ordinary practice at these meetings. If Sir F. Abbott knew any objection to the views before the meeting, and would state them, he (the chairman) was sure that Colonel Cotton would reply to them when his turn came.

Sir F. Abbott would bow to the decision of the chairman, and would then briefly refer to one or two objections which occurred to him in the plan of Colonel Cotton. He had already said that the plan was to provide large trunk water communications for India. He was confident that in one part, including one-half of India, this could not be carried out. Water trunks of communication must be either canals or rivers. Canals might be of two kinds, flowing or still water. He would say that many of the rivers of India are of a nature that they could not collect the waters in sufficient body to form navigable streams for boats of large capacity. Colonel Cotton had said that large boats did navigate the Ganges; but he (Sir Frederick) had never seen any large steamers upon the Ganges. An engineer, who was well acquainted with the character of the Indian rivers, and had written much upon them, sent out a plan for boats to waddle, as it might be termed, over the sands when the water failed. Colonel Cotton's plan might be a very good one if the rivers of India were like the Mississippi. Mr. Ayrton had very correctly stated, that during three months of the year they were enormous floods, and for eight or nine months they were merely miserable streams. It was very different to the streams they were ordinarily acquainted with in England and America. Such waters might be easily collected and made subservient to the purposes of commerce by a little engineering skill; but what could they do with rivers whose beds extended over five miles of shifting sands. Mr. Simms had proposed the erection of groins, and he (Sir Frederick) had seen the plans of them, and whilst he was engaged both as military and civil engineer in the Western provinces of India, he found it would be cheaper to turn the whole course of the Ganges into one bed than to apply these groins; and that was not the worst. It was found that in the moveable banks of the rivers the groins would not remain, or that the river would form a new channel. Where they caught a river upon a rocky bed they might control it; they must then go to the rocky head of the river and then they might control it; but then the supply of water in most cases would be very limited and insufficient to carry steam-boats of large burthen—he meant in the peninsula of India. He could understand that it might be so—in a hilly country; where we caught the river between rocky banks, we could control its waters and turn them where we pleased. In such a country, too, where the chief obstacles to navigation consist of interposing rocks, any judicious expenditure of money would produce a certain and a permanent effect. But how could the same remedy be applied to the plains of India—to that vast region extending from the Indus south-eastward to the Burhampooter river, from the Himalaya Mountains southward to the Vindhaya range, a tract of country comprising more than one-half of our Indian possessions. There the case was entirely different. There we could not control the rivers which, during eight months of the year, meandered in shallow streamlets.

Mr. Carnac Brown would call attention to the observation which had been made, that the rivers of Upper India were unsusceptible of canalisation. He thought that was the purport of the observations of the last speaker. He would ask whether one of the greatest achievements of the present age, both as to magnitude and as a work of art and science, did not consist in the diversion of a portion of the Ganges into the Great Ganges Canal, which was accurately described to them at the last meeting as being 850 miles in length; and he would ask whether that was not a canal of irrigation as well as of navigation.

Sir Frederick Abbott—Not for steam-boats of large capacity.

Mr. Brown said it was no answer to the general proposition, to say that large steamers did not ply upon that canal; but there was a case in point, that a river in the country of which the gentleman who last addressed them had spoken was susceptible of canalisation. With regard to the other part of the proposition, he would ask whether the Punjaub, the country of the five rivers, was not capable of being intersected, from the base of the Himalayas to the Indus, by canals drawn from these rivers; and yet they were told that the provinces of the upper part of India were not susceptible of canalisation.

Sir F. Abbott was perfectly aware that canals could be made in Upper India; he had been associated with many such works, but he contended that these canals could not be made navigable by steam-boats of large capacity on the canals with which he had dealt. The rivers which fed them were diverted from their channels as they broke through the lower range of the Himalaya chain, but the supplies generally were not sufficient to give navigation for large steamers. Lord Ellenborough objected to sanction the Great Ganges canal unless Sir Probus Coults would promise to render it navigable for steamers to Allahabad, which could not be done.

Capt. Andrew Henderson said, allusion having been made to the desirableness of confining the discussion to the means of developing the resources of India by the

diffusion of information based on experience rather than theoretical schemes or controversy as to plans or routes proposed, he was induced to follow the former course by the deep interest he felt in this important question, from having been upwards of twenty years in India engaged in maritime enterprise, unaided by Government. And since his return to this country he had participated in most of the practical efforts that had been made to establish tteam communication throughout the Indian seas, on the Hoogly, Ganges, and Burhampooter, and to the cultivation of tea, and its transit from the upper branches of the latter river to the consumer in England ; also in the improvements of the harbours of India, and the facilities afforded to trade by dock accommodation. The subject might be divided under three heads. First. The works on the Godavery in reference to irrigation and communication, which were more particularly the subject of Colonel Cotton's paper. Second. Other public works or private enterprises tending to develop the resources of India and improve communication. Third. The mode of carrying out those works, whether by Government or private enterprise. The valley of the Burhampooter afforded the same field for improvement to the Bengal Government which the valley of the Godavery did to the Madras Government, as the difficulty experienced in the former case might be useful in preparing for the latter. Fully concurring with Colonel Cotton in the very great advantage that must accrue to India by the extension of the means of transit, either by rail, steamers, rivers, or canals, from his own experience he doubted the immediate applicability of any one system to the valley of the Godavery, or other rivers where there was no existing traffic. The cotton and produce of these valleys found a market at Bombay and Mirzapore by costly land-carriage, but the cheap river transit calculated for the Godavery could only be attained after years of experience and improvement of the river, and an actual *creation* of the traffic that was to flow along its banks, *i. e.*, to divert it from the present land route to Bombay and Mirzapore to the valleys of the Nerbudda and Godavery, with ports at Surat and Coringa. He understood the basis of Colonel Cotton's proposal to be, that the cotton of Berar now costs 6*l* per ton for land carriage to the sea-board, and that it could be conveyed for 10s. a ton by the Nerbudda or Godavery being made navigable for some 500 miles to the port of Surat on the west of Coringa on the east coast. Against this, the advocates of the rail allege that cotton could be conveyed by railroad at some 14s. a ton—160 miles to the port of Bombay in eight hours. There might be a certain amount of truth in both these propositions, but the question of transit could only be met by a combination of both, *i. e.*, the use of river navigation as high as was practicable, and the construction of a cheap line of railway from the point where the navigation ceased. Colonel Cotton was perfectly right in saying that none but the very cheapest navigation would do. What he (Captain Henderson) was afraid of was, that gentlemen who supposed that we were to have a railway at once, were reckoning without their host. We must give time for the trade to be developed—you must first of all get ports to get rid of it. What was the use of having a railway up the valley without a port to take the produce to? It was absurd to talk of expensive locked passages for vessels; when a navigation was available from its natural state, or where a very small expense would put it in good repair, it would be, of course, right to use it. The attention of the Indian government should be directed to the improvement of places actually navigated. We were constantly hearing of difficulties attending the navigation of the Hooghly below Calcutta, and even the monstrous idea of a ship canal, 24 miles in length, had been proposed. Under the second head, he should wish to allude to many works, the undertaking of which he had himself been interested in, or in which he had taken an active part; and, as in the case of the Assam Company, he could but refer to the little encouragement the Indian government had given—a policy he hoped now to be mentioned only as of the past. One of the first of these was a proposal made, in 1838-39, by the East Indian Steam Company, to maintain a complete system of steam communication with the presidencies of India, with vessels of 2,000 tons, if guaranteed 100,000*l.* a year, or 6s. 6d. a mile, by the East India Company. The Court of Directors replied, that to any well organised extension of steam communication they would give support; on the faith of which he conducted the steamer Indus to Calcutta, and opened steam communication with Suez; eventually, the Peninsular and Oriental Company obtained a large grant of 115,000*l.* a year for performing work very much less than the service that was proposed by the East Indian Steam Company. The East India Company relinquishing all control to the Admiralty, Indian steamers were refused all participation in the trade, and to steam enterprise the revenues of India now contributed seven-sixteenths of a payment of 160,000*l.* a year to the Peninsular and Oriental Company, for eight years, and of 199,600*l.* the next ten years. This monopoly of public support effectually ruined every Indian steam enterprise, the East Indian Steam Company of Calcutta being refused any compensation for some 40,000*l.* losses incurred in first opening steam communication with Suez, although an appeal was made to the Court of Directors and Board of Control. In 1838, the East India Company wishing to develop the resources of the Burhampooter when they had relinquished the monopoly of their tea trade, commenced the cultivation of tea in Assam, and spent some 60,000*l.* or 70,000*l.* in maintaining a Government establishment for the purpose of carrying on the tea trade; after that they handed over their establishment to a Company, which laid out 200,000*l.*, and, in short, went a-head too fast, their operations being based upon calculations such as were now before us about the Godavery. But what he wanted to show were the practical difficulties that we found there. We had there a splendid navigable river; we were told that steamers of four feet draught of water could go 1,000 miles up, and that the place was full of timber. What was the result? Why we sent the appliances before the trade was there. According to the Company's officers' reports, they told us that in five years we were to have 2,000,000 lbs. of tea; that would be somewhere about 3,000 tons. We thought that we must send a steamer and sawmills to cut the timber; they were both sent there, at an expense of nearly 30,000*l.*, and they were of no use whatever. The consequence was, that the saw-mill was put on one side for ten years, and the steamboat was taken off; and after we had been fifteen years at work, we were in the best position that any enterprise could be in. At our general meeting the other day, we had a clear profit of twelve per cent., and this had been by patiently following out the experience that could only be obtained at great cost. In this instance, loss of interest might be estimated at 60 per cent. on 194,000*l.* capital invested 15 years, the Indian Government refusing all aid, even to a participation in the cost of many hundred miles of road made. Had they guaranteed the interest at 5 per cent., as now adopted with railways, it would have amounted to 116,000*l.*, to be repaid when the profits exceeded 5 per cent., which, in the Assam country, must occupy 5 to 10 years. In 1840, he took part in the formation of a Company to cross the Hooghly at Calcutta, with steam ferry bridges, similar to those now at Portsmouth. Two of these were landed at Calcutta in 1842, but the enterprise could not be carried out from the want of support from Government, and from other causes. The bridges, engines, and chains, which cost 37,000*l.* were sold for 7,000*l.* The same mode of passing that river must, he believed, be eventually carried out, the large traffic from the north-west rendering it absolutely necessary, whilst the difficulties attending the construction of a fixed bridge were, he believed, insuperable. He proposed in 1850 the construction of piers, graving-docks, and a railway, from a land-locked harbour to

Singapore, as a naval station for the Indian seas, if guaranteed the interest on 100,000*l.*; but here again they met with no response from the authorities, although the value of such a work could not be denied. From the likelihood of war, the attention of the Indian Government had been turned to this harbour, as well as to Basseen, near Cape Negrais, in the newly-acquired province of Burmah. Works were in progress to improve the bar of the Godavery at its port Coringa, which was most important as the Madras coast was, destitute of harbours. On the coast of Western India, there was a field for improvement in the harbour of Surat on the Taptee and Kurachee on the Indus. Lastly. He might venture a proposal to form wet docks at Calcutta, a question which he brought forward in 1843 and in 1844; it was taken up by the Indian Government. They appointed a committee of Government officers and merchants, who, in 1846, reported the practicability of constructing docks for 200 ships, at a cost of 500,000*l.* The site recommended was below Calcutta, on the left bank of the Hoogly, the railway station being formed opposite Calcutta, on the right bank of the Hoogly. Experience showed that docks should be connected with railways. A proposal to this effect was submitted to the Government of India and the Court of Directors, to construct docks near the railway station at Howrah, and to connect them with the steam ferry bridge, if guaranteed the interest on a capital of 600,000*l.*, which was now under the consideration of the Government. There were great advantages in India being under a form of government which could decide peremptorily on the best mode of doing things. Here in England divided interests had caused an absurd and useless expenditure of money. Everybody allowed that greater conveniences in modes of transit could now be obtained for half the money, if the Government had demanded and enforced a system. This was no excuse for the Indian Government, so far at least as a proper system for the execution of public works. The existence of a new Board of Public Works in India was a step towards the fulfilment on the part of Government of at least some of this. And this led to the question of the *mode of carrying on public works in India.* There was a general feeling among Englishmen in favour of works being carried on by joint-stock companies, but, at the same time, a strong feeling on the part of the British capitalist not to invest money in India. This arose in a great measure from the want of interest in Indian subjects, a feeling that they had no direct mode of controlling the actions of the Indian government, *i.e.*, in matters which might affect the profitable employment of capital. And this would point out the necessity and justice of guarantees in all public works. Public works should be reported on and decided by the Public Works Board. To explain the relation mentioned between the necessity for a guarantee and the political action of the Indian government, a government which was responsible for a vast sum yearly to various companies, must always be cautious in those movements of peace or war, which might affect the profitable result of those companies, and indeed this was the only mode which an English capitalist had of controlling the Indian government to his own interests. If public works were to be carried on by the Indian government, there should be a system organised for the employment of the vast army or a part of it, in a manner similar to the old Roman legionaries. There was an inconsistent action of the Indian public and press, on the question of government executing public works; if government did nothing there was a great outcry, and if money was raised, the holders of other government securities spoke of it as a "scandalous action," and as "base and unprincipled." Doubtless the Indian government would jog on as it best may, and do its duty, but these facts all pointed to the advantage of carrying on public works by means of private companies, guaranteed a rate of interest proportionate to the value of money at the time that the company commenced operations in the particular work for which it was formed.

Mr. Dickinson wished to point out one or two facts connected with Indian communications. One sentence of the last speaker would bring us to our point. He said that Colonel Cotton stated that you might get to the interior of India and get the cotton from Berar at the rate of 10s. a ton, and that the railway gentlemen, on the other hand, said they could bring the cotton from the same distance for 14s. Now let us see how far this was true. The other night we had a gentleman connected with a railway—the managing director of the Bombay railway—who told us that his railway was sanctioned to Malligaum, the centre of Berar, 160 miles from Bombay, by which he could bring this cotton from the centre of Berar to Bombay for 14s. At the present time, according to the report of his own railway company, published the next day, his railway was *not* sanctioned further than the foot of the Ghauts, here at Shawpore, Malligaum being in the centre of Candeish, Berar being there (pointing to the map), 250 miles away. That was rather an important fact. Colonel Cotton had proposed to improve this river (the Godavery), and he (Mr. Dickinson) had recently seen a report by a very first-rate engineer upon it in India, in which he said that he could improve the Godavery as far as it was requisite, making tramways up the remaining distance to the very centre of Berar, about 80 miles, he believed, for a comparatively small sum, very little more than 500*l.* a mile, and that he would do this in a single year. We had been recently led to expect that we should have peace, but it appeared by the second edition of that day's papers, and by the receipt of intelligence from the Continent, that we were no longer so certain of it. Now, bearing this in mind, it was important to consider that you could have wheat from the centre of India at a wonderfully cheap rate. There was a gentleman present who had frequently shipped produce from Berar, and had taken boats up both the Nerbudda and the Godavery, and he could corroborate him when he said that you could get any quantity of wheat at 12s. a quarter in Berar, and it could be brought to Liverpool at an excessively cheap rate. Now he thought this would become a very important question, or rather it was so at present, looking at the high price of wheat at this time. Then, another advocate of the railways said the other night, that Colonel Cotton had entirely left out of sight that the rivers on the western side of India were wholly unnavigable. You might see marked on the map the line of the Syudhnee range from Cape Comorin, stopping at these two rivers. The Taptee was not navigable, but with respect to the other river (the Nerbudda) he had a report from one of our political agents in the country, who implored the people of this country to get up a company to navigate the Nerbudda, stating that a native chieftain, Holkar, had already a steamer upon the river, which would hold 100 people easily, and he remarked upon the facility with which the natives seemed to manage the machinery; and he said he had another steamer 250 miles up the river, towed up all the way over the falls, which might very easily be converted into a navigable channel. Now, with regard to the general subject of India, there were one or two other things which we were told the other night—we were pointed to the Bhore Ghaut, and told that there was only one gradient of one in thirty-eight, and that was nothing after the Lickey incline near Bristol, in which you go up nearly a mile with a gradient of one in thirty-seven.

Mr. Nicholson.—The Lickey incline is three miles long, and it is one in thirty-six.

Mr. Dickinson continued.—Here was the report of the Bombay Railway, stating that by successive surveys they had found such an incline upon the Thul Ghaut, and they hoped, upon further investigation, to find such another upon the Bhore Gaut. It was very important to observe that it was not on this line intended to tap the cotton district, for the meeting were led to understand the

other night it was so. The same gentleman got up the other night, and drew a plan on a board, of which he supposed the map before the meeting was a more perfect representation, with all these lines, saying, "There, gentlemen, all that railway system is sanctioned! There are 4,000 miles—what can the government do more, and what can you wish for more in India?" In the first place he was sorry to say he had to contradict some of those remarks. He stopped the Great Indian Peninsular Railway at the foot of the Bhore Ghaut, to begin with; for by their own report it was sanctioned no further than Shawpore; that it was not sanctioned into Candeish, and that Lord Dalhousie wrote a minute, recommending this railway system, because he wanted to do something that should satisfy the public over here; he found it necessary to say that there should be a great system of railways in India, and that it should go generally in those sort of lines; and those sort of lines generally had been commenced, and companies had been sanctioned to begin railways upon them. In one case 100 miles had been sanctioned; in another, 120 miles, and about a thousand on the line which ran parallel with the Ganges; but the whole system, as laid down on the map, was not sanctioned. There was, however, a bit sanctioned that was not laid down, viz., the Bombay and Baroda line to Surat, which *is* sanctioned. He did not know why that was left out. When we got to Surat, however, it became again a question, how were we to get this cotton and wheat from the interior of India? At the present time we felt exceedingly uncomfortable about the possibility of the annexation of Cuba. Even if there should be a short crop in the United States we should be exceedingly puzzled to get on in this country without this Indian cotton. The question was how to get at this district. Colonel Cotton had said that for very distant traffic you could have nothing but water-transit. Dr. Lardner had previously said that the distant traffic of America was entirely conveyed by water. Now, the Indian press was so mistaken upon this subject that it said the railway traffic upon the Indian railways must wait until they got a few hundred miles into the interior for us to be able to judge of their capacity of carrying traffic; but when they did so they would never be able to carry cheaply enough to convey the long traffic down to the coast. But there was another point. Those railways had been suddenly sanctioned by the Indian government to silence the clamour in England with regard to communications in India. The clamour which arose in 1844 was silenced in the same way. They then started two lines, and he should like to show the meeting what one of those lines had done, because he was always told when he came to these railway affairs that so and so would be opened, and so and so would be done. Now, what had actually been done. In the *Indian News*, August 15th, 1854, there was an article on the Bengal railway, showing that supposing them then to have made 100 miles of railway, and to have half a million sterling in hand, which was perfectly well known was not the case at that time, they would then have spent 20,000*l.* a mile in a country presenting no engineering difficulties, without having anything to pay for the land, and incurring no parliamentary expenses—and this in a country where money was stated by the directors to be worth seven times as much as in England; that was to say, they spent a sum equal to 140,000*l.* a-mile. Now, what had they done for that? The other day they had opened a bit of it, and they had spent now about 3,000,000*l.*, equal to 21,000,000*l.* sterling in this country, and they were said to have opened up to this time 66 miles of railway, from the Calcutta terminus to Burdwan. He took this from the newspaper which recorded the inauguration and opening of the railway to Burdwan. We wanted something very much more cheap and speedy to open India, than these railways. We had 32 miles open on one side, and there were 17 more in progress to Shawpore. If that was all we could do, he really saw no help for it at all. It was a hopeless case. What we wanted literally, was thousands of miles a-year. When it was considered that this country was as large as the whole of Europe, we wanted hundreds of thousands of miles of main communications, to have them in the same proportion as we had them in Europe. As he had not heard the statement of Colonel Cotton, and his calculations with regard to the difference of price be-between water and land transit disputed, he must assume that water transit was incomparably cheaper than land transit, and in that case it was obvious that one of the best modes of opening India would be to open these great rivers. In the case of the Godavery Delta, it immediately gave rise to a transit company, which paid in the first year 20 per cent. dividend, carrying for the eighth of a penny, which he thought the railways would be puzzled to do. It was the interest and duty of England to begin with this water communication. Nothing of the sort had been done hitherto. On the contrary, the water communication had been systematically discouraged, and a case was brought before the public only the other day, in which the canals which brought the traffic to Calcutta had been neglected for a series of years, till the boats could hardly get through them at all.

Mr. Cornelius Nicholson, having been so pointedly alluded to by the gentleman who had just sat down, begged to be allowed to offer a few observations in reply, and he would refer them to the map upon the wall in order to make his case quite clear. The meeting had heard that gentleman's correction of an error into which he (Mr. Nicholson) had unwittingly fallen at the last meeting with regard to Malligaum being situated in the cotton field of Berar. He found on further examination —having addressed the meeting on the former occasion in an unprepared manner—that Malligaum was in Candeish; but he contended that, although he had made a geographical misstatement, yet, in reference to the article of cotton, that it in no way shook or affected the *facts* of the case, because the question had arisen how the cotton of Berar was brought through Malligaum to Bombay. He knew at the time he was speaking that Malligaum was a large cotton district, that large quantities of cotton was sent thence to Bombay. Malligaum, as would be seen, was situated at the junction of the two lines of railway—the main line and the branch which went into the Berar cotton district. He would put a parallel case to them. Suppose, instead of being in London, they were in India, and instead of discussing the article of cotton they were discussing the transport of iron in England. They were accustomed to speak of iron as coming from the Staffordshire districts, and in his observations he had selected Birmingham as a centre. But, then, the gentleman opposing his facts, got up and said, "There's a pretty sort of man to discuss this question, when he does not know that Birmingham is in Warwickshire, and not in Staffordshire at all, and, therefore, nothing that he has said can be depended upon." Birmingham was not in Staffordshire, and Malligaum was not in Berar; nevertheless, nearly the whole of the Berar cotton comes through Malligaum to Bombay on the backs of bullocks, by hackeries, and other means of slow transit. Mr. Dickinson had twitted him upon the statement which he (Mr. Nicholson) made on the last occasion, that the Government had sanctioned these 4000 miles of railway. What he said was reported in the *Journal*, namely:—"To the great and lasting credit of Lord Dalhousie, since he had held the office of Governor-General of India, a grand system of railway communication had been laid down, which had received the sanction of the authorities at home, and was now in course of construction." He had stated that in broad terms, and he repeated it; for it was a known fact, that Lord Dalhousie had laid down in an official report this great system of communication; and, with regard to the 4000 miles, since the last discussion on this subject he had measured the entire distance, and he found he was quite correct in representing that that system of railway communication for India had been projected, and those lines he pointed out on the former occasion.

Five separate companies were proceeding with the surveys and construction of these lines—the surveying engineers were now spread over the whole district, from Bombay on the west, to Calcutta on the east, as well as the surveys of lines which would connect the two Presidencies of Bombay and Madras in one unbroken communication. He, therefore, thought he had fully established the truth of what he had stated with regard to the railway communication already sanctioned and in progress. He would now say one word with regard to the cotton. Col. Cotton had spoken of the production of cotton in Berar in a way, from the beginning to the end of his paper, to lead to the impression on the minds of those who were uninformed on the subject, that the Berar cotton field was *the* (only) cotton field of India. And the gentleman who had just spoken, and who appeared as the disciple of Colonel Cotton, had taken up the same line of argument; for when he (Mr. Nicholson) spoke of the Bhore Ghaut being surmounted at a gradient of 1 in 38, Mr. Dickinson got up and said, "Oh! that has nothing to do with the question, inasmuch as by the Bhore Ghaut you do not take a line of railway into *the* cotton fields of India." He begged to tell that gentleman that there was a large cotton field beyond the Bhore Ghaut, as well as over the Thul Ghaut, and they must not make a communication to one cotton field merely. He would give them, with permission, an account of the quantity of cotton exported and re-exported from Bombay in the year 1853. The total quantity, from different and distant parts of India, was 217,430,000 lbs. There were brought through the British Concan 75,500,000 lbs.; from Guzerat, 79,000,000 lbs.; from Scinde, 22,000,000 lbs.; from Darwar and Sholapore, 41,000,000 lbs.; and from the Coromandel Coast, 45,000,000 lbs., making a total of 217,500,000 lbs. brought to Bombay in 1850. Therefore, when they spoke of Berar, it only produced one-fifth of the cotton of India, and it would not do to expend all the money for public works in the construction of one line of railway, or in opening out one communication. They would find it stated in Colonel Cotton's paper that Berar produced 30,000 tons of cotton per annum, which was equal to 67,200,000 lbs.; therefore, if Berar was to have credit for 67,200,000 lbs. of cotton, it was clear to demonstration that the Berar cotton, according to the gallant colonel's estimate, included that from Candeish as well. If, therefore, he (Mr. Nicholson) was wrong in fixing on a depot too much to the west, Colonel Cotton was equally wrong in fixing on a central depot too much to the east. That which was considered to be in the centre of the two districts was Kamgaum, to which place a railway was being laid out, and could be constructed, Kamgaum being about 300 miles from Bombay, and the cotton being brought at a penny per ton per mile, the whole of the Berar and Candeish cotton would be brought to Bombay for 25s. per ton, and if they could do it at that sum in sixteen hours it was more than could be done by Colonel Cotton's river communication. He wished it to be understood that he did not in any way decry river communication. It might be a great and valuable adjunct to the railways, but if they could bring cotton for 25s. per ton, that was, he thought, a mode of communication preferable to the opening up of the Godavery—as part of the cotton would then still have to be carried on the backs of bullocks, or by other means, between 100 and 200 miles to the nearest point of the river where it was navigable. He, therefore, humbly represented that railway communication was, for main lines, superior to any water communication, and they could carry railways where water communication was wholly impracticable. He would conclude with one further observation as to what Colonel Cotton had said with regard to railways not being adapted to carry goods in India, and he stated that the most carried on any railway in England—

Colonel Cotton—I did not say that. I say you cannot carry 5,000,000 tons of goods by railway.

Mr. Nicholson—The gallant gentlemen said they could not carry 5,000,000 tons of goods by railway. He would show them that they could. Colonel Cotton had given 400,000 tons as the largest amount of goods carried on any railway in England, as he would quote from the printed paper:—"The most crowded railway in England only conveys about 400,000 tons." "On the East Coast of England, 3,500,000 tons of coals alone are conveyed, and, *probably*, 8,000,000 or 10,000,000 tons of *goods* in all, while on the Great Northern Railway only 400,000 tons, as before stated, are carried." He (Mr. Nicholson) had been, that morning, to the offices of the London and North Western Railway, and had obtained returns from their books, which showed that during last year 5,114,259 tons of goods, merchandise, and coals, were carried on that line! That was thirteen times the quantity of goods traffic that Colonel Cotton said had been carried on any railway in England.

Mr. Beardmore asked how many miles that had been carried?

Mr. Nicholson—500 miles, or more; but only *half* the length of the Bengal line.

Colonel Cotton said this was a remarkable point, and, perhaps, he might be allowed to notice it at the present moment. The railway returns constantly gave an account of so many hundred thousands, or so many millions of tons of goods conveyed on the line; but what did that mean? Did any one know? He was sure the gentleman who had just addressed them did not know. The railway mentioned was in fact a vast system of railways, of 640 miles in length. This was the total number of tons of goods entered for conveyance on those railways—some being carried to places 20 miles from Euston-square, and others to more remote distances, but the average receipts for goods, as stated in the railway returns, gave about 29 miles as the average distance which each individual ton of goods was carried; thus, upon a line of 640 miles in length, the goods were carried on an average 29 miles each ton, or about a thirty-fourth part of the total length of the railway, and, if they calculated, they would see that the average quantity over each mile was 200,000 tons exactly. When he was speaking of what a railway could carry, he spoke of the quantity of goods that passed over any one part of the railway—not 20 miles here and there, and added up upon the whole length of the line. He repeated that the average quantity carried over each mile in the case mentioned, was 200,000 tons.

Mr. Nicholson said that explanation did not meet the case he had quoted from the paper.

Mr. R. W. Crawford said he had very little privilege to address the meeting, because he was not present on the former occasion, when this subject was brought under discussion. In fact, he hardly knew upon what the discussion was, as it had received very little elucidation from the turn which it had taken that evening, but he would offer one or two remarks with reference to the East Indian Railway, with a view to dispel any erroneous notions that might have been formed with regard to that undertaking. Mr. Dickinson had stated that 66 miles of that line only were opened. It so happened that the number of miles at the present moment in active operation was 122, and the number of miles which the company were under contract to complete was, he believed, 946, or at all events between 900 and 1,000 miles. They were under contract to complete and deliver over for the public use, in entire operation, the whole of that immense line before the end of the year 1860; and so far did the public in India sustain the company in their endeavours to that end, that contracts had been entered into for the execution of the earthworks which would complete the whole distance before the end of the year 1857. He maintained that whatever might be the opinion of some persons as to the extent to which railways had been constructed in India up to the present moment, there was a great prospect of an enormous system of railways being

in active operation there before many years were past; and his own experience of that country justified him in assuring this meeting that the amount of traffic would be to an extent and degree which the people of this country were hardly able to appreciate. With reference to the cotton districts on the western side of India, it was true, as stated by Mr. Nicholson, that there existed a large cotton-field there, which the proposed railway connecting Bombay and Madras was intended specially to serve. And there was another point which he thought had been a little overlooked, that was, that as the traffic of that part of India at the present time was carried on almost entirely by animal power, and as one of the limits to that traffic was the limitation of the animal power, so when these railways were opened an immense number of beasts of burden would be set free from their present occupations, and would contribute very largely to carry on communication between the places in the district where the produce was grown, and the lines of railway as they were gradually opened up. A gentleman had stated that wheat could be obtained at 12s. per quarter in the neighbourhood of the Nerbuddah, but he (Mr. Crawford) believed he was correct in stating that it might be purchased at a cost of 9s. per quarter, and even for less than that: and he had no doubt that when the railway of which Mr. Nicholson was the managing director was in operation, a large amount of wheat, linseed, and various other productions of the country, would be brought upon that line. To talk of canals in that part of the country, there were not the means to make them; and as to the Nerbuddah being made navigable, and the gentleman who had sailed up and down the Nerbuddah, if he had sailed on it for any useful purpose, and with any good practical result, he (Mr. Crawford) would be exceeingly glad to find such had been the case.

Mr. R. F. Davis remarked, that gentlemen evidently came there with preconceived notions, and instead of discussing the best means of developing the resources of India, it amounted at present to a discussion between the managing director of a railway in India, as to this, and the secretary of the India Reform Association, as to that: while, to use the language of Burke, "the subject which embraces all mankind is given up to a mere party." The subject before them was the benefit of India. Col. Cotton had stated certain plans. Those who knew Col. Cotton knew that he was, as all men must be more or less who set themselves down to work a great reform, a man of determination—a man, to some extent, of one idea; and following out that one idea, if he had gone a little too far to suit the notions of some of them, they were not, therefore, to say, "all was wrong—and this is the only way;" and because they thought they had got something a little better, to decry the plans of Col. Cotton altogether. The common-sense view of the question was this—there was a saying now very much in use—"the right things in the right places." He had studied India a great deal. He had many friends resident in and largely connected with India, and although he had not a practical acquaintance with the country, yet, having as he had said, studied the subject for many years, he had come to these conclusions—that India required improvement in her water communication to the utmost extent possible—improvement in her country roads. There was a specimen of those roads before them [pointing to an illustration of the present condition of roads in India on the wall] — improvement in communication by means of railways. He was himself a warm advocate of railways in India; but when gentlemen got up and said—nothing but the East Indian Railway, and nothing but this or that would do for India, and all that Colonel Cotton had advanced was wrong, he (Mr. Davis) came to the conclusion that those gentlemen were all wrong themselves. The gentleman who spoke last had said that when they got railways in India they would set a large amount of animal power free. He (Mr. Davis) was quite aware of that; but whilst they were speaking of railways for India, they must regard them with different eyes to what they looked at them in this country. On the other side of the Atlantic, they did not find Brother Jonathan laying down railways through what were once trackless wastes, but now smiling homesteads, with rails of 60 lbs. or 80 lbs. to the yard, but the object there was to lay down cheaply-constructed railways, and to bring them into operation as quickly as possible. That was what was wanted in India; instead of laying down 200 or 300 miles of railway, at a cost of 20,000*l.* a mile—

Mr. Crawford—10,000*l.* The East Indian will be made for that.

Mr. Davis believed that as much as 3,000,000*l.* had already been spent upon 127 miles; and, he believed, the cost would be nearer 20,000*l.* per mile than 10,000*l.* What the people of India wanted was cheaply and expeditiously constructed railways, and he would say, the man who introduced cheap railways into India would be a benefactor to that country. They did not want 300 or 400 miles of railway, to go at a speed of 40 miles an hour, but they wanted thousands of miles of cheap railway, to go from 10 to 15 miles an hour, which was quite fast enough for any purposes in India. It was very well to say that any particular part was the centre of the cotton district; it was, in fact only the depôt, and the quicker they made the railways of the kind he had advocated, the sooner would they get the cotton, the wheat, the rice, and the other productions with which India was teeming, which we in this country were very much in want of. One gentleman had said, that canals could not be constructed, but they found that that gentleman was running his head against something which Col. Cotton had not said. The question of large steam-boats on the canals had been introduced, which idea, it seemed, had not entered into the mind of Col. Cotton in the consideration of this subject. The object of the gallant Colonel was not merely to span the rivers with bridges, but also to carry fructifying waters to those parts where they were needed; and he (Mr. Davis) considered that canals in India ought to be encouraged to the fullest extent possible, as works of communication and also of irrigation. Col. Cotton had been twitted with the remark, that in this and that district it was impossible to construct canals; and no doubt Col. Cotton had never sat down to entertain the idea of carrying canals over the mountains. But what Col. Cotton said, and what he thought they must all agree with, was that the Government had been lax in carrying out public works in India. After repeated goadings from the public, they at length gave their sanction to a certain system of railway. He (Mr. Davis) called upon the Government to do the same with regard to the rivers of India, in order to give communication of all kinds with the interior of the country. He called upon the Government to spend the public money also upon works of irrigation, and not to spend the whole of the public money upon these great lines of railway. If they could assemble in that room the more intelligent portion of the people of India, he was sure they would say, "Don't give us 40 or 50 miles of high-speed railway here and there, but give us thousands of miles of cheaply-constructed railways, to go at 10 or 15 miles an hour." The public money had been spent upon one grand project, which, he contended, was not suited to the peculiar wants and requirements of the country. They called upon the Government to improve the river navigation, to improve the canals, to improve the irrigation, to improve the means of internal communication, and not to exhaust the pecuniary resources of the country in a project which was not adapted to the land in which they lived.

Mr. Ayrton presumed that the gentleman who last addressed the meeting had never been in India, or he thought he would not have displayed the facility he had in devising plans for the advantage of the people of that country. The gentleman had, in a manner, come forward as the representative of popular opinion in India; but he (Mr. Ayrton) thought those who knew him would, perhaps, re-

gard him as a better exponent of the opinion of the natives on these matters. He would mention one circumstance, to give them an idea of what their views were. He believed the largest original shareholder in Indian railways, either here or in India, was a native of that country, Sir Jamsetjee Jeejeebhoy, whose capacity to appreciate any project for promoting the welfare of India he would place in the scale against that of the whole school of Young India; in fact, the subject of railways in Western India was taken up by those who had advocated them in Bombay, not as a matter of speculation, but entirely with a view of benefiting the country, and all the principal native and English merchants in Bombay had co-operated in the undertaking. He had imagined that he was invited to attend these meetings because he was supposed to have studied this subject, which, in fact, he had done, having taken it up before any movement was made on the part of the Government, in order to impress upon the Government its duty towards the public of India, and, at that time, now about 10 years ago, he rather startled people by saying the time was not far distant when the Government must be prepared to spend millions of money upon railways in India. He was thought to be an enthusiast, and speaking at random, but the result, even in that short space of time, showed that he was not far wrong, for they found that a sum of no less than 17,000,000*l.* had been guaranteed by the Indian Government for railway operations in that country. It was a mistake to suppose that these enterprises could be wholly carried on without the support of the Government. It had been tried and failed. It was not Mr. Chapman who first suggested the idea of railways for Western India, although he originated a company during the railway mania here, but Mr. George Clarke, a civil engineer in Bombay; and from that time forward communications were carried on with the Government, pressing the subject upon its attention. The promoters of railways had only considered what was best for the people of India, and the natives having the largest commercial dealings and the greatest knowledge and experience of the wants and circumstances of the country had duly appreciated their efforts, and, therefore, he was surprised at a gentleman bringing before a learned and scientific body like this, not only positive propositions for districts with which he was no doubt acquainted, but negative propositions for districts of which he probably knew nothing. He would call attention to one or two points in the gallant colonel's paper, to show how lightly he had arrived at his general conclusions.

Colonel Cotton—I have taken 30 years to arrive at them.

Mr. Ayrton—Certainly no conclusion with regard to the Indian railways could have been come to, or thought of, 30 years ago. It was stated in the colonel's paper, that transit by steam on canals would be the most economical means of conveyance. Now, it would be found that steam navigation already existed, under the most favourable circumstances, on the Ganges, but it appeared, by the list of rates in the colonel's paper, that the cost of steam transit in the Ganges was 3d. up the stream, and ¾d. down, making an average of nearly 2d. per ton per mile; and on the Indus, for 500 miles, there was a charge varying from 1½d. to ½d.—making an average of 1d. per ton per mile. If they found, so far as steam navigation on rivers existed, the cost was as he had stated, it was, he thought, a bold assumption to say they could make other rivers navigable, and that the cost would be less. He thought the cost would rather be increased by the expense which would have to be incurred in the works necessary for that purpose. With regard to the deficiency of the depths of the rivers,—to make them capable of navigation by the larger class of vessels, proposed by Colonel Cotton, he believed to be wholly impracticable, and if any one—scientific or unscientific—looked into the question of making a large ship canal, he would find that it would be a work of millions of money, and would be a more expensive enterprise than any railway. The moment they came to the question of depth, the expenses would increase as the square of the depth, and, beyond a certain size, in a ratio much greater in proportion to the dimensions. They had an instance of a large canal—the Caledonian—which was constructed under favourable circumstances: it was not more than 15 feet deep, 60½ miles long, of which 37 miles were natural lakes, but it cost more than 1,100,000*l.* of money, and yet he believed the returns did not pay the expenses of the staff required to work it, whilst on the other hand no railway had been so unproductive. But, long ago, a canal mania arose, and he believed some 70,000,000*l.* were expended on those projects, the average returns from which, he believed, had been most unsatisfactory. Now, with regard to the 5,000,000 of tons of traffic, he (Mr. Ayrton) did not for a moment believe that that amount would be carried from any one place to any other place, over the same point, on any main line of railway. There were 2,500,000 tons now carried annually on the Ganges, but it would be found that about one-twentieth of that traffic came from Mirzapore to Calcutta.

Colonel Cotton—2,000,000 of tons come from one point, that is what I say.

Mr. Ayrton—They must not imagine that it came from Mirzapore, or from any single place. Some of the most fertile districts of Bengal were to the north and east of Calcutta. The 2,500,000 tons were made up of goods brought to Calcutta by water from all those districts, as well as from all the intermediate places between Mirzapore and the Hooghly. Much of the traffic on the Indian railways would be just the same as on the London and North-Western railway, between different places on the line and not along its entire length, and though it would, no doubt, be ample to make the railways remunerative, it would not approach the extravagant quantity of 2,500,000 tons on any part of the line. People spoke of the Ganges as if it were like the Thames, capable of being navigated from the wherry to vessels of the largest tonnage. It was a most extraordinary river. Land was formed and cut away with a rapidity that was astonishing. A man owning a fine estate on one side of the river, might after a flood of the river find it had vanished, and that a new estate was formed on the other side of the river. How were they to deal with such a river? It was impossible to convert it into a navigable canal deeper than it was formed by nature. If they were to excavate the bed, they would find it filled up again by a day's flood. It was said by Colonel Cotton, railways could not be used for a large goods traffic, but it was to be borne in mind, that the peculiarity and the speciality of English railways, in which they differed even from continental lines, was this—they were obliged to run numerous express and fast trains, at all hours, for passengers only. These obstructed their regular employment for goods traffic to a tenth of the extent of which they were capable of being used, if all the trains for passengers as well as goods went at an uniform speed, even if that speed were 20 miles an hour. But, in India there would not be the same demand for passenger trains, and if there were it would only prove the propriety of having constructed the railways, and that canal boats would have been most unsuitable. He wished to call attention to another fact—the circuitous course of canals, unless they were made wholly regardless of expense. A little way out of London they found the New River, or any of the canals, winding about, whilst the direct distance between any two places through which they passed was only about half their length. He would like to know whether Colonel Cotton's rates were for conveyance per mile along the canals, or whether he had reduced them to the direct distances, or whether in his statement of the rates on the Ganges and other Indian rivers, he had computed the cost by the river's length or by direct distance, for with regard to the Ganges, the distance from Mirzapore to Calcutta by it was about 800 miles; the direct distance being only about 400 miles. It appeared to him, also, that Colonel Cotton had made his estimate of the

cost of transit by canals exclusive of the tolls, which went to pay for the construction of the canal itself, and the comparison he had drawn from the tables prepared was, therefore, only of limited application. They did not embrace many charges which constituted the commercial cost of transit, and which were all included in the rates charged by the railways. To omit the tolls on canals was to disregard the entire cost of constructing them. He would allude to one more point only, as the time was limited. He would ask Colonel Cotton whether, in stating his broad propositions, he had considered the quality of the soil in particular parts of India. The soil over a great part of the country was not retentive of water, and anything in the shape of a canal would have to be made retentive of water by artificial means, throughout its whole course, and, therefore, could not be compared with the canals cut in many parts of the delta, where the water would be retained in any channel which might be cut for it; and he would also like to know on what assumption the gallant gentleman had proceeded in laying down the data for the cost of irrigation; whether he had estimated that the water might have to be drawn from any and what depth, or whether he calculated upon an interminable supply of running water. In many parts it might be 5 feet or 50 feet below the surface, and then what would be the cost of irrigation.

Colonel COTTON said it was again so late before an opportunity was given to him of answering the objections that had been made, that he must content himself with selecting a few of them on which to make his remarks. He would begin with Mr. Ayrton's arguments against water being a remedy for famine. That gentleman said:—

"Canals, as applied to irrigation, would be no remedy for famine. The rice, wheat, and other varieties of grain, would not be raised by artificial irrigation when they could be grown by the showers of Heaven without cost. The great staple food of man and cattle in India would be produced by those crops which were given by the bounty of Providence from the sowing of the seed, and by the action of the periodical rains upon a naturally fertile soil. It was to be remembered that produce did not fail till all the mischief was done, which no artificial irrigation would remedy. When the husbandman sowed the seed, he was under the expectation of the ordinary periodical showers; he waited for them from day to day, and if they failed then famine had arisen, and no system of irrigation would ever prevent the calamity." He then adds—"He saw several gentlemen shake their heads."

No wonder. What would any one of ten thousand black men say to such white wisdom? Every chain in this grand argument implied the most complete ignorance of the facts of irrigation. It was one of the innumerable queer things that this gentleman had spoken. It would take him a long time to show the absurdity of everything he had said when he touched upon engineering matters. He might have just as well delivered a lecture on watch-making. He would just mention some things showing the nature of his career in India, because it seemed necessary that the meeting should know that he had real grounds for speaking without presumption on these matters. He did not get any knowledge of irrigation and Indian rivers in a lawyer's office in Bombay. After a short employment in the field, soon after his arrival in India, he was called to the civil duties of an engineer. The first work he was called to was the examination of the pass between Ceylon and the main; this brought Court questions under his notice. He was then appointed to the charge of irrigation works and communications in various districts of the Madras Presidency, in the course of which every kind of country was brought under his notice, hill country, undulating tracts and deltas, forest, jungle, and open plains, with soil and rock of every description. It was in the course of these occupations placed in charge of the delta of the Cauvery, and employed in throwing two weirs across that river, which was 1100 furlongs broad at the site of the upper one, and in the planning and executing innumerable works connected with both communication and irrigation, bridges sluices, locks, tunnels, &c., as well as in controverting and regulating these to the rivers. Latterly he was employed in the Delta of the Godavery, where a weir had been constructed across the sandy bed of the river, at a point at which it was just four miles broad, including low islands, which were under water when the river was full. From this river, channels to contain $1\frac{1}{4}$ millions of cubic yards per hour, were led off; 1,200,000 acres would be irrigated, and full 1000 miles of connected water communication would be completed. He must be excused mentioning these things, because Mr. Ayrton endeavoured to give what was a totally incorrect representation of the whole matter, by commencing his speech with talking of Colonel Cotton's *theory*, as if he came here with some wild speculations on what he thought would be the effects of some untried plans. He had been thirty years coming to his conclusions, and these thirty years had not been passed in cantonments, but in tents, in actual contact with the matters of which he spoke. He had always been looking for, and had indeed been compelled to see, the actual results of such operations. He had brought before the Society, in his paper, real facts, and fair arguments based upon those facts. Now, to endeavour to make it appear as if he was merely bringing forward a theory, was certainly not calculated to help us in finding the truth, as Mr. Ayrton said he supposed the object was to investigate truth. He was sure we should never get at the truth in this way. Now, to return to the subject of the effect of irrigation in preventing famine. We had heard what Mr. Ayrton's ideas of irrigation were. But what was its result? One plan was this—we went to a river, like the Godavery, for instance, which never failed, and which conveyed, when full, water enough in three days to water the whole Delta all the year round; we threw a weir across it to raise the water, and then cut channels so as to lead the water to the surface of the land. These channels were thus kept flowing all the year round, through both the monsoon and the dry season. The cultivators opened a sluice, flooded their lands, and commenced their cultivation, with as great a certainty of a supply of water as was possible, instead of being dependent upon the local rivers, which were always very irregular, and sometimes failed entirely. Another way was to form large reservoirs (tanks) filled by damming up some large stream, or by cutting a channel from some rivers. Some of these tanks contained water enough for one year, some for two whole years. When the tank was a quarter or half filled the cultivator sat about his operations with confidence. Now compare these actual facts of irrigation with Mr. Ayrton's ideal sketch of it. And this gentleman told us, "he knew something of irrigation." He thought nobody present could find much difficulty in apprehending that the proposition, "Irrigation cannot prevent famine," was rather more *theoretical* than his views. Then Mr. Ayrton spoke of a theory for the whole of India, and that it must be wrong. Did he apply any theory to the whole of India? What were his words—"What has been done and is now doing in Rajahmundry, *or corresponding works, according to the nature of the country*, should be at this moment going on in every district in India." And again, "All the districts certainly could not be improved in nearly *the same way* as Rajahmundry, because it is a delta, and has peculiar advantages both for irrigation and water communication, but they ought all to be improved *on the same principle*, that is, every advantage should be taken of the peculiar natural facilities of each district to supply it as quickly as possible with these two grand requisites—irrigation and cheap transit." What had this to do with a general theory for all India? Let us now consider what he said about the Damooda. He gave a dreadful description of the navigation of the river, and no doubt it was about the worst of the navigable rivers of India; but hitherto it had conveyed all the coal from Burdwan to Calcutta. But now how did matters stand? As a remedy for this all the skill and ex-

perience that could be procured in England was brought to bear upon a land communication; and 20,000*l.* per mile was spent upon it.

Mr. CRAWFORD—10,000*l.* a mile.

Col. COTTON believed that a much larger sum had been spent; and now we had all that science, experience, and Western energy, and enormous sums of money, and backed up by steam power could do, to oppose this wretched river being navigable, on which not one European thought nor one shilling had been expended, and worked by human labour. What an unequal contest; of course the question of the issue of it answered itself; nobody could dream that a ton of coals could ever again be put into a boat. Well, in the last mail it was said that at last, after several months' discussion, the coal company had come to an agreement with the railway company to give them the transport of their coal. But by a report of the matter from a Bengal newspaper about three months ago, the negotiations at that period, after having been continued a long time, failed, as the railway company could not undertake to convey at a rate that would be altogether cheaper than the river transit.

Mr. CRAWFORD stated that an agreement had been made to carry them at 1d. per ton per mile.

Col. COTTON—The Ganges transit cost under three-eighths of a penny a ton, and allowing for the acknowledged inferiority of the Damooda, there could not possibly be much advantage to the coal company to have their coals carried at 1d. per mile. Now he begged to call attention to this case, because it was admirably to the point. It was all but a balance between the railway costing 10,000*l.* a mile or more, and worked by steam, and an unimproved river worked by human power. Thus, from his knowledge of Indian rivers generally, and from what he had read of the Damooda, he had not a doubt that five-eighths of the evils of the navigation mentioned by Mr. Ayrton could be removed at an expense of 100*l.* or 200*l.* a mile; in which case the railway would not have had a chance with the river in the conveyance of heavy traffic. He had no doubt whatever that a fiftieth or a hundredth part of what the railway cost would reduce the cost of the river transit to a farthing a mile, including risk and all items. But thus it was; we spent unlimited sums on land and enabled ourselves to use steam on it, while we left the water totally unimproved, and then said, "See how superior land transit is to water;" indeed, in this case, it was after all difficult to say which was superior for heavy traffic, this worst of unimproved rivers or the railway. Mr. Ayrton next spoke about the enormous cost of ship-canals, and said that millions were spent upon them. Thus, again, did he (Colonel Cotton) say one word about ship-canals? What were we to think of a cause which compelled men continually to put words into his mouth which he never spoke. If they could answer what he did say, they certainly never would take the trouble to answer things he did not say. But what had the fact of a million being spent on the Caledonian Canal to do with steam-boat canals for India? What was the actual cost of canals in India? Take the case of the Ganges canal; its length, with its two branches, was 850 miles; its dimensions at the head were 60 yards broad, with ten feet deep of water. It diminished gradually to the other end, where it might be perhaps 10 yards broad and 6 feet deep. Now this immense canal, which was nearly completed, would have cost about 2 millions sterling, or 2400*l.* a mile. This was a specimen of the cost of canals in India. With respect to the cost of canals in England, he had a conversation with the proprietor of one of them, which was remarkably to our present purpose. It was the Oxford canal. He said, "you have a fair contest with a parallel railway, what are the results?" He replied, "Oh! they have ruined us." "Well," I said, "but what is the actual state between you." "What is your dividend?" "12 per cent." "This is a curious way of being ruined." "Oh! we used to get 32 per cent." So the ruined canal was, at this moment, yielding 12 per cent., and the victorious and flourishing railway about 4 per cent. In investigating this question, in which such large words had commonly come into use about railways, we must take care to ascertain what meanings now attach to the words we use. The cost of this canal was 2,500*l.* a mile, and one part of it had since been improved; it was cut very straight, as straight as many railways, made half as wide again as it was at first, and in fact required little more to be done to it to make it a steam-boat canal, and this part of it, both in original cost and improvements together, cost 6,500*l.* a mile, one-sixth of the cost of a railway. He must now advert to what was said about the power of railways to convey the great traffic of a country. It was said, that in England, the grand obstacle to it was "fast trains." Now, what was the one object for which everything else was being sacrificed in these Indian railways; it was speed. What could have been said that would have more powerfully supported the main points of his position, than this that was so brought forward. This was what he insisted upon, that if we would give up this idol "high speed," we could do any thing, and that for this comparatively insignificant object, we were sacrificing all the real interests of the country. And in answer it was said, that the ground obtacle to the railways carrying the great traffic of the country, was the high speed of some trains. Now only give up the high-speed trains in India, in order to enable you to carry the great traffic, and you give up your whole position. If high speed was given up, and the people were satisfied with a moderate one, such as from 3 to 6 miles for goods, and 8 or 10 for passengers, and improved rivers, and canals, and light railways, would more than answer all our purposes, for they would give us more speed than this at very low rates. There was not time to reply to a tenth part of the uttered or implied mistakes in the different speeches to-night, but he thought this *exposé* would afford a tolerably correct estimate of the shadowy nature of these objections generally. And no time at all was left him to say what he ought to have been allowed time to say on the real points of the question. He believed there were few gentlemen in the room who had a stronger opinion than he had of the advantages of high-speed railways. But our question was this—Under the circumstances of India which would be most beneficial, a few miles of high-speed railway, that would convey goods at a penny a mile, and carry passengers at thirty miles an hour, or ten or twenty times the length of some other kind of communication that could convey goods and passengers at 1-4th or 1-10th of the cost by rail, but with a moderate speed—suppose 50 or 100 miles a day for goods, and from 200 to 300 for passengers? This was the question which had been so studiously kept out of view by the different speakers. And no wonder, for it would not bear an hour's discussion. Was it wise to throw away all the natural facilities and advantages which the country afforded, and to leave the great body of the country without either cheap transit or irrigation for the sake of two or three lines of railway, which, when done, could neither carry the quantity nor at the low cost which the country imperatively demanded. The ten years, and the thirty or forty millions that it was proposed to spend on these works, would go far to secure every part of India from famine, would provide food for the whole community by means of irrigation, with the labour of a comparatively small portion of the population, and would bring cheap transit to within fifty miles of every point, together with a very fair speed, quite sufficient for all present purposes. And when these great essential ends were obtained we might proceed to provide ourselves with rapid passenger transit.

The CHAIRMAN said he must claim attention to the subject of one art, the art of the collection and distribution of water as means of giving fertility to a large proportion of the soil of India, and to the mode in which it had hitherto been conducted, and was proposed to be conducted. One speaker (Mr. Ayrton), whilst deprecating generalities, in

respect to the whole of that continent, had yet stated one general condition under which it was placed, of sudden and immense floods, of torrent-filled rivers, and of prolonged droughts, which certainly demanded works of extensive generality and magnitude for the collection and storage of these sudden falls, and for their regulated distribution. Such works had been commenced by the Company, but in important respects on erroneous principles. It appeared that the water leading was by open cuttings, in the branches as well as the mains, and that the ultimate distribution was mostly by the method of submersion. Where the mains were not stagnant, and where they could be made to serve the purposes of traffic as well as of water distribution, the method of conveyance by open cuttings had, no doubt, compensating advantages; but in Peru, where the Spaniards raised enormous cereal crops by irrigation, it was a saying, that to lead water in open cuttings, was to lead it into the air; and it must be so, to a great extent, in India. This appeared to have been formerly well understood. In Colonel Chesney's work might be found the native remains of ancient water-leading, by covered channels under the present arid and desert seats of former populations and civilisation. The method of ultimate distribution by the water meadow, old though it might be, was open to the fatal objection that it created marsh surfaces, and engendered marsh miasma. The Chairman, in his sanitary researches in England, had found, and it was abundantly proved, that the water meadows generated the rot in sheep and the ague in men. His friend, Captain Baird Smith, in his able report on the Italian irrigations, had stated the fact, that from experience of the injurious effects of such irrigations, the formation of such works was in several states prohibited within six miles of towns; but he did not appear to have given to that fact its due and decisive weight. If such were the effects in European climates, it might be expected that they would be aggravated in the East by a more rapid decomposition under a more powerful sun; and so they were. Medical reports which he had seen, shewed, particularly in the province of Agra, peculiar manifestations of the malarious influence in the enlargement of the spleen. The medical men reported that they could tell by the extent of enlargement of the spleen, the extent to which the population had been exposed to the malarious influence. Now he, the chairman, had a large faith that unwholesome processes were not intended, and were not the best for the most economical or the most productive results. One effect of them was almost to necessitate with the inferior labour, a depressed, inferior, and expensive population. In some consultations on drainage works for the productive and sanitary improvement of Guiana, he was not surprised to find the slave labour in reality dear, as well as inferior labour, obstructive of improvement. He had been assured by a large planter, that he could afford to give as much as 3s. per diem for labour as good as common day labour in England. Then, why not import it? The answer was, that it had been tried, but that the free labourers could not stand the climate, and would have recourse to rum, which destroyed their value as labourers. What was called "the climate" was, in the particular instance, the miasma from the stagnant ditches used to drain the land, and which so closely intersected it, that the plough which might there have been otherwise used, could not run. In England, he had promoted the use of covered but permeable tile drains in substitution of the open ditch drains, which commonly surrounded our towns as well as lands, and they were now proved to be the most economical. The late Dr. Shier agreed that in the particular instance they would have removed the barrier to the introduction of superior labour, as well as the obstructions to the working of the plough. It appeared that, in consequence of the irresistible evidence in India of the effect of the miasma from the irrigation by submersion, it had been provided that they should not be carried on within such distances as three miles from a town. If, however, six miles distance were required for the protection of the population of Italian towns, three miles was certainly too short a distance in India. He had evidence even in England that marsh effluvium had been perceptible for fifteen miles. After a continued prevalence of wind from over the marshes and open ditch drains in Essex and Kent, at Plumstead, comparatively weak as was the power of decomposition here, scattered cases of marsh fever—known as such to medical officers conversant with the marsh diseases—and ague, were found to occur amongst the population to the very extremity of the metropolis. In some of the reports of the Company's officers, it was stated as conclusive and satisfactory, that from the provision made, "only a few" cases of enlarged spleen occurred amongst the adjacent population. To those who understood the subject, however, "the few" developed cases, which usually on examination turned out to be not a few, denoted the prevalence of wider deleterious influences. But this supposed protection wholly disregarded those who were to labour in the artificially created marshy surfaces; it was in ignorance of that to which he must repeatedly call attention as a practical economical principle—that inferior processes, processes which were physically injurious and depressing, made inferior labourers and inferior populations. He was happy in being able to convey confident assurances that these unsanitary consequences were avoidable, and, moreover, were avoidable with a profit. From having been compelled to struggle with the difficulties of dealing with the refuse of towns, he had been led to propose, in substitution of the practice of applying liquid manure by the method of submersion, the principle of pipe distribution or the application of liquified manure by pipes and hose and jet. This was now in course of increasing application in farms, and its sanitary success would be found to be everywhere demonstrated. As with applications by the horticulturist, or by the gardeners' water-pot, no more was given at one time than the soil could at once absorb. Plants whose natural habit was not submersion in liquid, were not subjected to it. There was no stagnant water and no decomposition. Even where liquified manure was applied, there was an immediate chemical combination with the soil, which it was proved retained it permanently, and there was no loss from decomposition, and no atmospheric pollutions from that cause. There was also a large economy of water. But what perhaps was of the most immediate importance, there was a large economy of original outlay, as well as in working expenses. Captain Baird Smith, in his report on the Italian irrigations, had shown that as much capital as 40*l.* per acre had been expended in the construction of the water meadows and the connected works. The average cost of the Wiltshire water-meadows was about 16*l.* per acre. The Chairman held in his hand a tabular view of the comparative outlay and the working expenses. From this table (*see next page*) it would be perceived, that the total cost of the works and apparatus of all the prominent examples examined of irrigation, by bed works and gutters, including the instance of catch water meadows, had been 31*l.* 14s. 7d. per acre, and that the total annual charges and working expenses were 3*l.* 7s. 1d. per acre; whilst the cost of the new works and apparatus on the average of all the examples of distribution by underground pipes had been 2*l.* 7s. 1d. per acre, and the annual charges and working expenses 8s. 11½d. per annum per acre. The cheapest instance found of the method of distribution by open gutters, the Pusey catch-water meadows, was 14s. 3d. per acre, whilst the total annual expenses of the cheapest method of distribution by closed channels and underground pipes, and by jet and hose, was 7s. 1½d. per acre. The detailed particulars of works from which every competent officer might judge for himself were to be found in the official minutes published on the subject, and one additional advantage would be seen in this, that the works did not confine the cultivation to one method, but were equally applicable to arable and to arboretal cultivations. From what had been stated of the cheap rate at which water was raised in India by simple

means, there could be little doubt that the experience here as to economy of construction and working were applicable, *mutatis mutandis*, to India. It should be our mission to introduce into that country the most advanced improvements of modern civilisation, and our dominion should be based on the benefits rendered by it to the population. Care should be taken that in mere routine, and from poverty of resource in adaptation, we did not introduce European defects. This was of primary importance in relation to those works on which the productive powers of the country must mainly depend, namely, those for the adjustment of the supplies of water. At the same time the company's service, military as well as civil, furnished some of the most brilliant examples of fertility of resource and administrative ability in the empire. It would have enlarged the sphere of their discussion, and presented an example worthy of high regard, as it appeared only imperfectly known in India, and almost totally unknown in this country, if, from the papers officially printed by the company, he might have presented to them in detail the example of the conquest, the reclamation, and the civilisation of the Mairwara, of which the foundation had been laid by Colonel Hall, of the company's service, but the brilliant superstructure had been worked out by Lieut. Col. C. J. Dixon, of the Bengal Artillery. It was the case of a wide range of hilly district, badly cultivated, infested by wild beasts in jungles, and occupied by a robber population, whom it became necessary to subdue, for the protection of the inhabitants of the surrounding districts. Under ordinary routine, it would have been merely garrisoned at a great expense, but Colonel Dixon perceived that the failure of the crops from the irregular supplies of water, at times necessitated predatory habits, to which the long intervals of labour from a rude and bad cultivation gave them leisure. To meet this condition Colonel Dixon projected works for the collection, storage, and distribution of water. He obtained government advances of money, and occupied the robber population in their construction. Subsidiary works were designed, money advanced, and the same population was engaged in the reclamation of jungles and in that steady and highly productive cultivation, which the adjusted water supply and distribution afforded the means. The time of the population was so well occupied, that they had no leisure nor inducement to think of depredation. He succeeded in doing there what our administrators had not succeeded in doing here, in making absolutely condemned criminals prefer honest and productive industry. For cultivation and the conveyance of produce, roads had to be made, villages to be constructed; for the supply of the villages a town had to be created, and for the sale of the produce, markets and fairs to be instituted. The Government advances of capital were repaid with interest. Instead of laying black mail on the surrounding population, instead of occasioning the expenditure of a revenue, in maintaining the repressive action of troops, the district now furnished good subjects and good troops, and a good revenue for the maintenance of the local as well as the general government, from a thriving and increasing population. All this had been done in a very few years, and the instance might be cited in proof of the possibility, by similar administrative appliances, of altering completely the condition of that empire within the span of one generation. The following is the table of the comparative cost and working of the two descriptions of works, as applied to the distribution of liquified manures, and referred to by the chairman:—

| Name of Place. | No. of English Acres. | Mode of Application. | Total cost of works & apparatus per acre. | | | Annual interest, &c., at 7½ per cent. per acre. | | | Annual working expenses per acre. | | | Total annual charges per English acre. | | | Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | £ | s. | d. | £ | s. | d. | £ | s. | d. | £ | s. | d. | |
| NOTTINGHAMSHIRE: Duke of Portland's Clipstone Meadows | 300 | Catch-meadow, gravitation, and open gutters.............. | 120 | 0 | 0 | 9 | 0 | 0 | 0 | 10 | 0 | 9 | 10 | 0 | Previously worth from 3s. to 5s. per acre per annum, produce now upwards of 12*l.* |
| EDINBURGH: Craigentinny Meadows: High Level ............ | 63 | Steam engine, pumps, and open gutters and panes ...... | 31 | 14 | 11 | 2 | 7 | 7 | 1 | 17 | 4 | 4 | 4 | 11 | Average rental, upwards of 16*l.* per English acre. |
| Sea Meadows ......... | 38 | Gravitation, open gutters, and panes ............................ | 18 | 8 | 5 | 1 | 7 | 7½ | 0 | 10 | 5½ | 1 | 18 | 1 | Worthless 25 years ago, now worth 520*l.* per English acre. |
| Old Meadows ......... | 228 | Gravitation, open gutters, and panes ............................ | 11 | 16 | 10 | 0 | 17 | 9 | 0 | 10 | 5½ | 1 | 8 | 2½ | Maximum rental, 25*l.* per English acre. |
| WILTSHIRE: Wiley Meadows ......... | 150 | Bed-work of ridge and furrow, gravitation & open gutters | 20 | 0 | 0 | 1 | 10 | 0 | 0 | 7 | 0 | 1 | 17 | 0 | Four heavy crops of grass per annum. |
| DEVONSHIRE: Duke of Bedford's Tavistock Meadows... | 90 | Bed-work, and catch-meadow, gravitation & open gutters | 13 | 2 | 10 | 0 | 19 | 8½ | 0 | 15 | 0 | 1 | 14 | 8½ | Land more than quadrupled in value after only five years irrigation. |
| BERKSHIRE: Pusey Meadows ......... | 100 | Catch-meadow, gravitation & open gutters .................... | 4 | 9 | 0 | 0 | 6 | 8 | 0 | 7 | 7 | 0 | 14 | 3 | Land not previously worth more than 5s. per acre, now yield 6 heavy crops of grass per ann. |
| STAFFORDSHIRE: Duke of Sutherland's farm near Trentham | 83 | Steam engine, pumps, underground iron pipes, gutta percha hose, and jet pipe ... | 6 | 5 | 5 | 0 | 9 | 5 | 0 | 4 | 4¾ | 0 | 13 | 9¾ | Tanks constructed sufficient for 300 acres. |
| GLASGOW: Mr. Harvey's farm ...... | 508 | Steam engine, pumps, underground iron main pipes, and iron distributing pipes ...... | 2 | 17 | 1 | 0 | 4 | 3½ | 0 | 9 | 5½ | 0 | 13 | 9 | 10 feet thick of grass cut from an acre in six months. |
| GLAMORGANSHIRE: Porth Kerry Farm...... | 50 | Gravitation, iron pipes, and gutta percha hose ............ | 6 | 0 | 0 | 0 | 9 | 0 | 0 | 4 | 0 | 0 | 13 | 0 | Tanks constructed sufficient for 300 acres. Upwards of 9 feet of grass grown. |
| AYRSHIRE: Mr. Kennedy's Myer Mill farm ............ | 508 | Steam engine, pumps, underground iron mains, gutta percha hose, and jet pipe ... | 3 | 2 | 6 | 0 | 4 | 8¼ | 0 | 6 | 4¾ | 0 | 11 | 1 | 70 tons of grass cut from an acre in six months. |
| Mr. Telfer's Canning Park farm............ | 50 | Ditto .............................. | 4 | 4 | 0 | 0 | 6 | 3½ | 0 | 4 | 4¾ | 0 | 10 | 8½ | 14¼ feet thick of grass cut in 7 months. |
| LANCASHIRE: Mr. R. Neilson's Halewood farm............ | 120 | Ditto .............................. | 4 | 6 | 11 | 0 | 6 | 6¼ | 0 | 3 | 3½ | 0 | 9 | 9¾ | One dressing of liquid found equal to 25 to 30 tons of solid farm-yard manure per acre. |
| CHESHIRE: Mr. Harrold Littledale's Liscard farm | 150 | Ditto .............................. | 4 | 9 | 7 | 0 | 6 | 8½ | 0 | 2 | 4½ | 0 | 9 | 1½ | A fourth crop of grass, equal to 10 tons per acre. |
| Marquis of Ailsa, Leg or Dunduff farm ... | 50 | Gravitation, underground iron mains, gutta percha hose, and jet pipe ...................... | 3 | 16 | 5 | 0 | 5 | 8¾ | 0 | 1 | 4¾ | 0 | 7 | 0¾ | 12 stacks per annum previously; 80 stacks last year. |

The following is the letter received from Mr. Bourne, mentioned at page 431.

Greenock, April 5th, 1855.

SIR,—It would have given me much pleasure to have been present at the Society of Arts next Monday, on the occasion of the discussion arising out of Colonel Cotton's paper "On Public Works for India," but as I am unable to promise myself that gratification, I willingly accede to your suggestion that I should send you a few observations, such as I would have ventured to offer had I been able to attend.

With many of the topics discussed by Colonel Cotton I do not profess to be familiar, but having now for a number of years given constant attention to the question of internal communication in India, and having by personal investigations in India, and by collecting from all available sources the best information that I could obtain, endeavoured to arrive at practical and unbiassed conclusions upon the subject, I think myself warranted in stating my belief that my opinions will not be found to be incorrect in many important particulars.

The great want in India is the want of internal communications. All parties are agreed upon that. This want may be relieved by the construction of roads, and railways, and canals, and also by improving the navigation of the rivers already subsisting in that country. Now, India is so vast a country, that to cast over it such a network of roads, or railways, or canals, as would effectually or largely subserve the purposes of internal communication, would cost a larger sum of money than could readily be collected for that purpose, and if we rely wholly on these instruments of amelioration, we cannot expect to make any very large progress in improving the internal communication of the country for a number of years. No doubt roads, railways, and canals, should be made, so far as we have the means of making them, in all those situations in which improved communications are very desirable, and in which there is no cheaper expedient available for satisfying the want; and the selection of the particular kind of road which should be adopted must depend upon local circumstances, as, indeed, will be obvious to every one. The rivers, which in other great tracts of country are the main arteries of internal communication, are in India so shallow and so full of sandbanks, that to navigate them by steam vessels of the kind commonly employed in other countries, is impossible, or, at least, possible only to a very limited extent, while to deepen those great and shifting rivers, so as to render them suitable for navigation by steam vessels of the ordinary form, would, as a general rule, be a far more costly operation than to construct contiguous lines of railway or canal. Although, however, we cannot expect to adapt the rivers of India to our familiar modes of navigation, it became obvious to me, from my investigations in India, that to construct vessels which should be of such a character as to be capable of navigating the shallow and shifting rivers of India, was a problem by no means beyond the power of engineering science to solve. On the contrary, it appeared to me that the construction of such vessels would be by no means a difficult achievement. If such rivers had existed in England, I felt persuaded that they would have been effectually navigated by steam long ago, and the only reason to which I could attribute the circumstance of their not being so navigated, was that few mechanical engineers had ever visited India, or were acquainted with the peculiarities of the rivers of that country, or were cognizant of the vast extent of country which any effectual expedient for navigating them would open up. I calculated that by establishing, upon the rivers of India, steam vessels of light draft, and of otherwise suitable construction, to overcome the difficulties of the navigation, about *ten thousand miles* of river would be opened to navigation by steam, without doing anything to improve the rivers at all. No doubt it would be found expedient to remove impediments out of the beds of some of the rivers at certain points, but this improvement, though desirable, was not necessary, and by the simple expedient I have mentioned, about ten thousand miles of great steam highway would be obtained, without any other expense than the construction of the steamers necessary to run upon it. Such an improvement as this, if really feasible and practical, must be admitted to be of much value, but the East India Company, to whom I applied six or seven years ago upon the subject, denied its feasibility, and refused to make the experiment. I, thereupon, in conjunction with some friends, offered to make the experiment at my own expense, requiring only, in the event of the success of the experiment being completely satisfactory to the East India Company, that a moderate recompense should be made for it, but after several references to India, and an appalling amount of reports and correspondence, the offer was declined, and the great advantage of the achievement, even if successful, was, at the same time, denied. I found that the main opponents of my proposal were the persons interested in the existing railways, which led me to believe that they, at least, believed it would be so successful as to render superfluous some of the expensive schemes of railway communication then proposed to be undertaken. My view, however, is, that railways are necessary too, and that there is abundant scope in India for their advantageous operation. But I think that, for the purposes of commercial transit at least, the railway should only begin where the waterway terminates, and that it is a waste of power to make either railways or canals by the side of a river which is susceptible of navigation by steam, so long as there are vast tracts of country where there are no rivers, or where the rivers are too small, shallow, or steep, to be navigable, awaiting the benefits of improved modes of transport. Of course there are many rivers in India, as in every other country, which cannot be navigated at all, even with any conceivable species of vessel; but there are also great numbers of rivers ramifying throughout the country, which can be so navigated as to convey articles of every kind at a cheap rate of freight, and at a considerable rate of speed. All the rivers of India are subject to periodical inundations, but this does not prevent them from being navigable. Some are merely large torrents, which are only susceptible of navigation during the rains, and in summer are dry, or form only a succession of long pools. Of course, no one proposes to undertake the regular navigation of such rivers as these, but, after all these impossible or doubtful rivers have been set aside, there still remains about ten thousand miles of rivers in India which have always water in them, and which are susceptible of navigation, by suitable vessels, at all seasons.

It would swell this letter to inconvenient dimensions, if I were to enter into any detailed description of the particular rivers of India which are navigable throughout the year, of the distance from the sea to which they are navigable, or of the particular species of vessel by which their navigation may be accomplished. I may mention, however, that the Ganges and Jumna, and some of their chief tributaries, are navigable to within a comparatively short distance of the point from whence they issue from the Himalaya and the Indus—and other great rivers of the Punjaub are navigable up nearly to a chain of mountains called the Salt Range, situated not far distant from the range of the Himalaya. The Mahanuddy, Godavery, and some other rivers of Southern India, are navigable also through a considerable part of their course. The rivers flowing from the Himalaya to the sea, being fed by melting snows, have much water in them in the height of summer, and most of the great rivers of India take their rise in this great mountain range.

It will be seen from this general explanation of my views respecting the internal communications of India, that they are, as I believe, identical with those so effectively propounded by Colonel Cotton, and, although there may be differences of opinion upon small points among those discussing the accuracy of his views, I believe that

his main propositions cannot be controverted. Whatever we may think of the respective merits of railway and river transport, I think we must come to the conclusion that as we have not got the railways to any considerable extent, but have got the rivers which we can largely use without any expense but that of the locomotive power, we ought in the mean time to use the rivers as far as possible; and should the river communication be in time superseded by a railway, there is no loss involved in inconvertible works, but we have merely to shift the steam-vessels to some other river where no railway competition yet exists. It does not appear probable, however, that the existence of railways in India will supersede water conveyance, since it has not been found to do so in other countries. In 1846, when I drew up the traffic estimates of the East Indian Railway, I found that, unless it acquired a large proportion of the Ganges traffic, it could not be expected to be remunerative, and that it could not expect to acquire this traffic if the charge was more than 1d. per ton per mile. In the estimates made at the same time, by Mr. Chapman, for the Bombay Railway, and for which, at that period, no river competition was apprehended, the charge set down for goods was 2¾d. per ton per mile, and I presume the charge would be kept up to this amount, or up to such an amount as would suffice to compete with land carriage, unless a water conveyance were opened from Berar to the coast by the Godavery, which will afford the only assurance that can be got that cotton will continue to be conveyed to the coast at a cheap rate. If this cannot be done, then the supporters of the railway cannot be damaged by the experiment. If it can be done, as from their opposition to the project the railway advocates appear secretly to believe, then the public will be gainers by the increased cheapness of transport thus obtained.

From all I saw or could learn of the rivers of India, while engaged in engineering operations in that country, and from all the information I have been able to obtain, as to the expedients in successful use for navigating rapid and shallow rivers in other parts of the world, I have, I think, accumulated sufficient evidence to enable me to state with confidence that a large portion of the rivers of India may be navigated by steam in such a manner as greatly to accelerate and cheapen the internal communications of that country, and these benefits may be realised without delay, and at small expense. I believe that improved communication must be improvements calculated to increase production, else a market cannot be obtained for the additional articles produced; and to the same extent to which new outlets are afforded to Indian productions, will new inlets be afforded to British manufacture.

I am, Sir,
Truly yours,
J. BOURNE.

## TWENTY-FIRST ORDINARY MEETING.

WEDNESDAY, MAY 9, 1855.

The Twenty-first Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 9th inst., Joseph Glynn, Esq., F.R.S., in the Chair.

The following Candidates were balloted for and duly elected:—

| | |
|---|---|
| Bell, Edward. | Oliver, Joseph. |
| Cox, John. | Paden, Stephen. |
| Eardley, Eardley Gideon Culling. | Ricardo, Samson, M.P. |

The following Institutions have been taken into Union since the last announcement:—

390. King's Cliffe (near Wansford,) Reading Society.
391. Battersea branch of Belmont Mutual Improvement Society.
392. Belmont (Vauxhall) Mutual Improvement Society.

The paper read was

## ON THE MANUFACTURE OF STEEL, AS CARRIED ON IN THIS AND OTHER COUNTRIES.

By CHARLES SANDERSON.

The manufacture of steel is of great antiquity, coeval, if not anterior, to that of iron; it was known to the Chaldeans, the Hebrews, and the Greeks; the processes they are said to have used are detailed by Aristotle, Pliny, and Plutarch, but they are so obscure and contradictory that no reliance can be placed upon them. It appears most probable that steel was, in the first instance, produced accidentally, whilst attempting to obtain iron. This question is, however, more curious than useful; I therefore dismiss it, and turn to the subject before me. Steel is a carburet of iron, more or less freed from foreign matter; it can be produced by two processes, opposed to each other; the first, or earlier method, is by working pig iron, which on an average contains 4 per cent. of carbon, in a suitable furnace, until the carbon it contains is reduced to that quantity required for steel, which is 1 per cent. The second method is to heat wrought iron in bars (which contain little or no carbon), in contact with some carbonaceous matter, until it has absorbed that quantity of carbon which may be required for hard or soft steel purposes.

The various kinds of steel which are now manufactured in this and other countries, are:—

*Natural or raw steel*, which is manufactured from crude iron as obtained from the blast furnace;

*Cemented or converted steel*, which is produced by the carbonisation of wrought iron;

*Cast steel*, which is obtained by the fusion of either natural or cemented steel, but principally from the latter.

In the manufacture of steel, the quality of the iron from which it is made is of the first importance; it is absolutely necessary that it should be free from earthy matter, silicates of the metal, sulphur, arsenic, &c. Any foreign matter contained in the iron is very injurious for steel purposes, but the silicates are, in my opinion, the most deleterious, since they produce a red short quality, caused by their mechanical mixture with the carbonised molecules of the steel, thus destroying the malleability of the mass. The mines of Danemora have for many centuries enjoyed the highest reputation for producing iron of the finest description for steel, and this alone should be used for producing the very best cast steel. The high reputation and scarcity of this iron have combined in commanding for it a very high price. The marks Ⓛ.$\mathrm{C}_{\mathrm{L}}$. OO. are made wholly from the Danemora ores; the marks $\mathrm{C}_{\mathrm{F}}$.W.B. Grid, and some others, receive only a portion of these ores mixed with others in their manufacture. Sweden produces also a large quantity of iron suitable for steel, but of inferior quality to the above, and technically termed 2nd and 3rd marks. The ores from which the Swedish irons are produced are almost wholly black oxides, usually containing 50 to 60 per cent. of metal; they are very clean and pure, and might, if properly manufactured, produce finer iron than that generally obtained; their works are, in too many instances, badly constructed, and the manufacture itself is so far from being perfect that there is a great unnecessary waste in the manufacture of the pig-iron into bars, and also in the quantity of charcoal necessary to produce a ton of iron; nevertheless,

these commoner irons are sold for steel purposes. Recently some of the Swedish works have introduced our English charcoal refineries, and our mode of working, by which a sounder iron is obtained, and one freer from adventitious matter. The price of (L) is £36; GL £33; OO £32; GF and W £32; B £30; Grid and Stembuck, £24 at the present high prices: the iron called 2nd mark varies in price, according to its intrinsic quality, from £25 to £18. The 3rd mark from the latter price to as low as £13 per ton. Russia sends also a large supply of iron for steel purposes, of which the marks Kb and IOP3 form the mass, being from 6,000 to 7,000 tons annually. This iron is of good medium quality, and sells readily at from £17 to £19 per ton in ordinary times. It is manufactured in the Ural district of Russia, by the usual charcoal refinery process. A part appears, however, to have been puddled, using wood for fuel. In 1830 it was a question whether a puddling furnace could be so constructed as to admit of the use of wood. Berzelius was of opinion that it could not. During my residence in Styria and Carinthia, in 1832, I erected a puddling furnace at the works of Mr. Rosthorn, in Wolfsberg, in which wood was used as a fuel. I experienced no difficulty in working it, and it produced very good iron, with a large economy of fuel when compared with the charcoal-refinery process. In this furnace I puddled 30 cwt. of charcoal iron in 24 hours. During this time I consumed 180 cubic feet of wood, as usually measured in the forest, equal to about 1½ cord our measure. The blooms hammered very solid, and the waste was 10 per cent. The furnace was a small one, and the fire-room much larger than that used for coal. Since this trial, several works have used the process, both in Sweden and Austria, but it has not become general. By this plan an excellent steel iron can by produced. Steel iron may also be produced direct from the rich ores of this and other countries. For this process Mr. Clay obtained the first patent; it was tried in Liverpool, but was unsuccessful, first, because he could not sufficiently deoxidise the ore, and subsequently, in its manufacture into malleable iron he could not get rid of the earthy matter—this rendered his iron unfit for steel, as well as ordinary purposes. I obtained the next patent, in which I provided for a more ample deoxidation of the ore, and also for the separation of the earthy matter from the metallic—this iron made good steel. There exists a variety of causes why this process has not been worked, although perfect in itself; it is, however, now about to be adopted for the production of steel iron from the rich ores of England, which, it properly manufactured, will produce an excellent steel. Since this important branch of manufacture is becoming daily of greater importance, every step towards the production of fine steel iron in this country should be encouraged, inasmuch as it makes our own resources available for our wants.

In the manufacture of common steel, particularly that for railway springs, a very large quantity of steel iron is produced from English materials. Of this kind of iron not less than 15,000 tons are annually consumed in Sheffield for springs and common hardware. This iron is produced from the coke-made pig iron, by puddling, during which process substances are added which, although not always the same, yet produce nearly similar effects.

Oxide of manganese, salt, sulphuric acid, and clay, mixed together, formed the patented substance of Dr. Schafhaeutl, by the addition of which into the puddling furnace the metal becomes freed in a great measure from the earthy matter contained in the crude iron, and a purer and denser iron is produced. It is well known that the process of puddling and rolling was the invention of Mr. Cort, of Gosport; it was introduced in 1784, before which period the charcoal finery alone was used. This invention opened a new and extensive field for the industry of the nation; coal became the medium of the manufacture of wrought iron instead of charcoal; and the process has expanded the production of this kingdom from 17,000 tons in 1740, to 3,000,000 tons in 1854. The facility with which malleable iron can be produced with coal has caused the erection of magnificent and colossal ironworks, finding profitable occupation for a great number of men, and producing throughout the ramifications of its manufacture, and its subsequent uses, an amount of wealth almost incalculable. This is somewhat foreign to the subject, excepting that, by the use of this invention, the steel iron market is annually supplied with 15,000 tons; and to me it is a pleasure, as it is a pride, to bring forward to public notice the invention of a man which has produced such astonishing results in our works, our railways, and steam navigation.

At present we are largely indebted to Sweden for our supply of suitable iron for the manufacture of steel.

The following is a statement of our importation since 1845:—

| | Tons. | | Tons. |
|---|---|---|---|
| 1845 . . . | 18,607 | 1850 . . . | 28,096 |
| 1846 . . . | 30,840 | 1851 . . . | 35,467 |
| 1847 . . . | 28,264 | 1852 . . . | 23,817 |
| 1848 . . . | 20,438 | 1853 . . . | 23,540 |
| 1849 . . . | 26,605 | 1854 . . . | 24,436 |

With very trifling exceptions the whole of this iron is used for steel. The above figures give an average importation for ten years of 26,011 tons, to which we must add the importation from Russia and the steel now made in England. I therefore estimate the weight of steel manufactured in England at 40,000 to 50,000 tons annually.

The fuel used in England for the manufacture of steel is entirely coal and coke.

Coal is used in the converting furnace for heating the cases which contain the bar-iron during its process of cementation. In a properly-constructed furnace one ton of good hard coal is consumed in the conversion of one ton of iron, thus representing a consumption of 40,000 to 50,000 tons per annum for this purpose.

Coke is used in the melting process—the consumption being on an average 65 cwt. per ton of ingots. Although all iron is converted, and we can thus obtain the consumption of fuel, yet we have no means of exactly ascertaining the weight of cast steel manufactured annually in England. I should estimate it at from 25,000 to 30,000 tons. This would give a consumption of 81,000 to 97,000 tons of coke; and assuming that the coal will produce 60 per cent. of coke, it will represent a consumption of 113,700 to 136,500 tons of coal.

In Germany, France, and Austria, with trifling exceptions, steel is produced in a furnace similar to the charcoal refinery: it is termed raw or natural steel, deriving its carbon from the metal from which it is produced. Charcoal is the fuel used; the quantity is very variable, depending in a great measure upon the dexterity of the workman: we may, as a general average, estimate the consumption at 240 bushels per ton of raw steel produced.

Having laid before you an estimate of the raw materials used in the manufacture of steel, I shall now proceed to explain the processes which are used in various countries. The kinds of steel which are manufactured are:—Natural steel, called raw steel or German steel; Paal steel, produced in Styria, by a peculiar method; cemented or converted steel; cast steel, obtained by melting cemented steel; puddled steel, obtained by puddling pig iron in a peculiar way.

Natural or German steel, is so called because it is produced direct from pig iron, the result of the fusion of the spathose iron ores alone, or in a small degree mixed with the brown oxide: these ores produce a highly crystalline metal, called *spiegle eisen*, *i.e.*, looking-glass iron, on account of the very large crystals the metal presents. This crude iron contains about 4 per cent of carbon, and

4 to 5 per cent. of manganese. Karsten, Hassenfratz, Marcher, and Reamur, all advocate the use of grey pig iron for the production of steel; indeed they state distinctly, that first quality steel *cannot* be produced without it; that the object is to clear away all foreign matter by working it in the furnace, to retain the carbon, and to combine it with the iron. This theory I hold to be incorrect, although supported by such high authorities; grey iron contains the maximum quantity of carbon, and consequently remains for a longer time in a state of fluidity than iron containing less carbon; the metal is then mixed up, not only with the foreign matter it may itself contain, but also with that with which it may become mixed in the furnace in which it is worked. This prolonged working, which is necessary to bring highly carbonised iron into a malleable state, increases the tendency to produce silicates of iron, which entering into composition with the steel during its production, renders it red short. Again, by this lengthened process, the metal becomes very tender and open in its grain; the molecules of silicate of iron which are produced will not unite with the true metallic part, and also, whenever the molecular construction of iron or steel is destroyed by excessive heat, it becomes unmalleable; both these are the causes of red shortness, and also of the want of strength when cold. For these reasons I consider that grey pig iron is by no means the best for producing natural steel; and for the same reasons I should not recommend the highly-carbonised white iron, although it is now used both in Germany and in France. In Austria, however, they have improved upon the general continental process; their pig iron is often highly carbonised, but they tap the metal from the blast furnace into a round hole, and throwing a little water on the surface, they thus chill a small cake about ½ an inch; this is taken from the surface, and the same operation is performed until the whole is formed into cakes; these cakes are then piled edgewise in a furnace, are covered with charcoal, and heated for 48 hours; by this process the *carbon* is very much discharged. By using these cakes in the refining, the steel is sooner made, and is of better quality. In the opinions I have given to many German steel makers, and in the advice I have offered them, I have endeavoured to show that pig iron can only be freed from its impurities whilst in a fluid state. I take the advantage of the property of cast iron, and previous to melting it in the steel refinery, I submit it to a purification, by which process I seek to *reduce* the degree of carbonisation of the metal, and to separate and dissolve the earthy matter with which it may be combined; I then obtain a purer metal for the production of steel. The metal itself being to some extent decarbonised, is sooner brought into "nature," as it is termed; that is, it sooner becomes steel. The process being shorter, and the metal itself being purer, there is less chance or opportunity for the formation of deleterious compounds, which, becoming incorporated with the steel, seriously injure its quality. Of course, steel manufactured from crude iron, either purified or not, of any defined quality, will inherit such quality, be it good or bad. Art can in some degree remove these noxious qualities from the crude iron. Chemistry has lent its powerful assistance, yet nature will maintain her sway, and in all cases the good or bad qualities of the metal will be transmitted to the steel.

The furnaces in which raw or natural steel is manufactured are nearly the same, as far as regards their general construction, in all countries where such steel is produced; yet each country, or even district, has the fire in which the metal is worked differently constructed. We find, therefore, the German, the Styrian, the Carinthian and many other methods, all producing steel from pig iron, yet pursuing different modes of operation. These differences arise from the nature of the pig the country produces, and the peculiar habits of the workmen. These modified processes do not affect the theory of the manufacture, but they rather accommodate themselves to the peculiar character of the metal produced in the vicinity; in Siegen they use the white carbonised, manganesian metal, whilst in Austria a grey or mottled pig iron is used.

The furnace is built in the same form as a common charcoal refinery.

FIG. 1.

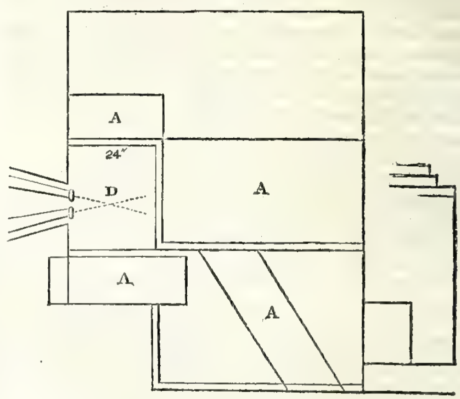


FIG. 2.

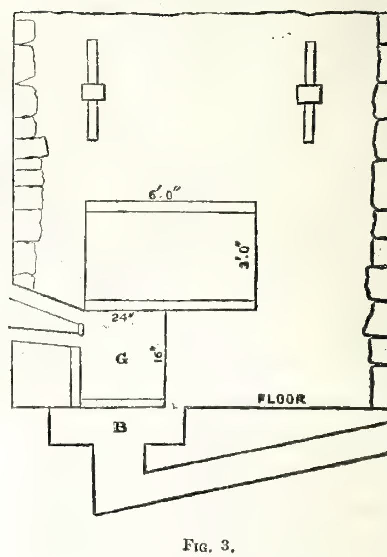


FIG. 3.

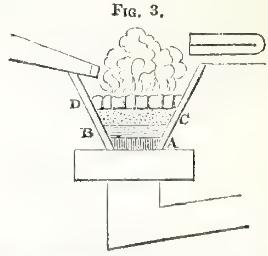


Fig. 1 shows a ground-plan of the furnace; Fig. 2 an elevation; and Fig. 3 the form of the fire itself and the position of the metal within it. The fire, D, is 24 inches long and 24 inches wide; A, A, A are metal plates, surrounding the furnace.

Fig. 2 shows the elevation, usually built of stone, and braced with iron bars. The fire, G, is 16 inches deep and 24 inches wide; before the tuyere, at B, a space is left under the fire, to allow the damp to escape, and thus keep the bottom dry and hot.

In Fig. 1 there are two tuyeres, but only one tuyere-iron, which receives both the blast nozzels, which are so laid and directed that the currents of air cross each other, as shown by the dotted lines; the blast is kept as regular as possible, so that the fire may be of one uniform heat, whatever intensity may be required.

Figure 3 shows the fire itself, with the metal, charcoal, and blast. A is a bottom of charcoal, rammed down very close and hard. B is another bottom, but not so closely beaten down; this bed of charcoal protects the under one, and serves also to give out carbon to the loop of steel during its production. C is a thin stratum of metal, which is kept in the fire to surround the loop. D shows the loop itself in progress.

When the fire is hot, the first operation is to melt down a portion of pig iron, say 50 to 70 pounds, according as the pig contains more or less carbon; the charcoal is then pushed back from the upper part of the fire, and the blast, which is then reduced, is allowed to play upon the surface of the metal, adding from time to time some hammer slack, or rich cinder, the result of the previous loop. All these operations tend to *decarbonise* the metal to a certain extent; the mass begins to thicken, and at length becomes solid. The workman then draws together the charcoal and melts down another portion of metal upon the cake; this operation renders the face of the cake again fluid, but the operation of decarbonisation being repeated in the second charge, it also thickens, incorporates itself with the previous cake, and the whole becomes hard; metal is again added until the loop is completed. During these successive operations, the loop is never raised before the blast, as it is in making iron, but it is drawn from the fire and hammered into a large bloom, which is cut into several pieces, the ends being kept separated from the middle or more solid parts, which are the best.

This operation, apparently so simple in itself, requires both skill and care; the workman has to judge, as the operation proceeds, of the amount of carbon which he has retained from the pig iron; if too much, the result is a very raw, crude, untreatable steel; if too little, he obtains only a steelified iron; he has also to keep the cinder at a proper degree of fluidity, which is modified from time to time by the addition of quartz, old slags, &c. It is usual to keep from two to three inches of cinder on the face of the metal, to protect it from the direct action of the blast. The fire itself is formed of iron plates, and the two charcoal bottoms rise to within nine inches of the tuyere, which is laid flatter than when iron is being made. The position of the tuyere causes the fire to work more slowly, but it insures a better result.

The quantity of blast required is about 180 cubic feet per minute, at a pressure of 17 inches water gauge. Good workmen make 7 cwt. of steel in 17 hours. The waste of the pig iron is from 20 to 25 per cent., and the quantity of charcoal consumed is 240 bushels per ton. The inclination of the tuyere is 12 to 15 degrees. The flame of the fire is the best guide for the workman. During its working it should be a red blueish colour. When it becomes white the fire is working too hot.

From this description of the process, it will be evident that pig iron will require a much longer time to decarbonise than the cakes of metal which have been roasted, as already described; and, again, it must be evident, that a *purified* and *decarbonised* metal, such as I have proposed, must be the best to secure a good and equal quality to the steel, since the purified metal is more homogeneous than the crude iron.

When, therefore, care has been taken in melting down each portion of metal, and a complete and perfect layer of steel has been obtained after each successive melting, when the cinder has had due attention, so that it has been neither too thick nor too thin, and the heat of the fire regulated and modified during the progressive stages of the process, then a good result is obtained; a fine-grained steel is produced, which draws under the hammer, and hardens well. However good it may be, it possesses one great defect; it is this. During its manufacture, *iron* is produced along with the steel, and becomes so intimately mixed up with it, that it injures the otherwise good qualities of the steel; the iron becomes, as it were, interlaced throughout the mass, and thus destroys its hardening quality. When any tool or instrument is made from natural steel, without it has been very well refined, it will not receive a *permanent* cutting edge; the iron part of the mass, of course, not being hard, the tool cuts only upon the steel portion, the edge very soon, therefore, becomes destroyed. There is another defect in natural steel, but it is of less importance. When too much carbon has been left, the steel is raw and coarse, and it draws very imperfectly under the hammer; the articles manufactured from such steel often break in hardening; thus it is evident, that in producing the steel, every care, skill, and attention are required at the hands of the workman. These defects very materially affect the commercial value of the steel; the irregular quality secures no guarantee to the consumer that the tools shall be perfect, and, consequently, it is not used for the most important purposes; yet, where the raw steel is refined, it becomes a very useful metal, and is largely used in Westphalia for the manufacture of hardware, scythes, and even swords. It possesses a peculiarity of retaining its steel quality after repeated heating, arising from its carbon being, as it were, incorporated with *each* molecule of the mass. This property renders it very useful for mining and many other purposes.

The raw steel, being so imperfect, is not considered so much an article of commerce with the manufacturer, but it is sold to the steel refiners, who submit it to a process of welding. The raw steel bloom is drawn into bars, one or two inches wide and half an inch thick, or less; a number of these are put together and welded; these bars are then thrown into water, and they are broken in smaller pieces to examine the fracture; those bars which are equally steelified are mixed together. In manufacturing refined steel, the degree of hardness is selected to suit the kind of article which it is intended to make. A bar, two to three feet long, forms the top and bottom of the bundle, but the inside of the packet is filled with the small pieces of selected steel. This packet is then placed in a hollow fire, and carefully covered from time to time with pounded clay, to form a coat over the metal, and preserve it from the oxidizing influence of the blast. When it is at a full welding heat it is placed under a hammer, and made as sound and homogeneous as possible; it is again cut, doubled together, and again welded. For very fine articles, the refining is increased by several doublings, but this is not carried at present to so great an extent as formerly, since cast steel is substituted, being in many cases cheaper. Although the refined natural steel is very largely consumed in Germany, and also in Austria, yet a considerable quantity is exported to South America, the United States, and to Mexico. The Levant trade takes a large portion, and is supplied from the Styrian and Carinthian forges. This is shipped from Trieste; it is sold in boxes and bundles. That in boxes is marked No. 0 0, up to 4. The 0 0 is the smallest, being about ¼ in. square; number 4 is about ½ in.; 0, 1, 2, and 3, being the intermediate sizes. It is broken in small pieces, about 3 to 7 inches long. In bundles of 100 lbs. the steel is drawn to various sizes, and is so packed. A large portion is sent to the East Indies, and also to the United States. For this kind of steel Halbach enjoys a high reputation, also Hassenclever, both Westphalian manufacturers.

The average price of that sold in boxes is £20 to £24 per ton; in bundles, £17 to £20; and the raw steel, as sold to the refiners, £15 to £18 per ton: whilst the refined steel increases in price according to the number of times it has been refined.

I take the manufacture of puddled steel as next in order, because the product is similar to that of natural steel, that being obtained direct from the crude pig iron. It is a steel of very recent invention, and its manufacture is

carried on entirely in Westphalia. But a few years ago a very small quantity of this steel was produced from *one* work. There are now several large establishments for its manufacture. The produce is becoming considerable, and likely to increase on account of its cheapness.

The object of the operation is similar to that adopted in the making of raw steel, to decarbonize pig iron down to that point at which it can be treated as steel. The process is this. About 280 lbs. of pig iron are charged into a puddling furnace. As soon as this metal begins to melt the damper is partly closed, and 12 to 16 shovelsful of cinder, &c., as it comes from the hammer and rolls, are thrown into the furnace; the whole is then melted down together, and the mass is puddled with great care. The metal having become so far decarbonized as to lose its liquidity, the damper is opened, and 40 lbs. of pig iron are charged near the fire-bridge of the furnace. This is allowed gradually to melt and mix itself with the metal previously charged, which causes it to boil; a blue flame rises from the surface of the mass, and very shortly the metal stiffens. The damper is again three-quarters shut, and the mass is worked until it becomes waxy. The metal is then collected into balls and hammered into blooms. This steel is very imperfect; too much depends upon the manipulation of the process; it is out of the sight of the workman, and equally from under his control, being continually covered with cinder. Practice has, no doubt, assisted materially in the improvements made in the manufacture of this steel since its introduction, but it is evident that steel produced by such a process can only be serviceable for the commonest purposes, being subject to many serious imperfections. The blooms resulting from the process described are drawn, doubled, and welded precisely in the same manner as charcoal raw steel is refined; yet, such is the acknowledged inferiority of this steel, that whilst charcoal natural steel sells for £18 per ton, the puddled steel will not command more than £14 per ton, and an equal reduction is made on the refined steel manufactured from puddled steel blooms.

The next process is the Paal method, so called from the name of the works at which the plan is used. These works belong to Prince Schwartzenberg, and are situated near to Murrau, in Styria. The process is based upon the old one of Vanaccio; it consists in plunging iron into a bath of melted metal. The carbon of the metal combines with the iron, and in a very short time converts it into steel. This process was carried further by Vanaccio, who contrived to add wrought iron to the metal until he had decarbonised it sufficiently; this was found to produce a steel, but unfit for general use. That produced by plunging iron into metal was found to be very hard steel on the outisde, but iron within; while that produced by adding iron to the metal was found too brittle to be drawn. The Paal method, however, as I saw it used at these works, is a decided improvement in the manufacture of refined natural steel. They produce natural steel at the prince's various works, and bring it to Paal to be refined. The packets, as already described in the refinement of natural steel, are welded and drawn to a bar; whilst hot they are plunged into a bath of metal for a few minutes, by which the iron contained in the raw steel becomes carbonised, and thus a more regular steel is obtained than that produced by the common process. The operation requires great care, for if the bars of steel be left in the metal too long they are more or less destroyed, or perhaps entirely melted. It commands a little higher price in the market, and is chiefly consumed by the home manufacturers, excepting a portion which is exported to Russia.

I have now described the manufacture of steel by various processes, in all of which the carbon is derived from the metal itself, and in which the whole of the molecules of the metal may be said to be equally charged; they contain the necessary amount of carbon, or steelifying principle, within themselves, and to this may be attributed the reason why, after repeated heating and hammering, the steel never loses its property of hardening. On this account natural steel is used almost exclusively by the Mexican and South American miners for their tools.

I shall now turn to the second mode of producing steel, by introducing carbon into iron to such an extent as may be needful for the various purposes to which it is to be applied.

In explaining the theory and practice of manufacturing natural steel, I have shown that the object is to prevent the mass from becoming iron, the process being arrested at that point where the metal has lost so much of its carbon that the *remainder* is necessary for it to possess as a steel.

The process of converting iron into steel by cementation is the reverse of the process already described. The iron to be converted is placed in a furnace stratified with carbonaceous matter, and on heat being applied, the iron absorbs the carbon, and a new compound is thus formed.

When this process was discovered is not known. At a very early period charcoal was found to harden iron and make it a sharper cutting instrument; it seems probable that from the hardening of small objects bars of iron were afterwards submitted to the same process. To Reamur certainly belongs the merit of first bringing the process of conversion to any degree of perfection. His work contains a vast amount of information upon the theory of cementation; and although his investigations are in many instances not borne out by the practice of the present day, yet the *first* principles laid down by him are now the guide of the converter; our furnaces are much larger than those used by Reamur, and they are built so as to produce a more uniform and economical result; they give, however, precisely the same results which he obtained in his small ones.

A converting furnace consists simply of two troughs, built of fire-brick—12 feet long, 3 feet wide, and 3 feet deep; the fire-room is placed between them, and the whole covered by an arched vault, so that the heat may pass entirely around these troughs, and distribute itself equally. The bar iron is placed within these troughs, stratum superstratum along with charcoal, which is broken to the size of beans. When the troughs are full they are covered with sand or loam, which partially vitrifies and cakes together as the heat of the furnace increases, and thus, by hermetically sealing the top, the air is excluded. This furnace being charged with about 20 tons of iron, the fire is lighted, and in the course of 60 to 70 hours the iron will have become fully heated; *at this point the conversion commences.* The pores of the iron being opened by heat, the carbon is gradually absorbed by the mass of the bar, but the *carbonisation* or conversion is effected, as it were, in layers. To explain the theory in the clearest manner, let me suppose a bar to be composed of a number of laminæ—the combination of the carbon with the iron is first effected on the surface, and gradually extends from one lamina to another, until the whole is carbonised. To effect this complete carbonisation the iron requires to be kept at a considerable uniform heat for a length of time. Thin bars of iron are much sooner converted than thick ones. Reamur states, in his experiments, that if a bar of iron 3-16ths of an inch thick is converted in 6 hours, a bar 7-16ths of an inch would require 36 hours to attain the same degree of hardness. The carbon introduces itself *successively*, the first lamina or surface of a bar combining with a portion of the carbon with which it is in contact, gives a portion of the carbon to the second lamina, at the same time taking up a fresh quantity of carbon from the charcoal; these successive combinations are continued until the whole thickness is converted; from which theory it is evident that from the exterior to the centre the dose of carbon becomes proportionately less. Steel so produced cannot be said to be perfect; it possesses in some degree the defect of natural steel, being more carbonised on the surface than at the centre of the bar. From this theory we perceive that steel made by cementation is different in

its character from that produced directly from crude metal. In conversion the carbon is made successively to penetrate to the centre of the bar, whilst in the production of natural steel, the molecules of metal which compose the mass are *per se* charged with a certain per centage of carbon necessary for their steelification; not imbibed, but obtained by the decarbonisation of the crude iron down to a point requisite to produce steel.

During the process of cementation, the introduction of the carbon disintegrates the molecules of the metal, and in the harder steel produces a distinct crystallisation of a white silvery colour. Wherever the iron is unsound or imperfectly manufactured, the surface of the steel becomes covered with blisters thrown up by the dilation of the metal and introduction of carbon between those laminæ which are imperfectly melted. Reamur and others have attributed this phenomena to the presence of sulphur, various salts, or zinc, which dilate the metal; but this is incorrect, because we find that a bar of cast steel which is homogeneous and perfectly free from internal imperfections never blisters, for although it receives the highest dose of carbon in the furnace, yet the surface is perfectly smooth. From this it is evident that the blisters are occasioned by imperfections in the iron. Iron increases, both in length and weight, during conversion. Hard iron increases *less* than soft. The augmentation in weight may be said to be $\frac{1}{200}$, and in length $\frac{1}{150}$, on an average.

The operation of conversion is extremely simple in its manipulation, nevertheless, it requires great care, and a long as well as a varied experience, to enable a manager to produce every kind or temper required by consumers. Considerable knowledge is required to ascertain the nature of the irons to be converted, because all irons do not convert equally well under the same circumstances; some require a different treatment from others, and, again, one iron may require to be converted at a different degree of heat from another. The furnace must have continual care, and be kept air-tight, so that the steel, when carbonized, may not again become oxidized. Generally speaking, in working converting furnaces, but little attention is paid to the theory of producing steel, which I have endeavoured to explain. It is known amongst steel-makers, that if iron be brought in contact with carbon, and if heat be applied, it will become steel. This is the knowledge gleaned up by workmen, and I may add, by too many owners of converting furnaces. The inconvenience arising from a want of care and knowledge of the peculiar state of the iron *during* its conversion, sometimes occasions great disappointment and loss. The success usually attained by workmen may, however, be attributable to an everyday attention to one object, thus gaining their knowledge from experience alone, good, I admit, in a workman, but this should not satisfy the principal or manager of a steel work. It is, perhaps, not needful that he should be a man of science, but I consider it the duty, as it certainly is the interest, of every owner of such works, not only to satisfy himself, but to be able to convince the minds of others, that he is fully conversant with the cause and effect of every operation in his business, and although a knowledge of chemistry may throw much light upon his operation, it is also necessary that he should possess a varied experience in conjunction with it, before he can pretend to produce steel of such superior and uniform quality as the arts require. The conversion, or carbonization of the iron, is the foundation of steel making, and, as such, may be considered as the first step in its manufacture. Before bar steel is used for manufacturing purposes, it has to be heated, and hammered or rolled. Its principal uses are for files, agricultural implements, spades, shovels, wire, &c., and in very large quantities for coach springs.

Bar steel is also used for manufacturing shear steel. It is heated, drawn to lengths 3 feet long, then subjected to a welding heat, and some six or eight bars are welded together precisely as described in the refinement of natural steel; this is called single shear. It is further refined by doubling the bar, and submitting it to a second welding and hammering; the result is a clearer and more homogeneous steel. During the last seven years the manufacture of this steel has been limited, mechanics preferring a soft cast steel, which is much superior when properly manufactured, and which can be very easily welded to iron.

The price of bar steel varies according to the price of the iron from which it is made, but, as a general average, its price in commerce may be taken at £5 per ton beyond the price of the iron from which it is made. Bar steel produced from the better irons is usually dearer than the commoner kind, on account of their scarcity.

Shear steel in ordinary size sells at £60 per ton nett.
Coach-spring steel from foreign iron, £22 ,,
Coach-spring steel from English iron, £18 ,,
These may be taken as approximate prices in 1854-5.

From the outline which I have given of the processes by which various steels are manufactured, it will be seen that that there are in each great defects, want of uniformity, temper, or clearness of surface, unfitting them for many useful purposes. To obviate these defects, both bar converted and also raw steel are *melted*, by which the metal is freed from any deleterious matter which the iron might have contained; a uniform and homogeneous texture is obtained, whilst an equality in temper or degree of hardness is secured; besides which the surface is capable of receiving a high, clear, and beautiful polish,—qualities which the other steels I have described do not possess. The first steel which may be called cast steel is the celebrated wootz of India; it is produced by mixing rich iron ore with charcoal in small cups or crucibles. These are placed in a furnace, and a high heat is given by a blast. After a certain time this ore melts and receives a dose of carbon from the leaves and charcoal charged with it. The result is a small lump of metal with a radiated surface about the size of a small apple cut in two; it is very difficult to work; nevertheless, swords and other steel implements are manufactured from it in the east; it is not found in England as an article of commerce. The melting of bar steel was first practically carried out by Mr. Huntsman, of Attercliffe, near Sheffield, whose son yet carries on its manufacture, for which he enjoys a very high celebrity, by making use of the best materials, and insisting upon the most careful manipulation of his steel in every process. The manufacture of cast steel is in itself a very simple process. Bar steel is broken into small pieces, which are put into a crucible, and are melted in a furnace about 18 inches square and 3 feet deep. The crucible is placed on a stand 3 inches thick, which is placed on the grate-bars of the furnace. Coke is used as fuel, and an intense heat is obtained by having a chimney about 40 feet high. Although a very intense white heat is obtained, yet it requires 3½ hours to perfectly melt 30lbs. of bar steel. When the steel is completely fluid, the crucible is drawn from the furnace, and the steel is poured into a cast-iron mould. The result is, an ingot of steel, which is subsequently heated and hammered, or rolled, according to the want of the manufacturers. Although I stated that the melting of cast steel is a simple process, yet, on the other hand, the manufacture of cast steel suitable for the *various wants* of those who consume it requires an extensive knowledge; a person who is capable of successfully conducting a manufactory, must make himself master of the treatment, to which the steel in manufactures will be submitted by every person who consumes it. Cast steel is not only made of many degrees of hardness, but it is also made of different qualities; a steel maker has, therefore, to combine a very intimate knowledge of the exact intrinsic quality of the iron he uses, or that produced by a mixture of two or three kinds together; he has to secure as complete and as equal a degree of carbonisation as possible, which can only be attained by possessing a perfect practical and theoretical knowledge of the process of converting; he has to know

that the steel he uses is equal in hardness, in which, without much practice he may easily be deceived; he must give his own instruction for its being carefully melted, and he must examine its fracture by breaking off the end of each ingot, and exercise his judgment whether or not proper care has been taken; besides all this knowledge and care, a steel maker has to adapt the *capabilities* of his steel to the *wants* and *requirements* of the consumer. There are a vast variety of defects in steel as usually manufactured; but there are a far greater number of instances in which steel is *not adapted* for the manufacture of the article for which it was expressly made. Cast steel may be maufactured for planing, boring, or turning tools; its defects may be, that the tools when made crack in the process of hardening, or that the tool whilst exceedingly strong in one part, will be found in another part utterly useless.

Cast steel may be wanted for the engraver. It may be produced apparently perfect, and with a clear surface, but may be so improperly manufactured, that when the plate has been engraved and has to be hardened, it is found covered with soft places. The trial is even greater when the engraving is transferred by pressure to another plate. I might cite a vast number and variety of instances in which cast steel is manufactured by unskilful persons, and for want of a proper knowledge of the treatment which the steel will receive after it has left his control, it is found more or less *unsuitable*. It is, therefore, evident that a steel maker must not only attend to the intrinsic quality of his steel, but he has to use his judgment as regards the degree of hardness and tenacity which it should possess, so as to *adapt it to the peculiar requisites of its employment*. Now as to the prevention of the defects I have mentioned, although it is a task requiring much practical knowledge, yet it is attained by many who, having combined a knowledge of their own business with that of their customers, have gradually earned for themselves a deserved reputation.

The manufacture of cast steel is open to great temptations, which may be termed fraudulent. Swedish iron, as I have already stated, varies in price according to its usefulness for steel purposes; cast steel may, therefore, be manufactured from a metal selling at £20 a ton, whilst the price charged for it to the consumer presumes it to have been made from a metal worth £30 per ton. The exterior of the bar is perfect, the fracture appears to the eye satisfactory, and its intrinsic value is only discovered when it is put to the test; thus, whilst a steel maker has to exercise his knowledge, judgment, and care, he has a moral duty to perform, by giving to his customer a metal of the intrinsic value he professes it to be, and for which he makes his charge.

In manufacturing the commoner descriptions of steel, particularly cast steel made from English iron, oxide of manganese has been largely used; its use produces malleability to a common metal, and the effect upon the steel during the operation of melting has been a subject of much speculative discussion, not only amongst scientific men, but also at the bar. The great question of the late Mr. Heath's patent is now before the House of Lords for their final decision. I cannot agree with any of the causes which have been set forth during the various discussions in the courts of law, as producing the effect every day obtained. I find no alloy of metallic manganese with steel, and certainly the very small quantity of carbon which the oxygen of the manganese takes up affects the degree of hardness very slightly.

I have examined this interesting matter, and in doing this I have set up no theory of my own, but I have carefully examined the scoria or slag produced, when oxide of manganese was used, and when it was not; the metal also has been carefully weighed before and after melting. In my experiments I used English iron, which is so coarsely manufactured that it is mixed up with much deleterious matter. In more nicely investigating this subject, I used a Swedish iron, which contained a large amount of silicate of iron. I charged two crucibles each with 30lbs. of this Swedish metal properly converted into steel. Into one I put 3 per cent. of oxide of manganese—into the other nothing. Both crucibles were in one furnace, and melted down in about the same length of time. In the crucible containing the oxide of manganese I got more slag and a little less metal than in the other. The ingot melted with manganese drew very sound under the hammer; the other was filled with cracks. On an examination of the metal and the slag resulting from each crucible, I found that the oxide of manganese had attacked and dissolved all the silicate of the metal it could find, as the metal gradually melted, and converted it, with other deleterious matter, into a glassy slag, which was very fluid. The steel being thus freed from these noxious matters, is precipitated by its own gravity, and the molecules of metal coming in closer contact by the removal of the foreign matter, which before more widely divided them, the metal is of greater density, and becomes very malleable under the hammer. There have been various attempts to produce a cast steel from the rich iron ores by converting them and subsequently melting, but although cast these can of course be so obtained, yet it has no defined temper or steel quality. Charcoal also has been added to bar-iron cut into small pieces, but although steel is thus obtained, the same ingot produces several different degrees of hardness, and sometimes ingots of no value whatever. The experiments of Cluoet, Mushet, Briant, and others, have equally been productive of no useful result.

I have endeavoured in the foregoing to give a clear, and at the same time a condensed description of the raw materials required, and the processes used, in the manufacture of each kind of steel found in commerce, either in England, the continent of Europe, or America, which concludes the first part of this essay.

In contrasting the steel manufacture of England with that of America and the continent of Europe, I propose first, to form an estimate of the *weight* of steel manufactured in each country, and of *its value* as an article of commerce; secondly, to show that England produces a greater weight of steel than the whole of the continent of Europe and America, and also, by a comparison of the degree of perfection attained in each country, to prove that whilst England produces a greater weight of steel, she also eminently excels other countries in her knowledge of this branch of manufacture.

From these two heads I shall show the importance of this branch of our industrial commerce as a source of wealth to the nation, and contrast the high superiority of the various steels made in England with those produced in other countries, proving not only that the annual value is of importance to us as a manufacturing community, but that our scientific knowledge and practical skill have placed us very greatly in advance of other nations in the production of steel.

The following Table shows the production of steel in France:—

| Year. | Raw Steel. | Converted Steel. | Total Production. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| 1826 | 3,257 | 1,500 | 4,757 |
| 1835 | 2,949 | 3,308 | 6,257 |
| 1840 | 3,546 | 3,859 | 7,405 |
| 1841 | 3,202 | 3,684 | 6,886 |
| 1842 | 3,527 | 5,812 | 9,339 |
| 1844 | 3,212 | 7,782 | 10,994 |
| 1845 | 4,004 | 8,369 | 12,373 |
| 1846 | 4,408 | 8,546 | 12,954 |

The manufacture of steel in France is considerable. They produce natural steel from the white iron of Dauphiny, and the metal produced from the spathose ores, which latter they import. The manufacture of converted

and cast steel, has, during the past ten years, become important. The principle works are situated at St. Etiénne, at which Swedish iron is mostly used, as at Sheffield. Although the French produce a considerable weight of cast steel, yet its quality is by no means equal to that produced in England, since English cast steel is now largely imported, particularly for superior purposes.

Of the above it must be noticed that the raw material is not the manufacture of the country, but a large portion is imported from Sweden, yet the Table shows the weight of steel produced annually in this country.

In 1846, the produce is estimated at 12,954 tons, of which 4,408 were raw or natural steel, and 8,546 converted steel.

There is no return of refined steel, but as it is manufactured from the raw steel, it does not affect the statistical account. Cast steel being only made by two or three houses in France, the weight is not to be exactly obtained.

The raw steel is higher in France than in other countries, as it is protected by the import duties. I estimate it at £25 per ton.

The weight of cast steel I estimate in round numbers at 2000 tons, which I value at £60 per ton, on account also of the protective duty. The iron for this production is imported.

The value of the steel produced in France is

| | £ | s. | d. |
|---|---|---|---|
| 12,954 tons natural and converted steel, at £25 per ton . . . . | 323,850 | 0 | 0 |
| 2,000 tons cast steel, at £60 per ton . | 120,000 | 0 | 0 |
| 14,954 tons. | £443,850 | 0 | 0 |

In the Prussian dominions the major part of the steel produced is manufactured in Westphalia, around Remscheid, Lohngen, and Hagen. A portion is made in Silesia, Thuringia, and the Brandenburg district, in which there exist several converting furnaces.

The produce of the kingdom is as follows:—

| Year. | Raw Steel. | Refined Steel. | Cast Steel. |
|---|---|---|---|
| 1837 | 103,938 | 42,472 | 682 |
| 1838 | 101,820 | 60,308 | 818 |
| 1839 | 100,526 | 56,309 | 727 |
| 1840 | 97,930 | 68,602 | 636 |
| 1841 | 100,697 | 69,496 | 909 |
| 1842 | 95,926 | 61,483 | 909 |
| 1843 | 107,730 | 60,794 | 909 |
| 1844 | 100,642 | 68,391 | 1,500 |
| 1845 | 109,427 | 70,480 | 1,750 |
| 1846 | 81,966 | 47,449 | 1,223 |
| 1847 | 112,672 | 54,209 | 4,357 |
| 1848 | 105,276 | 51,644 | 5,069 |
| 1849 | 88,040 | 53,661 | 11,121 |
| 1850 | 107,674 | 68,379 | 17,645 |

These Weights are in Prussian Zentners.

In this Table the converted steel is included in the weight of raw steel, from which material both refined and cast steel are produced.

The number of furnaces employed to produce this steel are, 143 charcoal fires, or refineries for raw steel; 105 furnaces for refining raw steel; 7 converting furnaces; 58 melting holes, or furnaces.

In 1850 the Brandenburg district produced 3160 zentners of converted steel.

| | Zentners. | |
|---|---|---|
| Silesia produced . . | 1,630 | raw steel |
| Sax Thuringia . . | 4,918 | do. |
| Westphalia . . . | 41,261 | do. |
| ,, . . . | 57,220 | refined steel. |
| ,, . . . | 17,336 | cast steel. |
| Rhenish Prussia . . | 56,605 | raw steel. |
| ,, . . . | 11,159 | refined steel. |
| ,, . . . | 309 | cast steel. |

The refined steel is largely used in the manufactures of the country; a further quantity is exported to the United States of America, to France, and to Spain. The raw steel is used for common purposes. The cast steel is principally made into railway springs and axles. The refined steel is of course manufactured from the raw steel.

In estimating the value of the whole produce, I deduct the waste of metal which arises from the refining process so as to obtain the nett remainder of raw steel; this waste I estimate at 15 per cent. upon the weight produced in 1850, 68,379 cwt.; this will consume 78,634 cwt. Also, cast steel made both from raw and converted steel.

Of the 17,645 cwt. manufactured, I estimate 10,000 cwt. as produced from raw steel, and 7,645 from converted steel. 88,634 cwt. of raw steel is therefore consumed in the manufacture of refined steel and cast steel, leaving 19,040 cwt. for common uses, or exportation.

I estimate the whole of these products as follows:—

| Cwt. | Tons. | | |
|---|---|---|---|
| 68,379 or | 3,419 | refined steel, at 100 dols. per 1,000 lbs. Prussian, or £30 | £112,570 |
| 17,645 or | 882 | of cast steel at £45 per ton | £39,690 |
| 19,040 or | 952 | raw steel, at 65 dols. per 1000 lbs. Prussian, or £19 10s. . | £18,564 |
| | 5,253 tons. | | £170,824 |

The weight of pig iron consumed in Austria in 1848 was 368,000 cwt., equal to about ten per cent. of the whole product of the blast furnaces of that country, including Hungary. This metal produced 287,300 cwt. of raw steel, of which 80,000 to 90,000 cwt., or 4,500 tons, were consumed in the country in the form of steel, more or less refined, for the manufacture of scythes, files, and tools, besides the raw or common steel used for agricultural implements and the like.

The exportation in five years, from 1843 to 1847, was equal to 87,120 cwt., or 4,356 tons, shipped from Trieste to the Levant, Mexico, and South America.

The product of converted steel in 1848 was 125 tons; the product of cast steel in 1848 was 210 tons, obtained chiefly from the melting of raw steel.

From the above statement the product of refined steel is 8,856 tons, and 15 per cent. for waste in producing it from raw steel; and I find it requires 10,184 tons to produce it, leaving 4,181 tons of raw steel for common purposes, named above.

I estimate the whole produce of Austria as follows:—

| Tons. | | £ | s. | d. |
|---|---|---|---|---|
| 4,500 | refined steel, for manufacturing in the country, at £30 per ton . | 135,000 | 0 | 0 |
| 4,356 | steel exported, all sizes, averaged at £24 per ton . . . . . . | 104,544 | 0 | 0 |
| 4,181 | raw steel, used for common purposes, £19 10s. per ton . . . | 81,529 | 0 | 0 |
| 13,037 Tons. | | £321,073 | 0 | 0 |

Sweden produces both keg and steel in faggots, which is chiefly shipped to the East Indies. The demand is very variable for this steel, and whilst at one time a considerable quantity may be produced if the demand is brisk, at another their forges produce iron, which they can at all times either sell or send to the general depot at Stockholm.

Denmark, Holland, Spain, Portugal, Sardinia, and Italy, produce no steel of importance.

In the United States of America raw or natural steel is not produced; the only kind at present manufactured is converted steel, produced from the Russian and Swedish irons so largely imported by them. In a country which is advancing so rapidly it is impossible to form any distinct estimate of the weight manufactured, but from my personal knowledge of the extent of it I consider that 10,000 tons is a large estimate. Several attempts have been made to produce cast steel in New Jersey and Pittsburg, but hitherto without success.

The American blister steel is quoted at 5 cents per lb., or 102 dols. per ton, which, at 8 per cent. exchange, is equal to about £21 5s. per ton; on 10,000 tons this would represent a value of £212,500.

The manufacture of steel in England is chiefly confined to Sheffield, although it is also made at Newcastle and in Staffordshire. I have already shown, in the early part of this essay, that the importation of Swedish iron, combined with that furnished from English materials, amounts to from 40,000 to 50,000 tons per annum; of course this weight represents the quantity of steel manufactured of every description.

Mr. Scrivenor estimates the number of furnaces in Sheffield and its neighbourhood as follows:—

| | Converting Furnaces. | Cast steel Furnaces. or holes. |
|---|---|---|
| 1835 | 56 | 554 |
| 1842 | 97 | 774 |
| 1846 | 105 | 974 |
| 1853 | 160 | 1495 |

Now a converting furnace will produce 300 tons of steel per annum, but if I estimate each to produce 250 tons, 160 converting furnaces would represent a make of 40,000 tons of steel a year in Sheffield alone. Again, he says there are 1495 melting holes; now each furnace of 16 holes will melt 200 tons; this, therefore, shows a product annually of 29,900 tons, but as such furnaces may not all be in continual work from various causes, I have estimated the quantity of cast steel manufactured in Sheffield at 23,000 tons. The weight of coach spring steel, I have estimated at 10,000 tons, leaving a remainder of 7000 tons of bar for the manufacture of German, faggot, single and double shear steel. As regards the price, I take cast steel at 45*l.* per ton; its commercial value varies from 35*l.* to 60*l.* per ton nett, and as a large quantity of the cheaper steel is sold, I have fixed 45*l.* per ton on an average. The price of bar steel is below the real value, since it includes all shear steel, the best of which sells at 60*l.* per ton, whilst, however, a portion of this 7000 tons sells only at 28*l.*, and some even lower. The price of coach springs is the price now paid for them.

I estimate the weight and value of the steel made in England as follows:—

| Tons. | | £. | s. | d. |
|---|---|---|---|---|
| 23,000 | of cast steel, all qualities, at £45 per ton | 1,035,000 | 0 | 0 |
| 7,000 | bar steel, including German, faggot, single and double shear steel, average £35 per ton | 245,000 | 0 | 0 |
| 10,000 | coach-spring steel, £19 per ton | 190,000 | 0 | 0 |
| 40,000 Tons | | £1,470,000 | 0 | 0 |

From the foregoing statistics, we find that

| | | | | £ | s. | d. |
|---|---|---|---|---|---|---|
| France | produces | 14,954 tons, | average value of | 443,850 | 0 | 0 |
| Prussia | ,, | 5,453 tons, | ,, | 170,824 | 0 | 0 |
| Austria | ,, | 13,037 tons, | ,, | 321,073 | 0 | 0 |
| United States | ,, | 10,000 tons, | ,, | 212,500 | 0 | 0 |
| England | ,, | 40,000 tons, | ,, | 1,470,000 | 0 | 0 |

Such is the contrast of the manufacturing power of the steel-producing countries; it shows the eminent position of England, in both weight and value; this can only arise from the practical skill and scientific knowledge which we have brought to bear upon its manufacture; and the active energy which has enabled us to produce steel *suitable for every purpose in the arts.* This superiority not only enables our manufacturers to maintain the high position they now hold, but to increase it yet further; for we daily see our production expanding, not only to supply the wants of our home manufactures, but also for the continent of Europe, as well as the United States of America and Canada.

In conclusion, I may add, that whilst it is a business which affords a fair manufacturing profit to those who have embarked in it, it also adds very largely to the wealth of the empire. The working-classes also enjoy its benefits; independent of the well-paid labour required to produce steel to the value of one and half millions sterling, it gives occupation to the collier by causing a consumption of 120,000 tons of coals annually. I add

A LIST OF THE DUTIES IMPOSED BY VARIOUS COUNTRIES UPON STEEL.

| | |
|---|---|
| The Zollverein | 1 dollar, 15 silver groschen per cwt. |
| Austria | 4 florins, per Vienna centner. |
| Belgium | 80 centimes per 100 kilogrammes, about 2 cwt. |
| France | £13 4s. 0d. per ton on bars, £32 per ton on sheets. |
| Sweden | Cast steel, 6 rix-dollars; refined steel 15 rix-dollars; raw and converted steel, prohibited. |
| Russia | 75 copecks per pood, = to 36lbs. English. |
| Holland | 20kreutzers per Dutch centner. |
| United States of America | 15 per cent. ad valorem on cast, shear, German, &c., in bars; and 20 per cent. ad valorem on sheet and blistered steel. |

## DISCUSSION.

Mr. Harry Scrivenor, in a letter to the Secretary, says, "The process of the manufacture of steel is generally but little known in this country, but it is, and is still more becoming, a most valuable addition to our home manufacture. And it is with somewhat a proud feeling we may say, that while we almost monopolise the make of iron, we can also so far naturalise the make of steel that in its production we are enabled to leave all other countries far behind us." * * * "The great improvement in the manufacture of steel is stated by Dr. Ure to have originated with Mr. Josiah M. Heath, who took out a patent in 1839. One immediate consequence of his discovery was a reduction in the price of good steel in the Sheffield market of from 30 to 40 per cent. His claims have been disputed, and Mr. Sanderson says the great question of the late Mr. Heath's patent is now before the House of Lords for their final decision. Mr. Heath's patent introduced a portion of carburet of manganese into the melting-pot, along with the usual bars of blistered steel, and he found that a common bar steel, made from an inferior mark or quality of Swedish or Russian iron, would, when so treated, produce an excellent cast steel. I was lately speaking to a steel-manufacturer of Sheffield on the subject of this patent. He said we use no manganese in our improvements, and the steel was made from English materials. Some years back I was connected with a company which had steel works, and the principal foreign iron which they used was a celebrated Russian make (the Demidoff mark). This mark is not mentioned by Mr. Sanderson; but from an observation he makes that, "in the manufacture of common steel, particularly that for *railway springs*, a very large quantity of steel iron is produced from English materials." I am led to suppose that the Russian iron has in a great degree been superseded by English improvements, as the principal sale of the steel made from the above was for *coach springs*. If I am right, it is a great step in advance, and certainly the imports of iron from Russia have very materially decreased of late years."

The Chairman remarked that the paper they had heard read that evening was of so comprehensive a character as to leave little room for more to be said upon the subject. It was extremely gratifying to have a paper of this kind, because, it would be remembered, that the Society of Arts had on various occasions encouraged improvements in the manufacture and use of steel; he more particularly alluded to

the premiums offered by the Society for a cast trowel, and also the improvement in the adaptation of steel plates to engraving purposes; those beautiful engravings with which the Annuals and other books were adorned, were in the first instance encouraged and promoted by the Society of Arts. Although the art of engraving on steel was probably known to Albert Durer, yet the Society of Arts took a very prominent part in the improvements in steel engraving for printing purposes. He need not say one word upon the value of steel for many purposes in the arts. He would only allude to the familiar instance of the balance-spring of a watch, specimens of which were before him—one weighing half a grain, and another about a quarter of a grain—whilst in some parts of the movements the springs did not weigh more than the tenth part of a grain; and every gentleman was aware of the value of the balance-spring of his watch whenever he had the misfortune to break it.

A Gentleman wished to ask Mr. Sanderson whether he had used peat charcoal in the manufacture of steel, and with what results?

Mr. Sanderson said he had used peat charcoal in the manufacture of iron in the common charcoal refinery, and he had made a ton of iron of good quality and with less fuel than when wood charcoal was used.

Mr. Isaac Dodds (of Rotherham) directed attention to a variety of specimens of edged tools, and also English iron, manufactured under a new patent for effecting a partial steel conversion, upon the case hardening principle. The files exhibited were forged and cut in the *iron*, and subjected to the steeling or case hardening process. The material used was simply a mixture of charcoal with some of the bicarbonates and a little soda ash. He did not say they were superior to the cast steel files, but they answered all the purposes, and were produced at less cost, although they were an article that was scarcely as yet in the market. The same process, he said, also extended to the making of other cast steel tools, and also in the manufacture of railway axles and rails. Allusion had been made to the use of manganese in the manufacture of cast steel. He begged to state, that by Dodds' patented process manganese was not employed, and the grain of the metal was clearer, with less scoria and less liability to fracture than under the old process, besides which the steel was more easily tempered than that in which manganese was used. Some cutting tools were of such dimensions that they could not be made of steel, because the contraction was so great that they would break in the hardening, and here again, the process he had described applied, and by the same means an improvement had been made in the manufacture of steel wire, by which an article was obtained equal to that which was manufactured abroad. The process had become so uniform in its character, that garden tools, cutting tools, including augurs, &c., had been manufactured by it. He had nothing to add to Mr. Sanderson's paper, as that gentleman had probably a much greater practical acquaintance with the subject than he (Mr. Dodds) could lay claim to, his object being merely to call attention to an article that was as yet scarcely in the market, but which, it was believed, would have very general application.

Mr. Richard Knight observed that the statement made by Mr. Sanderson, that, in order to obtain steel of a good quality, the iron from which it is converted should of itself be of a certain degree of purity, was borne out by the magneto-electrical experiment of placing two bars of good quality iron in the dip of the magnetic meridian, and rotating a soft iron armature in the immediate vicinity of their poles. By this arrangement a very considerable deflection of the galvanometer needle was obtained upon making the necessary connection with that instrument. The iron bars were than removed and subjected to a process of decarbonisation, when they were again placed in the magnetic dip, and similarly treated in connection with the galvanometer, when an increased deflection of the needle was obtained. On the other hand, should the iron bars upon removal be subjected to a process of carbonisation, or in other words be converted into steel, then upon similar treatment in the magnetic dip a decrease would take place in the deflection of the galvanometer needle. But should these experiments be attempted with iron of bad or impure quality, they would be found very unsatisfactory if not entirely to fail, as the carbonisation as well as the decarbonisation of impure iron was attended with great uncertainty as to the results.

Mr. Siemens was not prepared to enter into a discussion of the paper, but it might not be uninteresting to state to the meeting some new applications of steel which had come under his notice. In visiting the workshops of his friend Mr. F. Crupp (of Essen, in Westphalia), he had seen steel applied in large bulks to the various parts of machinery, such as railway axles, and railway tyres, the latter being formed of cast steel in a very ingenious manner. A flat bar of steel was taken, two holes were bored in the ends of the bar, and by powerful machinery it was cut through from hole to hole. It was then opened out, and between rollers a perfect tyre was made without a weld. He had seen one tyre which, after running 30,000 miles, presented scarcely any appearance of wear on its surface. Another application of steel was to railway axles and crank axles of locomotive engines, where again the metal was called upon to sustain a great amount of wear and tear. He thought in all these cases the very best metal ought to be used, which in the end would always be found the cheapest, the excessive value of the steel being more than compensated by the greater load that could be put upon it, and by the much reduced wear and tear. Mr. Crupp was known to the British public by the steel gun, and the large steel rollers for rolling mills, which were so favourably noticed at the Great Exhibition.

Mr. Dodds remarked, that the steeling of the tyre of railway wheels was not a novel process, but had been patented some time ago by Mr. Sidney Jessop, but the cost was greater than some railway companies liked to incur, although he believed a great many tyres of that description were now in use. There was this advantage in them, they had all the toughness of the inner part of the tyre with all the additional wearing power of the outer portion of the tyre; and it was the same with axles, which could be supplied up to twenty tons weight. He would be happy to submit one of the axles to the inspection of the Society. The same method was now applied to the manufacture of spring steel, and he had been told they were very excellent.

Mr. Griffiths said, it would be desirable if some gentleman acquainted with the subject would explain the means by which it could be ascertained when steel was of a proper quality adapted for particular manufactures. They knew that in the manufacture of steel it assumed from time to time a variety of prismatic hues, from the pale straw-colour up to the dark blue. For his own part he was not acquainted with any index for such operations, and he thought a few facts on that subject would be interesting to the meeting.

The Chairman said, that rather related to the tempering of the steel by the workman than to its manufacture.

Mr. Sanderson explained that steel was hardened by being, when in a heated state, suddenly plunged into cold water or oil, which produced expansion, although some persons called it contraction, but it was in fact expansion. The steel was then too hard for any purpose. It was afterwards put into a fire and gently heated, and it then came to a straw colour, applicable to one purpose, or to a blue colour, applicable to another purpose; but the workman, by daily and constant practice, by observing the oxidisation on the surface of the metal, knew when the coat was sufficiently tempered to preserve the elasticity required for the purposes to which it was intended to apply the tool.

The Chairman than proposed a vote of thanks to Mr. Henderson for his excellent paper, which was passed by acclamation.

The Secretary announced that the paper to be read at the meeting on Wednesday next, the 16th inst., was on "The Capabilities for Mercantile Transport Service of Steam Ships," by Mr. Charles Atherton.

## INTERNATIONAL COMMERCIAL LAW.

### REPORT OF THE SUB-COMMITTEE.

A copy of the following report was placed in the hands of the President of the Board of Trade, by the deputation which waited upon him, as reported in the Journal of 6th April.

REPORT.

The Sub-Committee appointed to report on the desirableness of an application being made to the Board of Trade to support the propositions for a Congress at Paris, now under the consideration of the French Government; and on the particular points to be urged upon the President of the Board of Trade by such deputation; and also to enquire at the Foreign Office whether there are any means of ascertaining the general nature of the internal questions of commercial law which occur between British subjects and the subjects of Foreign States abroad, and whether such questions are frequently brought under cognizance of the British embassies and consulates; and further, to inquire at the Colonial Office whether the expediency of assimilating the colonial law has been considered, or any steps taken in relation thereto,—have now to report that with reference to the Colonial Department they learn that no particular measures have been prepared, or are at present contemplated in that department, for the assimilation of the divers laws now in force within our Colonies.

It appears probable, that in some of them, the laity, as well as the lawyers, within the Colonies, would be prepared to maintain, in respect to some of the laws, that they have the advantage over the English laws, and that the Department would not be prepared to dispute that advantage, or to rely on the opinion of English practising lawyers as to the superiority of their own law and practice. In this position, there would appear to be an advantage in referring the question of superiority of particular portions of substantive law to the examination of merchants, or competent and impartial laymen of different countries, aided by jurists, but by the appointment of English Law Officers the process of assimilation is quietly extending itself.

From the Foreign Office the Sub-Committee have not yet obtained the detailed information they seek; but they learn generally that a certain amount of correspondence is entailed upon that office by the differences in commercial law, domestic and foreign. The Sub-Committee still propose to pursue those inquiries.

The Sub-Committee also report that from inquiries made they learn that the report of the Mercantile Law Commission is now in a forward state, and will be presented to Parliament during the present session, and that it is probable it will be favourable to the expediency and practicability of the assimilation of the commercial laws of the United Kingdom.

The Sub-Committee have further to report that it is expedient that a deputation should wait upon the Board of Trade, for the purpose of presenting to the Right Honourable the President, the influentially-signed memorial praying that Her Majesty's Government will support the proposition already entertained by the French Government, of holding in Paris, during the ensuing summer, a Congress upon International Commercial Law.

Upon a general review of the subject, the Sub-Committee are of opinion that the following points should be specially pressed upon his attention, being of a practical character, interesting to the commercial classes, and such as it would be most desirable in the first instance to bring before the proposed Congress.

Partnership en Commandite.—Although much has been written on this subject, and its introduction into this country is extensively demanded, the real practical working of such partnership in Europe and America is not sufficiently known.

Anonymous Partnerships.—The authority for the formation of such partnerships in different States being in the hand of Government, much difficulty is generally experienced in obtaining it, whilst the cost in many countries is great.

Bills of Exchange.—The laws of different nations in respect to these instruments (essentially of an international character), prescribe different forms, and subject them to various legal incidents. Thus, where the Code Napoleon prevails, and elsewhere, a bill must be drawn in one place and be made payable in another, and must also contain certain words and indications which in England are not required. Under that code, bills must be accepted by name and in writing on the bill. In England, a foreign bill may be accepted by any word implying acceptance, and even by an instrument, as a letter or any paper, detached from the bill. An indorsement in some countries must be in full, in others, as in this country, it may be "in blank," by the mere signature on any part of the bill. The days of grace also differ in many towns and states.

Shipping.—In this country the ship owner's liability for the acts of the master is unlimited. In others it is limited to the ship and freight, and in others the owner has a right to abandon the ship when he declines to acknowledge the expence of the repairs, &c., by the master. The value of bills of lading is greater in other countries than in this.

Marine Insurance.—Many of the practices at Lloyd's are different from the insurance practice at Hamburg and other states. In some countries an insurance on profit, freight, and wages of seamen is prohibited, and in others it is permitted.

Bankruptcies.—A better system for international communication in regard to the rights of creditors to notices of meetings, dividends, &c., seems necessary. In the constant changes effected in our bankrupt law we might with advantage examine the foreign systems, the mode of division of assets, the classification of debts with different claims of precedence, the amount of restraint or punishment inflicted on fraudulent bankrupts, the value of acts done in view of bankruptcy, and the publication of the main causes of bankruptcy being all subjects of great importance.

Imprisonment for Debt.—The right of creditors on the person of the debtor, differing widely in many states, might advantageously be inquired into.

Law of "Foreign Attachment."—How far such a law exists on the Continent as it does in the city of London, and what are its principal objects and privileges, is a matter for inquiry.

Tribunals of Commerce.—It would be important to ascertain what is the best mode of settling commercial disputes, whether by the regular or exceptional courts—the constitution and practice of Industrial courts, such as the Court of "Prud'hommes;" also how far the principle of arbitration is acted on abroad, whether by forced or voluntary means. All such inquiries would facilitate the amendment and assimilation of International Commercial Law.

International Patentright and Copyright, Monies, Weights, and Measures, and the Laws of War relating to Commerce are also of great importance, and would form appropriate subjects of discussion at the proposed congress in Paris; but their being of a political character, and dealt with by treaty, the consideration they demand is probably greater than could be bestowed on them in connection with the more limited topics of international Commercial Law.

# Proceedings of Institutions.

LONDON.—From the fifth annual report of the London and South Western Railway Literary and Scientific Institution, it appears that the receipts during the year amounted to £254 15s. 4d. This is greatly in excess of the previous year, due to the extended working of the classes and the maintenance of the library; but the balance to the credit of the present year shows a small increase on that of the former year, being £25 11s. 0d. as against £21 5s. 5d. The evening school has enrolled no less than 68 boys; at a certain period the schoolroom was incapable of accommodating more than 30 of that number, but the removal of the school to a larger room has removed this difficulty, and there are now 76 on the list. By the liberality of the directors of the Railway Company, the whole of Brunswick-house, Wandsworth-road, has been fitted up and made available for the purposes of the Institution.

## MEETINGS FOR THE ENSUING WEEK

MON. Geographical 8½. 1. Prof. Paul Chaix, "Notes on the passage of Hannibal across the Alps, and the valley of Beaufort, in Upper Savoy." 2. M. Susini, "The Amazon and the Atlantic water-courses of South America." 3. Copies of letters from Drs. Barth and Vogel, respecting the progress of the Central African Mission."

TUES. Pharmaceutical, 12 a.m. Anniversary.
Royal Inst. 3. Dr. Tyndall, "On Voltaic Electricity."
Civil Engineers, 8. Mr. L. E. Fletcher, "Description of the Landore Viaduct, on the South Wales Railway."
Pathological, 8.

WED. Society of Arts, 8. Mr. Charles Atherton, "The Capabilities for Mercantile Transport Service of Steam Ships, with reference to the Mutual relations of their Tonnage, Displacement, Engine Power, Steaming Speed, Distance to be run without re-coaling, Tons weight of Cargo conveyed, and the Expenses per Ton weight of Cargo."
Geological, 8. 1. Mr. A. K. Isbister, "Geological Notes on the British Possessions in North America, accompanied with a Geological Map." 2. Mr. W. Bray, "Notes on the Geology of Georgia, U.S." 3. Mr. C. Forbes, "On the Geology of the Coal-bearing Rock of the Middle Island, New Zealand."

THURS. Royal Inst. 3. Mr. G. Scharf, jun., "On Christian Art."
Antiquaries, 8.

FRI. Royal Inst., 8½. Mr. J. P. Lacaita, "On Dante and the Divine Commedia."

SAT. Asiatic, 2. Anniversary.
Royal Inst., 3. Dr. Du Bois Reymond, "On Electro-Physiology."
Royal Botanic, 3¾.
Medical, 8.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 1st May*, 1855.

Par. No.
65 (3). Trade and Navigation—Accounts (31st March, 1855).
93. Bills—Downing-street Public Offices Extension.
94. Bills—Woolmer Forest.
97. Bills—Dissenters' Marriages.
98. Bills—Friendly Societies (as amended by the Committee, on Recommitment, and on second Recommitment).
Public General Acts—Cap. 13, 14, 15, 16, and 17. (Delivered on 30th April, 1855.)

*Delivered on 2nd May*, 1855.

110. Local Acts (28. London and South-Western Railway; 29. Hartlepool Pier and Port; 30. West Somerset Mineral Railway; 31. Grand Surrey Canal; 32. Weymouth Waterworks)—Reports from the Admiralty.
100. Bills—Militia (No. 2).
101. Bills—Cinque Ports.

*Delivered on 3rd of May*, 1855.

197. Shipping—Returns.
202. Committee of Selection—11th Report.
205. Deficiency Bills—Return.
95. Bills—Personal Estates of Intestates.
102. Bills—Newspaper Stamp Duties (amended).
103. Bills—Carlisle Canonries.

*Delivered on 4th of May*, 1855.

110. Local Acts (33. Barrow Harbour; 34. Great Western and Brentford (Thames Junction) Railway—Reports from the Admiralty.
199. Turnpike Trusts (Ireland)—Abstract of the General Statements of Income and Expenditure.
92. Bill—Parish Constables.

*Delivered on 5th of May*, 1855.

200. Foreign Troops—Return.
203. State Carriages—Returns.
206. Revenue and Expenditure—Account.
210. Criminal and Statute Law Commissions—Returns.
213. Foreign Officers—Return.
214. Army—Return.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, May 4th*, 1855.]

*Dated 23rd February*, 1855.

400. J. Norton, Dublin—Cartridges.

*Dated 1st April*, 1855.

456. T. Kennedy, Kilmarnock—Wadding for firearms.

*Dated 5th March*, 1855.

491. C. L. Fowle, Massachusetts—Stitching machines. (A communication.)

*Dated 9th March*, 1855.

539. W. Smith, 10, Salisbury-street, Strand—Safety harness.

*Dated 15th March*, 1855.

583. N. Robinson, J. Lister, and H. Stevenson, Bradford—Looms for weaving cocoa-nut matting, &c.

*Dated 26th March*, 1855.

672. C. Armbruster, Andermach, and O. Laist, Pfeddersheim—Sulphate of soda.

*Dated 28th March*, 1855.

681. F. G. Mulholland, 44, Vincent-square, Westminster—Fire-proof and waterproof roofing, flooring, and covering.
683. J. Higgin, Manchester—Thickener for mordaunts and colours for printing woven fabrics.
685. W. Hutchinson, Tunbridge-wells—Artificial stone.
687. J. Revell, Duckinfield—Propelling vessels.
689. G. H. Nicholl, Dundee—Laundry stoves.
691. W. H. Gauntlett, Banbury—Apparatus for cutting tools.

*Dated 29th March*, 1855.

693. F. W. Mowbray, Shipley, near Leeds—Axle bearings.
695. F. J. Anger, 16, Stamford-street—Preservation of vegetable substances.
697. W. Brown, 5, Catherine-street, Cornwall-road—Sheet metal casks and kegs.
699. A. McDougall, Manchester—Consuming smoke.
701. A. Dalgety, Deptford—Steam engines.
703. R., W. W. and R. (jun.) Johnson, 4, Waterloo-place, Limehouse—Covering for surfaces, linings, roofs, &c.

*Dated 30th March*, 1855.

705. A. Bère, Lille—Steam boilers.
709. W. Tytherleigh, Birmingham—Covering iron with copper.
711. M. Prentice, Stowmarket, and T. Richardson, Newcastle-on-Tyne—Manures.
713. M. Prentice, Stowmarket, and T. Richardson, Newcestle-on-Tyne—Manures.
715. T. W. Bunning, Newcastle-on-Tyne—Steam engines.

*Dated 31st March*, 1855.

717. A. Shanks, 6, Robert-street, Adelphi—Hand drilling machines.
719. J. B. Surgey, Lidlington-place, St. Pancras—Threading needles.
721. R. Hardman, Bolton-le-Moors—Looms.
725. T. R. Crampton, Adelphi—Furnaces. (A communication.)
727. T. Hedgcock, R.N., 7, Cavendish-grove, Wandsworth-road—Quadrant.

*Dated 2nd April*, 1855.

529. F. Phillips, Downham, near Brandon—Distributing manure, sowing seeds, &c.
731. J. Taylor, Hounslow—Covers for books.
733. R. S. Newall, Gateshead—Standing rigging of ships.
735. G. W. Friend, 52, High Holborn—Umbrellas and parasols.

*Dated 3rd April*, 1855.

737. F. T. Botta, Paris—Beer brewing.
739. H. Chapman, Kingsland—Supplying and adjusting electrodes used in the production of electric light.
741. P. R. Jackson, Salford—Making patterns and moulding.
743. W. H. Tooth, 2, Pilgrim-street, Kennington-lane—Floating vessels and machinery, and steam signals.
747. J. Cowen, Greycoat-street, and J. Sweetlong, Earl-street, Westminster—Locomotive land battery.
749. F. Joyce, Upper Thames-street—Percussion caps.
751. S. Greenwood, Sunderland—Rivets, bolts, nuts, &c.

*Dated 4th April*, 1855.

753. J. Crowley, Sheffield—Malleable cast-iron.
755. L. A. M. Mouchel, Paris—Joining pipes, tubes, and ducts. (A communication.)

*Dated 5th April*, 1855.

757. W. Goostry, G. Hulme, and C. Hough, Chedderton—Paper.
759. J. Chesterman, Sheffield—Knives.
761. C. Goodyear, Paris—Self-inflating pontoons and life-preservers.
763. J. E. Frost, 135, Goswell-street—Ball cocks.

766. H. M. Holmes, Derby—Tyres for wheels.
767. A. H. A. Durant, Tong Castle, Salop—Axle and axle-box.

*Dated 7th April*, 1855.

769. W. B. Hays, 47, Cambridge-street, Pimlico—Breakwater.
771. H. Gerner, Moorgate-street—Polygraphic writing and drawing apparatus.
773. J. Hall, Liverpool—Grinding corn.
775. R, Husband and G. Mallinson, Manchester—Hat plush.
777. G. Walker, Belfast—Power looms.

*Dated 9th April*, 1855.

779. W. Tuer, W. Hodgson, R. Hall, and S. Hall, Bury—Looms.
781. D. Cope, Birmingham—Metallic spoons, forks, and ladles.
783. A. E. L. Bellford, Essex-street, Strand—Pumps. (A communication.)

*Dated 10th April*, 1855.

785. S. Fielding, jun., Rochdale—Lubricating pistons.
787. A. Chaplin, Glasgow—Steam boilers and combustion of fuel.
789. J. H. Johnson, 47, Lincoln's-inn-fields—Cotton machinery. (A communication.)
791. Lord C. Beauclerk, Riding, Northumberland—Tilling and subsoil ploughs.

*Dated 11th April*, 1855.

793. Capt. J. Addison, H.E.I.C.S., 23, Basinghall-street, and D. Sinclair, 122, Oxford-street—Scabbards and holsters.
795. L. and A. Oudry, Paris—Preserving wood, metal, &c.
797. J. Fletcher, Facit, Rochdale—Spinning machinery.
799. J. V. M. Dopter, Paris—Printing fabrics.
801. S. Holt, Stockport—Weaving plush.
803. P. A. Devy, 10, Old Jewry Chambers—Coke ovens. (A communication.
805. J. L. Norton, Holland-street, Blackfriars—Separating animal fibres from vegetable matters, and drying same.

*Dated 12th April*, 1855.

809. A. T. Richardson and G. Mallinson, Manchester—Piled fabrics.
811. J. Vernon, West Bromwich—Slide valves.
813. A. Cuninghame, Glasgow—Sulphuric acid and sulphates of iron and alumina.

*Dated 13th April*, 1855.

815. J. B. Bagary and C. Perron, Paris—Knitting machinery.
819. S. Wimpenny, Holmfirth, and J. Wimpenny, Rawtenstall—Spinning machinery.
821. R. A. Brooman, 166, Fleet-street—Treatment of fatty and resinous matters. (A communication.)
823. G. Turner, Northfleet—Tents and marquees.

*Dated 18th April*, 1855.

850. F. L. Han Dauchell, 4. Arthur-terrace, Caledonian-road—Regulating fluids and indicating pressure.
852. J. Fordred, Hampstead—Reflecting surfaces.
854. R. Bridge, Chadderton—Power looms.
856. B. Cook, Birmingham—Horse shoes.
858. J. Lawson and S. Dear, Leeds—Combing machinery.

*Dated 19th April*, 1855.

862. D. Pallier and E. Taylor, Broad-street, Lambeth—Soap.
864. E. and W. Howes, Birmingham—Carriage lamps.
866. J. Hindle, Accrington—Printing woven fabrics.
868. A. V. Newton, 66, Chancery-lane—Machinery for crushing and grinding mineral substances. (A communication.)
870. W. Jones, Rhodes, near Middleton—Printing fabrics.
872. F. Jacot, Paris—Starch.
874. J. Atherton, W. Boyes, and W. Lancaster, Preston—Temples for textile fabrics.
876. J. H. Johnson, 47, Lincoln's inn-fields—Railway breaks. (A communication.)

*Dated 20th April*, 1855.

878. L. Sardieu, Paris—Letters and figures for signs, &c.
880. H. Macé, Paris—Transferring colours or metals in design on and from paper and stone on to surfaces. (A communication.)
882. J. A. Manning, Inner Temple—Agitation of fluids and solid matters contained therein.
884. S. C. Lister, Bradford—Treating rheea plant.
886. R. Bright, Broad-street—Lamps and lamp-wicks.
888. A. V. Newton, 66, Chancery-lane—Bolt machinery. (A communication.)

*Dated 21st April*, 1855.

890. E. Pettitt, Manchester—Spinning machinery.
892. W. Hadfield, Manchester—Looms.
894. J. Barnett, 134, Minories—Smiths' hearths. (A communication.)
896. J. H. Johnson, 47, Lincoln's-inn-fields—Prevention of smoke. (A communication.)
898. W. Winter, Nottingham—Warp-looped fabrics.
900. W. C. T. Schæffer, Bradford—Treatment of waste wash-waters of mills.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

920. W. Symington, Little Bowden, Northampton—Preparing peas and pearl and Scotch barley for culinary purposes.—25th April, 1855.
954. M. Lyons, Suffolk-street, Birmingham—Enamel for coating metals and bricks.—27th April, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed May 4th*, 1855.

2202. Louisa Monzani, Greyhound-place, Old Kent-road—Improvements in bedsteads, and packing-cases or boxes to contain the same and other articles.
2203. Louisa Monzani, Greyhound-place, Old Kent-road—Improvement in brushes and brooms.
2337. George Lee Baxter, Sneinton Hermitage—Improvements in reaping machines.
2373. Paul Pretsch, Sydenham—Improvements in producing copper and other plates for printing.
2413. Pierre Joseph Meeus, Paris—Improved wind instrument.
2418. Richard Archibald Brooman, 166, Fleet-street—Improvements in the manufacture of thread from gutta percha and similar gums, in gilding, silvering, and ornamenting the same before or after being manufactured into fabrics, and in machinery and apparatus employed therein.
2441. Charles Asprey, New Bond-street—Improvements in handles particularly applicable to dressing cases, despatch boxes, writing cases, and other similar articles.
2455. Nicholas Callan, Maynooth College—Improvements in exciting agents used in galvanic batteries and in the construction of galvanic batteries.
2571. James Edward McConnell, Wolverton—Improvements in steam engines.
273. Thomas Barnabas Daft, Isle of Man—Improvements in the manufacture of beds or surfaces to recline or lie on.

*Sealed May 8th*, 1855.

2363. William Stead, William Spence, and Samuel Wood, Bradford—Improvements in machinery for preparing and combing wool and other fibrous materials.
2379. John Berry, Richard Berry, and Thomas Berry, jun., Rochdale, and Thomas Royds, Salford—Improvements in machinery for spinning, commonly known as mules.
2392. Henry Witthoff, Manchester—Improvements in the construction of boats, ships, or navigable vessels, and in the means of obviating or diminishing the dangers attending accidents to the same.
2402. Joseph Armstrong, Normanton Station, Wakefield—Improvements in chairs and crossings for the permanent way of railways.
2466. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the preventing or removal of incrustation in steam boilers. (A communication.)
2497. Peter Armand le Comte de Fontaine Moreau, 4 South-street, Finsbury—Improvements in the construction of inkstands.
2538. James Biden, Gosport—The prevention of smoke from furnaces.
2564. Albinus Martin, Westminster—Improvements in the production of indigo dye colours in dyeing and printing textile fabrics and fibrous materials.
2676. James Langridge and Richard Langridge, Bristol—Improvements in stays or corsets.
2741. John Gray, Strand-street, Liverpool—Improvements in adjusting compasses on board ships or vessels.
320. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—Certain materials to be used for cementing and painting, and also applicable to printing and dressing or finishing fabrics. (A communication.)
455. Andrew Small, Glasgow—Improvements in marine compasses, and in apparatus applicable thereto.
484. William Johnson, 47, Lincoln's-inn-fields—Improvements in coating iron and steel wire with other metals or alloys. (A communication.)
514. Thomas Walker, Birmingham—Improvements in rotary engines to be worked by steam or other fluid.
515. Antoine François Jean Claudet, Regent-street—Improvements in stereoscopes.
550. James Hulls, Plaistow, and John Lowe, Lambeth-road—Improvements in coating iron and other metals with lead.
562. Alfred Vincent Newton, 66, Chancery-lane—An improved construction of engine to be actuated by the expansive force of explosive mixtures.
577. Charles Goodyear, jun., 42, Avenue Gabriel, Champs Elysées, Paris—Improvements in the plates of artificial teeth.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3712 | May 4. | Scutari Tea Pot | Alexis Soyer | Scutari. |
| 3713 | " 7. | Improved Portable Coffee Mill | Wm. S. Adams and Son | 57, Haymarket. |
| 3714 | " 9. | Improved Shirt Collar with Elastic Button Holes | Charles Rowland | Higher Tranmere, Chester. |
| 3715 | " 9. | William Langdon's Saddle | William Langdon | 9, Duke-street, Manchester-square, London. |

Journal of the Society of Arts.

*FRIDAY, MAY* 18, 1855.

## ARTIZANS' VISITS TO THE PARIS EXHIBITION.

A circular has just been addressed to the Mayors of Boroughs and the Superintending Registrars, by the Home Secretary, to the effect that Her Majesty's Government, being desirous of affording facilities to workmen for visiting the Industrial Exhibition in Paris, intend to grant them passports free of the usual fees. Lists of such workmen as wish for passports are to be forwarded from time to time to the Foreign Office, when passports, valid for one month, will be transmitted to the Mayors and Registrars, who have been requested to see that each passport is properly signed.

## INSTITUTE BOOK ORDERS.

The existing arrangements in regard to the purchase of books and periodicals by the Institutions in Union at reduced rates have now been in operation 19 months. The experience gained during this period shows that the delays necessarily involved in the execution of the orders at one particular period only in each month have been a source of inconvenience to the Institutions, and have been said, in some instances, to more than counterbalance the benefits derivable from the reductions. It has been found, too, that when the Agent's commission of 5 per cent. on the reduced rates came to be added to the account, the average rate of discount did not exceed 25 per cent., notwithstanding the much higher rates allowed by some publishers.

The Council, being desirous of improving on these arrangements, and if possible of obtaining greater facilities for the Institutions, caused inquiries to be made in the trade, and they have now the satisfaction of stating that a responsible firm are prepared to undertake the whole affair on the following terms:—To supply the orders sent through the Society of Arts from day to day, at a discount of 27½ per cent. off *books*, and 25 per cent. off *periodicals*, except where such periodicals are irregular in price, such as the Quarterlies, in which cases they will charge the *trade price*,—that is, the Institutions will receive the full benefit allowed to the trade.

In future one copy of an order only will be required. This must be sent to the Secretary to the Society, as heretofore, by whom it will be countersigned, and be at once passed on to the agents, with whom the remainder of the transaction will rest. It will then be invoiced, and the Institution will be informed by the Agents of the amount to be remitted. On this being received by them, the order will be immediately executed, the invoice being returned to the Institution receipted.

March Account.

| | Full Price. £ | s. | d. | Red. Price. £. | s. | d. |
|---|---|---|---|---|---|---|
| Annan, Mechanics' Institute ... | 18 | 0 | 10 | 13 | 8 | 3 |
| Colchester, Mechanics' Institution | 1 | 18 | 6 | 1 | 9 | 5 |
| Crieff, Mechanics' Institution ... | 10 | 9 | 3 | 7 | 9 | 7 |
| Durham, Mechanics' Institute | 9 | 10 | 0 | 7 | 5 | 4 |
| East Retford, Literary and Scientific Institution | 0 | 19 | 9 | 0 | 15 | 7 |
| Hants and Wilts Educational Association | 1 | 0 | 6 | 0 | 16 | 5 |
| Hitchin, Mechanics' Institute ... | 7 | 13 | 6 | 5 | 18 | 0 |
| Horncastle, Mechanics' Institution | 0 | 12 | 0 | 0 | 9 | 8 |
| Sevenoaks, Literary and Scientific Institution | 4 | 16 | 2 | 3 | 15 | 8 |
| Stamford, Institution | 3 | 2 | 1 | 2 | 10 | 10 |
| Stockton-on-Tees, Mechanics' Institute | 5 | 1 | 0 | 3 | 13 | 4 |
| Stratton (near Swindon), St. Margaret's Library and Reading Society | 1 | 15 | 6 | 1 | 7 | 8 |
| | £64 | 19 | 1 | £48 | 19 | 9 |

Being a saving of £15 19s. 4d., or nearly 25 per cent.

## TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 16, 1855.

The Twenty-Second Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 16th inst., the Right Hon. the Earl of Hardwicke in the Chair.

The following Candidates were balloted for and duly elected:—

Bowman, John | Holmes, Herbert Mountford

The following Institution has been taken into Union since the last announcement:—

393. Red Hill, Institute.

On the walls were suspended a collection of Photographic Views of the building in which the Industrial Exhibition was held at Munich last year, presented to her Majesty's Government by the Government of Bavaria, and forwarded by direction of the Earl of Clarendon to the Society.

On the table was exhibited, by Messrs. W. Appleton and Co., a patent bed or mattrass for the army and navy, for travellers and emigrants, and also for use in camp hospitals. It makes a round package, 2 feet long and about 7 inches diameter, and weighs only about 4¾ lbs. When spread open it forms a mattrass 6 feet long by 2 feet broad. The under covering consists of waterproof material, the upper of non-waterproof material. Between the two there are tranverse corrugations, 1¾ inches broad, filled with ground or pulverised cork (a sample of which was shown)

The advantages claimed for this invention are that from the absence of fibre, as in hair, wool, or cotton, the cork will not "mat" or "felt" together in the slightest degree; hence its elasticity is retained to the last. It will not imbibe water or moisture in the same degree as any other material, while the cork acting as a non-conductor, the warmth of the body is retained to a much greater extent than would be the case with other material of the same bulk and lightness; and from the nature of its manufacture, partially in the state of charcoal, it has sanitary and purifying qualities peculiarly its own. No insect can exist in it, and if it becomes damp it does not heat, ferment, or rot, as wool or straw when moist. From the buoyancy of cork the beds might, under certain circumstances, be combined, and be useful to the army for pontoons, and to the navy as floats to support rafts, or even overladen boats. Singly they will sustain the heaviest man in the water.

The Noble CHAIRMAN, after expressing his high sense of the honour conferred upon him by the invitation of the Council of the Society to preside on this occasion, and having referred to the novelty of that position as regarded himself, said he had been induced to take the chair at this time from the circumstance of that description of science which they were this evening called upon to listen to being connected with a profession in which he had been brought up, and which he ardently loved. It was also at a period of time when the science of this country must and ought to be directed with great perspicuity and attention to that branch which they would this evening be particularly called upon to attend to; and although it was a branch of science which, he might say, was better understood in this country than in any other, yet much required to be done to mature that branch in such a manner as to make it thoroughly and cheaply available to all the purposes which they desired it to attain. He had also felt that he might not only receive great enjoyment from a discussion of this kind, but that he should assuredly receive a great amount of information himself by having an opportunity of attending this meeting; and he, moreover, felt that this Society might connect itself at this period very importantly with the various branches of science that are in embryo in this country, but which did not receive from time to time that consideration and attention which they ought to receive. They did not receive that attention and consideration from certain portions of the public, and they required to be pressed upon the public by the earnest and ingenious minds of those who contemplated any experiments or any novelties that might fill their breasts. When speaking of the government of this country, he spoke of it as a machine for the interests of the country at large, bearing upon all those important points which regulate not only the government of the country, but which ought to tend to draw forth at this period all the abilities, all the scientific knowledge, and all the circumstances which might lead to the great object which they had every one of them in view. He would assume that the government of the country, so taken up as it was and pressed by the arduous duties it had to perform, stood in perfect horror and dread at all times of novelty. He had had that strongly impressed upon his mind, and it was one of those points which had induced him to appear before them this evening and to presume to take the chair, and which had led him also into the belief that he might, perhaps, be able to throw out some point or some view which they might take up and enforce in some manner that might lead to useful purposes and to great ends. That there exists an enormous degree of mental power in this country no one could doubt—and also that there exists an enormous amount of education that had raised that power to a great extent; but when that power was brought before the great authorities of the country—when anything in the shape of novelty was introduced, it was received with coldness and dissatisfaction, and no man had the slightest chance before the government authorities of the country of having any great experiment or any great subject he might have imagined brought to a fair consideration. If he stated that which was wrong, it was owing to a misconception of the case; but he had known so many instances himself of the bearing down of great aspirations in the minds of men who had thought and reflected on subjects in reference to great and scientific attainments and great and scientific ends—who had met with so much coldness, that they had been unable to carry on the pursuit of science in the direction they wished, and from their own position in life had been unable to push before the public the ends they had in view—that they had not known where to look for assistance and support. This country was now at war with a great power, and he thought it likely, from what he had seen and heard before, that the government was pressed very much at this time by a number of people who had notions that they could perform all sorts of wonderful deeds, and by which, if they could only get themselves listened to, they could not only take Sebastopol and destroy Cronstadt, but do a hundred other things which would astonish the world and attain the great ends which would satisfy their own honest ambition. But under the circumstances of the case they were not much attended to, and they were obliged to return to their homes, and they sought out some prominent member of parliament, or some other man whom they thought in a position of eminence in the country whom they would beg to look at their plans and give his support to them—he himself, it might be, being unable to say more than that he was obliged, but that he was unable to give them any assistance whatever. He held that there never was a time when among the duties which a great and scientific body might undertake or at least reflect upon, it was of more importance that that question might be met, for he held it to be one of great and serious consequence. He knew, and they all knew, doubtless, if they wished for illustrations of what he had been saying, examples which daily occurred. There was no sort of difficulty whatever in bringing before the public a series of cases of disappointed hopes. He knew a case, without mentioning names, and the public knew it very well, as an illustration of this sort of thing, wherein the government authorities connected with that branch of the profession he was about to mention, thought it right to hand over to a banker in London a sum of money for the purpose of relieving themselves from those duties which they ought to have performed. There was a point of science to be considered, for the invention was claimed by many persons. The individual alluded to was a banker; he was no judge, and he gave the money in a way to raise objections to the mode in which he had disposed of it, and in such a way as was considered on the part of some to be an act of injustice, and led people to apply to a court of justice for the purpose of getting what they considered their right. If there had existed in this country a body of men—a board of scientific individuals, qualified to have taken that case into consideration, and to have given judgment upon it, no doubt justice would have been satisfied, and whether right or wrong in their judgment, reasons would have been given why they so judged, and the public and the individuals themselves might have been satisfied. They had before them, amongst the many plans which existed for various things, an exhibition which, he ventured to say, was a disgrace to the science of this country, and displayed the greatest want of scientific knowledge that ever took place in this country, or perhaps in any country. He alluded to the construction of certain floating bodies, which were to carry death and destruction against the enemy, but which it might be presumptuous in him to say would never do any thing of the sort. By good chance they might take them

across the ocean; but he would venture to say this—if the science of this country had been permitted to deal with the principle that a floating body was to be constructed impervious to shot and shells, that if that principle had been placed in the hands of scientific men in this country, and they had been asked to produce that description of floating body,—he would answer for it this country would have given such a floating body as would perfectly achieve, as far as the floating power went, and the means of being conducted across the ocean—that this country could have given such a body perfect of its kind, and beyond doubt fitted for the proposal named. Whether it would maintain the principle started with, that of resisting shot, was a question which he did not think anything but experiment could deal with. He did not think putting a plate of iron $4\frac{1}{2}$ inches thick upon a raised wall of timber would by any means give the result anticipated, and unless it was tested by placing the vessel within the proper range of shot and shell, the experiment which had been made would afford no criterion of what would be the result under other circumstances. That was another reason why he esteemed it a privilege to occupy the chair of this meeting, if by anything he might say to those who might be inventors—men of inventive genius, offering themselves to the public, and having the Government backs turned upon them on every occasion—an opportunity might be gained by some description of machinery, which, if the Government would not create, this Society, or the men who act in it, might be disposed to aid, for the purpose of giving an opportunity of having before them the inventors and considering their inventions. He knew no more patriotic act at this time, none which would call down more affection on the part of genius and science, than the affording an opportunity to men of genius to lay before the public what they had thought and designed. There was no doubt, in that case, they would be overborne by an enormous quantity of rubbish—no doubt an enormous quantity of dross would fall from the metal, but he believed they would find that in the creations of the human mind, which was an emanation from the Great Creator himself, and was in the first instance not to be taught, for genius existed only through the Almighty power—that that genius would have an opportunity of being brought to light which in this country it had not at this moment. He could mention many other instances—some good, and some, perhaps, worth nothing at all — but he mentioned this circumstance as a reason why, independent of the honour conferred upon him of taking the chair on this occasion, as a reason why he rejoiced in having an opportunity of meeting any body of scientific men, if he succeeded in turning their minds to what he conceived would give an enormous satisfaction to the public at large. In the public writings of the day they were accustomed to see such expostulations as these—"Why is this man not listened to, and why is it not proved what that man can perform? Why are these people not permitted to have their plans examined and considered, that we might know, at least, whether millions of money might not be saved from the public pocket?" He was convinced that if some body, such as he had mentioned, had been in existence, they would never have had half the trouble they had with regard to the late Captain Warner. He was convinced that was a contest carried on for a long period of time, which, by the pertinacity of the public, and of a most proper character, was constantly pressed upon the public notice both in and out of Parliament, and in which the public always felt themselves disappointed. The Government thought they had to deal with a case which was impracticable, but the secrets of the case were never brought to light, the public were never satisfied, and the man passed to his grave. If he had lived in these days it would have been a source of trouble to the public and to the Government as to whether Captain Warner would go to defend Sebastopol, or whether we should give him what he once asked of him (the chairman) £400,000 for an invention which he would not disclose. This, he was aware, was perfectly foreign to the subject of the evening, but he had ventured to say thus much, for the reason that a chairman of a meeting like this must have some peg on which to hang some sort of a speech, or else he would be looked upon as unfit to take any chair, and therefore he had said that which had risen uppermost in his mind—foreign to the subject of the evening, but, nevertheless, in introducing himself to the meeting, he felt it was necessary to utter some few words to some purpose, and having done so, he would now proceed to what was more immediately the business of the evening. This being the first occasion of his appearance before this Society he needed some introduction, but the same was not to be said of his friend who sat on his left (Mr. Atherton). It was fortunate, in his estimation, that her Majesty's Government in these times had been able to obtain the services of that gentleman; in a time in which he did not know whether he could exactly say that steam was in its infancy, but at a time when steam power having obtained a certain standard in the country, there was wanted some men connected with the science of the country who could ascertain and define its capabilities. If he might use the simile, it was like a fine horse, whose paces were well known, but whose paces from its great spirit could not be properly regulated. They wanted some one who had turned his attention to these paces, and to the weights which the horse would carry, to put this subject before them. The subject to be submitted by Mr. Atherton appeared to him to be one more wanting to be considered than almost any other, a subject, it appeared to, him at this moment, if considered and brought into a proper focus, and into a properly tabulated and graduated form, which would render more service in point of revenue to the state, in point of revenue to the merchant, in point of fitting to the ship, than any other point which had been considered in reference to steam power. If from the meeting to-night should emanate a system which might be secured and fastened upon the maritime power of this country, then indeed should he glory in having been their chairman. If from the reading of this paper should emanate a system of classification for calculating the tonnage and power of steam ships, and also with regard to the assimilation of the power to the tonnage, if that point should be gained, dating from the period when this paper was read, and that he had the honour of sitting in the chair, then should he consider those amongst the most usefully spent hours of his life. He would leave merchant steamers out of the question, because they being in the hands of private individuals each was competent to exercise his own method of building, fitting, and equipping his own ship; but it would be later, if ever, that they arrived at that description of fashion which governed the ladies of this country, and which was more powerful in its influences than any law of the land. If the same fashion existed with regard to the fittings of the steam engine, they would give more money to the pockets of the merchants, and more facilities for making all voyages in all countries than by any other single act they could perform. The British navy, propelled by the power of canvas and the wind, immediately classified every sail and spar used for the propulsion of her floating bodies. She also classified her cannon, and everything else in reference to her ships of war, but upon the introduction of steam power into our navy the whole system was capsized; there was neither classification nor system. If a ship was built by a sudden fancy of the First Lord of the Admiralty, or was fitted with a set of engines which the first naval lord imagined to be fit, and some engineer came in and said, "I have got a wonderful invention. I'll drive your ship without steam. I'll do it with heated air alone"—to say not a word about the cylinders being burnt out—£60,000 or £100,000 was laid out, and the thing was done. So with the fittings of the ships and the engines. It was in their power to have every ship fitted with different engines—of different dimensions and power, and if an accident happened to any one of them, it might be a great difficulty to

replace the defaulting portion of the machinery through the mould perhaps having been lost or destroyed. But if from this day they should lay the foundation of any system of classification, which it was high time was done, then they might hope to have the navy as perfect as it could be made. They were that evening called upon to listen to the reading of a paper of very great importance, which, in his opinion, would lay the foundation of the very point that he had endeavoured to urge. They were called upon to attend to a subject whereby the capabilities of steam-ships for sea transport could be as correctly estimated as were the capabilities of the locomotive for land transport; that would be a near approach to laying down an entire system for that service, and they might then determine some standard rule whereby they might assign some definite data for the trial of the vessel if such facts could be actually substantiated. Those were the points that they would be called upon to discuss, and he had only now to apologise for having, as an unscientific man, and as a man with no pretensions to the attainments of the gentlemen he saw around him, but merely as belonging to a profession which had in it some assimilation, and as connected with the great services of the country, for having ventured most humbly to take the chair at this meeting.

The Paper read was

## THE CAPABILITY FOR MERCANTILE TRANSPORT SERVICE OF STEAM SHIPS, WITH REFERENCE TO THE MUTUAL RELATIONS OF THEIR TONNAGE, DISPLACEMENT, ENGINE POWER, STEAMING SPEED, DISTANCE TO BE RUN WITHOUT RE-COALING, TONS WEIGHT OF CARGO, AND THE EXPENSE INCURRED PER TON OF CARGO CONVEYED.

By Charles Atherton, M. Inst. C.E., Chief Engineer of H.M. Dockyard, Woolwich.

The object of the following exposition on steam-shipping is to suggest and exemplify some definite process of investigation and arithmetical deduction whereby the capabilities for sea transport service of steam-ships may be as correctly estimated as is the capability for land transport service of the railway locomotive engine. Railway capability has already been reduced to a definite process of calculation, while steam-ship capability has never yet been subjected to arithmetical deduction, simply because the very terms "tonnage" and "horse-power," by which the elementary details of steam-ship service are designated, are absolutely indefinite. No legislative enactment has hitherto defined the standard unit of quantity that is meant by the tonnage of a ship, as denoting the measure of a ship's capability for transport service, either as respects measurement or weight, or what is meant by "nominal horse-power" as the standard unit of the measure of the amount of force which a marine engine may be legally required to be capable of exerting. Nevertheless, ships' *tonnage* and marine-engine *horse-power* are made the nominal base of mercantile pecuniary contracts to the extent of millions per annum. For example, in the Government transport service for the past year (1854), the amount of shipping employed has been designated as about 210,000 tons tonnage and 26,000 horse-power, involving pecuniary contracts based on the indefinite terms *tonnage* and *horse-power* to the amount of £3,000,000 sterling. In fact, it may be plainly asserted that a contract for the building or hireing of ships based simply on the nominal tonnage of the ship and the nominal horse-power of the engines binds the contracting parties as to the sum of money that is to be paid, without affording any definite or specific guarantee whatever as to the amount of capability for service that the vessels so purchased or hired will afford.

Such are the circumstances under which, in continuation of the public efforts that I have made since 1850, by publication and otherwise, to expose the anomalies of steam shipping, I now respectfully call the attention of the Society of Arts to the subject of the capability for goods transport of steam-ships; and, considering that the Society of Arts is distinguished as the parent of no less than 350 Associated Institutions devoted to educational cultivation, and to the practical prosecution of all utilitarian pursuits in science and arts, I appeal to the Society, confident in the expectation that any effort to direct attention to the fundamental bases of steam-ship capability—namely, "tonnage" and "power"—as standard units of admeasurement, in such manner as to construct thereon some system of steam transport £ s. d. *arithmetic*, will not fail of being countenanced by the Society, and promulgated for the consideration of its numerous associated correspondents, with a view to its being matured and rendered practically useful.

In the prosecution of this inquiry the course which I propose to follow demands that I solicit the indulgence of the members of this Society, because, in the first place, I shall have to dwell on matters purely rudimentary, and the statistical character of the inquiry is suited rather for private study than for open dissertation; also, in the desire to be specific, repetitions will frequently occur. Thus, claiming your indulgence, I purpose to direct attention to the following points for consideration:—

1st. What is the builders' tonnage of a ship? What is the displacement of a ship? And, by reference to examples of steam-ship construction, to show that these two terms have practically no approximate ratio whatever to each other.

2nd. What is the nominal horse-power of a marine engine? What is the working power of a marine engine? And, by reference to examples of marine engine construction and practice, to show that these terms have no approximate ratio to each other.

3rd. To illustrate, by examples of steam-ship construction, the ratio of tonnage to nominal horse-power, which ratio is popularly regarded as expressing the efficiency of a steam-ship, as compared with the ratio of displacement to working horse-power, on which the locomotion of steam-ships is really dependent.

4th. To determine and define the measure of the unit of power which we assign to the term "horse-power," and also the unit of measure which we assign to the term "ton of displacement," as the fundamental basis of our calculations.

5th. To explain the law of resistance by which the motion of a ship is conventionally assumed to be affected, and enunciate the *rule* deduced therefrom, which may be regarded as sufficiently accurate to be practically available for calculating, approximately, the relation of displacement, power, and speed, in vessels of similar types of build, and for comparing the dynamic or locomotive capabilities of different types of build.

6th. To show the extent to which the co-efficients of steam-ship efficiency, resulting from the rule above referred to, differ from each other, thereby exposing the difference of locomotive efficiency between one ship and another.

7th. Assuming any given type of form, and any given size of ship, show the mutual relation of speed, distance, and cargo.

8th. To propose a system of arithmetical deduction whereby the cost of upholding and working steam-ships may be approximately calculated; and, by way of example, assuming a given type of build and given size of ship, show the mutual relation of speed and £. s. d. prime cost expenses incurred in the conveyance of goods on a given passage per ton weight of goods conveyed.

9th. To show the extent to which the cost of goods transport is affected by differences in the size of the ships employed, their co-efficients of dynamic or locomotive duty and other constructive data being the same.

10th. Assuming a given type of build, show the extent to which the cost of goods transport is affected, according

as it may be required to perform the whole passage direct without re-coaling, or to re-coal at certain intermediate stations.

11th. Show the extent to which the prime cost expense of goods transport per ton weight is affected by differences in the dynamic quality of the ships employed, as measured by the difference of their co-efficients of locomotive efficiency.

Recurring, now, to the foregoing divisions of our subject, taken in their order, it may be observed:

Firstly. The builders' tonnage of a ship, still usually adhered to, though now denominated as the old measurement, is determined as follows: Rule. From the length of the ship (measured between the perpendiculars of stem and stern in feet) take three-fifths of the beam, multiply by the beam, and by half the beam, and divide by 94, the result is the builders' tonnage.

For example; take H.M. steam-vessels *Fairy* and *Bruiser*:—*Fairy*, length 144 feet 8 inches, breadth 21 feet 1½ inches, tonnage 313. *Bruiser*, length 160 feet 6 inches, breadth 26 feet 6 inches, tonnage 540.

It will thus be observed that the tonnage makes no specific reference either to the depth of hold or to the draught of a ship.

The displacement of a ship is the cubical measurement of the quantity of water displaced by the hull of the ship, and, when immersed down to the constructor's deep-draught line, it is called the load displacement. The measurement is easily taken from the builder's drawing, showing the lines of the ship, and is dependent not only on the length, breadth, and draught of the ship, but also on the contour of the lines, whether it be full or sharp. The cubical measurement being thus ascertained, the weight of water displaced is readily deduced therefrom at the rate of 36 cubic feet of water to the ton weight, which will be exactly equal to the weight of the floating mass. Occasionally, builders supply the owners of ships with a statement termed *Scale of Displacement*, showing the weight of the water displaced by the hull of the ship, and therefore the weight of the floating body and its load as it becomes gradually immersed down to the constructor's deep-draught line. For example: displacement of the *Fairy* at the constructor's deep draught of 5 feet, is 176 tons weight; *Bruiser* at 14 feet, is 1013 tons weight. Hence, by again referring to the statement of tonnage, it appears that, in the *Fairy*, the ratio of tonnage to displacement is in the proportion of 313 to 176; that is, each 100 tons of tonnage, builder's measure, gives 56 tons weight of displacement; but in the case of the *Bruiser*, the ratio of tonnage to displacement is in the proportion of 540 to 1013; that is, each 100 tons of tonnage, builder's measure, gives 188 tons weight of displacement.

Thus, it appears that two ships on the respective types of the *Fairy* and the *Bruiser*, may be of precisely the same builders' tonnage, say 1000 tons; but the displacement of the one will be 560 tons, and of the other 1880 tons; and supposing the weight of the respective ships and their machinery and equipment, when ready for cargo, to appropriate one-half of their respective displacements, the one ship will carry 280 tons of cargo only, while the other will carry 940 tons, that is, the one will carry only one-third the cargo of the other, though both ships are of the same builders' tonnage, viz., 1000 tons. Hence, it appears that the builders' tonnage of ships affords no approximate indication whatever, either of the ship's displacement or of the tons weight of cargo that the ship will carry; and, in like manner, since no notice is taken of the depth of hold, the builders' tonnage affords no certain indication of the capacity of the ship for cargo. This latter defect is approximately corrected by the new measurement of tonnage, but still the new mode of measurement takes no cognisance of displacement, and therefore affords no guarantee of the tons weight the ship will carry when immersed down to the constructors' deep-draught line.

Secondly, as regards horse-power. The nominal horse-power of marine engines has hitherto been determined by a rule which originally may have duly represented the then general practice of steam-engine construction, and the rule was as follows:—

*Assume* the effective pressure on the piston at 7lbs. per square inch, after making all deductions for imperfection of vacuum, friction, and other drawbacks; next, *assume* that the working speed of the piston is at a given rate, according to a certain specified and tabulated rate of speed dependent on the length of stroke; assume 33,000lbs. raised 1 foot high per minute as the measure of the unit of power to be denoted by the term horse-power; then, multiply the area of the piston expressed in square inches by the assumed effective pressure on the piston (7lbs.); and again, multiply by the speed assigned to the piston expressed in feet per minute, according to the length of stroke: the product is assumed to give the total amount of moving power expressed in pounds raised 1 foot high per minute, which divide by 33,000; the result is the nominal horse-power. For example:—

H.M.S. *Terrible*, 4 cylinders, 72 inches diameter, 8 feet stroke, at 240 feet per minute, 829 nominal horse-power, called 800.

H.M.S. *Banshee*, 2 cylinders, 72¼ inches diameter, 5 feet stroke, at 210 feet per minute, 364 nominal horse-power, called 350.

H.M.S. *Elfin*, 2 cylinders, 26⅝ inches diameter, 2 feet 6 inches stroke, at 170 feet per minute, 40 nominal horse-power.

In calculating the nominal power of screw-propeller engines, it has become customary to give the engines credit for the speed of piston actually attained instead of the tabular speed; but this practice is not enforced by any conventional rule, nor is it invariably adopted; and the distinction thus partially introduced between the paddle-wheel engines and screw-propeller engines only adds to the confusion. Hence, the nominal horse-power is based on assumption, not on fact, and by the only recognised rule for calculating power, no notice is taken of the boiler, on which everything depends.

The working horse-power, usually denominated the *indicated* horse-power, (because ascertained by means of an instrument called the indicator), is measured as follows:—

Ascertain, by means of the indicator, the *actual* pressure of steam per square inch on one side of the piston, and the *actual* condition of the partial vacuum on the other side of the piston; these together will give the gross pressure per square inch exerted by the piston. Multiply the area of the piston expressed in inches by the *actual* gross pressure per square inch, and again multiply by the *actual* speed at which the piston moves, expressed in feet per minute, and divide by 33,000. The result is the gross indicated horse-power; and it has been laid down by some acknowledged authorities in such matters that the nett effective power of an engine may, as a general rule, be expected to be 25 per cent. below the gross power; that is, if we divide the gross moving power by the divisor 44,000, instead of 33,000, the result will give approximately the nett effective horse-power as given out by the engines. For example:—the following statement shows the nominal horse-power, the gross indicated horse-power, and the effective horse-power, of H.M. steam ships *Trident*, *Retribution*, *Caradoc*, and *Elfin*, as follows, namely:—

*Trident*, nominal 350, gross indicated 492, effective, taken at 25 per cent. less than the gross indicated, 369.

*Retribution*, nominal 400, gross indicated 1092, effective, taken at 25 per cent. less than the gross indicated, 819.

*Caradoc*, nominal 350, gross indicated 1600, effective, taken at 25 per cent. less than the gross indicated, 1200.

*Elfin*, nominal 40, gross indicated 244, effective, taken at 25 per cent. less than the gross indicated, 183.

Hence, it appears that in the *Trident* the ratio of the nominal horse-power to the effective horse-power, has been 350 to 369; that is, each 100 nominal horse-power has worked up to 105 effective horse-power.

In the case of the *Retribution*, the ratio of nominal horse-power to the effective horse-power has been 400 to 819;

that is, each 100 nominal horse-power has worked up to 205 effective horse-power.

In the case of the *Caradoc*, the ratio of nominal horse-power to the effective horse-power has been 350 to 1,200, that is, each 100 nominal horse-power has worked up to 343 effective horse-power.

In the case of the *Elfin*, the ratio of nominal horse-power to the effective horse-power has been 40 to 183; that is, each 100 nominal horse-power has worked up to 457 effective horse-power.

Thus it appears that four different sets of marine engines may be of the same nominal power, say 100 nominal horse-power, but, nevertheless, their effective powers may be 105, 205, 343, and 457; that is, very nearly in proportion to the numbers 1, 2, 3, 4; that is, the unit of nominal horse-power of the *Trident* is one-half that of the *Retribution*, one-third that of the *Caradoc*, and one-fourth that of the *Elfin*. In other words, the nominal power of a marine engine, though contracted for as a definite quantity, say 100 horse-power, affords no guarantee, not even approximately, of the effective power of the engines to be delivered under the contract.

Thirdly. Such being the anomalies as respects the nominal size of ships expressed by tonnage with reference to their really effective size expressed by displacement, and such being the anomalies as to the nominal power of marine engines with reference to their effective power, it is evident that the ratio of nominal horse-power to tonnage, which is usually quoted as expressing the mechanical efficiency of a steam-ship, is a delusion, in so far that both terms are mere fictions, affording no certain indication of the comparison between the means really employed—namely, the effective horse-power with reference to any definite unit, and the service really performed, namely, the displacement in tons weight actually moved at such speed as may be; to illustrate which, I will refer to a few ships which are nominally powered very nearly alike, that is, in the ratio of about 100 tons of tonnage to 40 horse-power, or $2\frac{1}{2}$ tons of tonnage per nominal horse-power. For example:—

| Vessels. | | Builders' Tonnage. | Nominal Power. | Ratio of Builders' Tonnage to Nominal Power. |
|---|---|---|---|---|
| H.M. steam-ship | *Encounter* ... | 953 | 360 | 100 to 38 |
| ,, | *Conflict* ...... | 1038 | 400 | 100 to 38 |
| ,, | *Termagant*... | 1547 | 620 | 100 to 40 |
| ,, | *Niger*......... | 1072 | 400 | 100 to 38 |
| ,, | *Sharpshooter* | 503 | 200 | 100 to 40 |
| ,, | *Undine* ..... | 290 | 110 | 100 to 38 |
| ,, | *Fairy*......... | 313 | 128 | 100 to 41 |
| ,, | *Garland*...... | 295 | 120 | 100 to 41 |
| ,, | *Violet*......... | 298 | 120 | 100 to 40 |
| ,, | *Elfin* ......... | 98 | 40 | 100 to 41 |

Thus, the above-named vessels are nominally powered very nearly alike, namely, about 40 nominal horse-power to 100 tons of tonnage; but in reality, as determined by their actual displacement, and their measured working power, these same vessels are effectively powered as follows:—

| Vessels. | Displacement Tons weight. | Effective Horse-power, based on Indicator Measurement. | Ratio of Displacement to Effective Power. |
|---|---|---|---|
| *Encounter*..... | 1482 | 505 | 100 to 34 |
| *Conflict*......... | 1628 | 583 | 100 to 35 |
| *Termagant* ... | 2312 | 988 | 100 to 43 |
| *Niger* ......... | 1454 | 690 | 100 to 47 |
| *Sharpshooter*... | 620 | 306 | 100 to 50 |
| *Undine*......... | 250 | 331 | 100 to 132 |
| *Fairy*........... | 177 | 273 | 100 to 154 |
| *Garland*........ | 250 | 376 | 100 to 182 |
| *Violet* ......... | 250 | 434 | 100 to 177 |
| *Elfin* ......... | 65 | 183 | 100 to 281 |

Hence, it appears that although the before-mentioned steam-ships are nominally powered alike, namely, in the ratio of 40 horse-power to 100 tons of builders' tonnage, and are officially rated as such, the absolute proportions of effective power to tons of displacement in these identical vessels actually fluctuate from 34 horse-power up to 280 horse-power for each 100 tons of displacement. Nevertheless, the locomotive efficiency of steamers is publicly recognised, even by the Board of Trade Mercantile Navy List, as being represented by the ratio of their tonnage to their nominal horse-power, and no cognisance whatever is taken of the displacement of ships at the constructors' load-line draught, or of the available effective power of the engines with reference to any definite unit of motive power. The delusion is recorded and published as fact, the truth is altogether disregarded. Is it possible that the service of steam-ships can be effectively conducted under such a system of uncertainty and delusion in regard to their respective capabilities?

Fourthly. We now come to treat of the dynamic or locomotive operation of steam-ships, and since it is the engine-power that causes a steam-ship to move, and the tons weight of displacement moved at such rate of speed as may be, that constitutes the effect produced, it becomes utterly impossible to treat of and discuss the subject of steam-ship locomotion without defining, in the first place, what shall be the measure of the unit of power which we denominate as marine horse-power. We have already referred to the nominal horse-power as being calculated on assumed limitations, which are no longer recognised in marine-engine practice, and are therefore a mere fiction; but we have referred to the gross indicated power as a reality, in so far that it is an actually measured quantity, based on the definite standard of 33,000lbs., raised one foot high per minute; and the gross measure, as exerted by the piston of an engine, has been, by tacit concurrence, converted into nett or effective working power of the unit above referred to, by the assumption that friction and various other causes of detriment, not definitely measurable, may be fairly expected to obstruct the action of an engine to the extent of 25 per cent.; that is, in order to obtain effective horse-power of the unit 33,000 lbs. raised one foot high per minute, the gross indicated force exerted by the piston, as measured by aid of the indicator, and described in pounds weight raised one foot per minute, must be divided by the divisor 44,000, in order to give effective horse-power of the unit 33,000lbs. raised one foot high per minute; but even this measure of the effective unit of power of marine-engines has been altogether superseded in modern marine-engine practice, and no definite measure has been, by common consent or by legal enactment, substituted in its place. For example, referring to an essay recently published by myself on Steam-ship Capability, page 5, it appears that the engines of ten steam vessels lately employed by the Government as mail packets, namely, *Banshee*, *Llewellyn*, *Caradoc*, *Vivid*, *Garland*, *Violet*, *Onyx*, *Princess Alice*, *Undine*, and *Elfin*, were contracted for and supplied to Government as amounting in the aggregate to 1,840 nominal horse power; but the measured gross indicated power capable of being exerted by these engines actually amounted to a power equivalent to 285,758,000 lbs. raised one foot per minute; which, divided by 1840, gives 155,303 lbs. raised one foot high per minute, as the gross measure of the unit of marine horse-power thus actually delivered under the denomination, nominal horse-power. In consideration, however, that the contractor's supplied engines for the mail packet service exerting an amount of power undoubtedly above the ordinary practice of trade, and considering further that the working power exacted from these mail packets, on the occasions of the proof trials by which the efficiency of the engines was tested, may have been forced beyond the limits of ordinary work, I have allowed 15 per cent. for this excess, and assumed 132,000 lbs. raised one foot high per minute as the gross indicated measure of the unit of power which may be expected to constitute a

marine horse power, and on which I have based my calculations in the essay above referred to. It may, however, be observed, that the commercial result of such calculations is not affected by the measure of power that may be fixed upon as the standard unit of marine horse-power, whether it be 33,000 lbs. raised one foot high per minute, or 44,000 lbs., or 100,000 lbs., or 132,000 lbs., or 155,000 lbs., or any other number; for, in proportion as the measure of the unit may be increased or diminished, so will the number of such units be the less or greater to perform a given service; but, for the purposes of arithmetical calculation as to the comparative economy of different ships, it is evidently indispensable that *some definite measure of power be fixed upon as the unit of power*, and that the same measure of the unit be applied to all. In the following calculations, therefore, the unit of the gross marine horse-power as exerted by the piston of an engine, will be regarded as equivalent to 132,000 lbs. raised one foot high per minute, and we shall regard the constructor's load-line displacement in tons weight at the rate of 36 cubic feet of water to the ton, as expressing the size of a ship on which we base our calculations; observing, however, that this measurement will not represent, or be any certain indication of, the entire capacity of the ship with reference to roomage for measurement goods. Equity requires that the builder be paid with reference to size or roomage, as one element of the building cost, but science requires that the work performed by a steam ship be ascertained with reference to the tons weight as measured by the ship's displacement, combined with the speed at which the ship may be propelled.

Fifthly. Our next step must be to determine the formula or "rule," whereby the law of resistance, as expressed by the mutual relations of displacement, power, and speed, in vessels of similar form, worked by engines of corresponding efficiency, may be most satisfactorily represented. The writer of this paper referring to the labours of others on this subject, and without impugning their conclusions, has been practically brought to the opinion that theoretical investigations in search of the form of vessel that shall give the greatest locomotive effect with a given amount of power, generally result in mathematical complications of too abstruse a character to be practically available, and that the theoretical deductions which may be thus arrived at would, after all, require experimental confirmation before being taken for granted. Our object is to determine what ships actually do, not what they theoretically ought to do. It is, therefore, presumed to be only by the result of actual experience, not of mere models of ships, but of ships themselves, that the type of form best adapted for locomotive duty will be ascertained. By adopting this principle of practical trial, though we may not arrive at perfection, we may obviate unheeded retrogression, which has hitherto been the bane of steam-ship constructive progress, and by taking the chance of occasionally getting a small step in advance of all previous types of build, we shall progress towards the attainment of perfection at which it may never be said that we have absolutely arrived.

This course of procedure, however, evidently demands that we determine upon some standard rule whereby we may assign some definite number as the index number or coefficient indicative of the dynamic or locomotive efficiency of steam ships, such coefficient being based on the data which the trial of the vessel may actually substantiate. Our object now is to fix the formula or "rule" by which this "coefficient" of locomotive duty shall be calculated. I believe it to be generally admitted that, for all practical purposes, though not strictly correct, the velocity (V) of a steam-vessel will vary as the cube root of the effective power, or as the cube root of the gross indicated power, provided that the effective and gross indicated powers be in a constant ratio to each other; or, in any given vessel the power will vary as the cube of the velocity ($V^3$) provided the displacement be constant, and friction evanescent. Also, if the speed be constant, the friction evanescent, and the types of form of the immersed hulls be perfectly similar to each other, though different in size or displacement, the resistance at any given speed, and the power to overcome that resistance, will vary as to the maximum cross section (A). Hence, for *similar types of form*, the friction being supposed to be evanescent, we have $\frac{V^3 \times A}{\text{H.P.}} = C$, C being some constant number for vessels of similar type of form, and of equal mechanical efficiency. But this formula is not adapted for calculations which involve the weights of the ship and cargo. We must, therefore, convert it into a form embracing displacement. Now, in similar types of form, the lengths, breadths, and draughts of one vessel will be in the same degree proportional to the length, breadth, and draught of another, and the maximum cross section (A) will vary as the square of either one of the analagous dimensions ($a^2$), whilst the whole cubical dimensions of the immersed hull or displacement (D) will vary as the cube of the same dimension ($a^3$), or $a$ will vary as the cube root of D, and, therefore, $a^2$ will vary as $D^{\frac{2}{3}}$; but $a^2$ also varies as the maximum sectional area (A); consequently the maximum sectional area (A) varies as the cube root of the square of the displacement ($D^{\frac{2}{3}}$); consequently, for vessels of a similar type of form, propelled by engines of equal efficiency, $\frac{V^3 \times D^{\frac{2}{3}}}{\text{H.P.}}$ will be a constant number (C). If, however, the hulls be of dissimilar types of form, and the engines not equally efficient, the coefficient (C) will not necessarily remain constant; the different types of form and differences of external surface may affect the resistances in a different degree, and that type of form and engine adaptation thereto will be the best adapted for locomotive duty which, on actual trial of the ship, shall produce the highest coefficient, assuming that the engines be equally effective as respects the ratio of the gross indicated power to the nett effective power, whereby the ship is actually propelled, and which may be tested by means of the dynamometer.

Hence, to test the locomotive efficiency of a steam-ship, let the vessel be tried by successive runs over a given distance; let the displacement of the hull at her trial draught be accurately measured; also, let the gross power as measured by means of the indicator, and the corresponding speed, either in knots or in statute miles per hour, be ascertained; then observe the following rule:—multiply the cube of the velocity ($V^3$) by the cube root of the square of the displacement ($D^{\frac{2}{3}}$), and divide by the gross horse-power: the result will be the numeral coefficient (C), which denotes the locomotive efficiency of the ship, or, in other words, the constructive merit of the type of form combined with engine adaptation thereto.

If the comparative efficiency of the engine department alone is to be determined, it may be effected approximately by working the engines at moorings, and ascertaining the ratio between the effective power as determined by the dynamometer and the gross power as determined by aid of the indicator, and at the same time taking the consumption of coal per hour with reference to the gross indicated power; and if the comparative efficiency of different types of form be required irrespective of the engine department, then the nett effective horse-power must be determined by aid of the dynamometer, and substituted in the above mentioned formula for the gross indicated horse-power.

Sixthly, assuming the rule:—multiply the cube of the velocity ($V^3$) by the cube root of the square of the displacement ($D^{\frac{2}{3}}$), and divide by the horse-power (H.P.) as producing a numeral co-efficient or index number approximately indicative of the relative constructive merits of vessels as respects their types of form and engine adaptation thereto, I will now give a few examples of the application of the rule, showing the great difference that exists between one ship and another as respects their locomotive or dynamic efficiency, thence inferring the necessity which exists for such test trials of ships being

more commonly had recourse to, as the most available means of *checking retrogression*, and duly maintaining in new ships our already realised advancement in the art of steam-ship construction:—

| Names of Vessels. | Displacement. Tons Weight. | Gross Indicated Power. (Ind. H.P.) | Marine Horse-power. (H.P.) | Speed per Hour. Knots. | Index Number, or Coefficient of Locomotive performance. |
|---|---|---|---|---|---|
| *Candia* . . . | 2520 | 1356 | 339 | 12 | 944 |
| *Rattler* . . . | 1078 | 436 | 109 | 9·64 | 862 |
| *Fairy* . . . | 168 | 364 | 91 | 13·32 | 792 |
| *Vulcan* . . . | 2076 | 793 | 198 | 9·6 | 728 |
| *Arrogant* . . | 2444 | 623 | 156 | 8·3 | 664 |
| *Dauntless*. . | 2251 | 1218 | 304 | 10·29 | 616 |
| *Niger*. . . . | 1323 | 920 | 230 | 10·43 | 592 |
| *Conflict* . . . | 1443 | 777 | 194 | 9·29 | 528 |
| *Termagant* . | 2370 | 908 | 227 | 8·55 | 492 |
| *Dwarf* . . . | 98 | 216 | 54 | 10·54 | 460 |

Thus, the coefficient of locomotive duty of the *Candia* (944), is about 30 per cent. superior to that of the *Vulcan* (728), and upwards of the double, or 100 per cent., superior to that of the *Dwarf* (460), though the engines of these three vessels were all made by the same manufacturer; the effect of which is, that, supposing two vessels of, say, 2500 tons displacement, of the respective types of form and engine adaptation thereto of the *Candia* and the *Dwarf*, the former would be propelled at the speed of ten knots per hour, by 196 marine horse-power of the unit 132,000 lbs. raised one foot high per minute, while the latter would require 400 marine horse-power to be propelled at the same speed.

It must be observed that, in this great difference of locomotive efficiency between the *Candia* and the *Dwarf*, there are involved not only the known differences of type of ships' form and difference of engine efficiency, but also probable difference of resistance resulting from difference of friction from the immersed hull being possibly cleaner in one case than in the other; also, possible differences of engine management, the one engine probably being screwed up or packed too tight, and the other running free. The difference of the co-efficients in the cases referred to, shows that a positive malconstruction, or defective condition, or bad management, or abuse of some kind, exists to the extent of about 100 per cent.; and being thus proved to exist, the cause thereof should be inquired into, detected, and remedied, if remediable; or, possibly, it may be better to condemn an inferior ship, rather than run her at the disadvantage of incurring 100 per cent. extra expenses in the engine department of her service. (See Note at end of Paper.)

In mercantile steam-ship navigation, no method whatever of a definite description, such as that above described, has ever been adopted for testing the capability, condition, and management of steam-ships. The sacrifice of national interests, from vessels being ill-adapted for the most economical performance of the service required of them, is, probably, enormous, and, in my opinion, attributable to no specific quantities having been assigned to the terms *tonnage* and *horse-power* as standard unit measures applied to steam shipping. This deficiency in legislation requires correction, for, without such correction, inquisitorial arithmetic, as applied to steam navigation, can have no sound fundamental starting point; and the Society of Arts, more appropriately than any other, may undertake the task of effecting so desirable and so important a reform.

Seventhly. Presuming that the foregoing rule be admitted as representing, with sufficient accuracy for practical purposes, the mutual relations of displacement, power, and speed, in vessels of homologous construction, and that the numeral value of the coefficient or index number (C) be determined for a whole class of vessels of similar type by the actual test trials of any particular ship, we thus have the means of arithmetically developing the mutual relations of displacement, power, and speed, for all vessels of that constructive type; and I now proceed to develop, in the first place, the mutual relation of speed and power, assuming the size of the vessel at 1,500 tons displacement, and that, on test trial, the engines working at 240 horse-power, gave 12 knots per hour, whereby the coefficient of locomotive efficiency would be 944, the unit of power being taken at 132,000 lbs. raised 1 foot high per minute. In this case, the horse-power required for propelling a vessel of 1,500 tons displacement at variations of speed from 6 knots per hour up to 20, would be as follows:— 6 knots, 30 horse-power; 7 knots, 48; 8 knots, 71; 9 knots, 101; 10 knots, 139; 11 knots, 185; 12 knots, 240; 13 knots, 305; 14 knots, 381; 15 knots, 468; 16 knots, 569; 17 knots, 682; 18 knots, 809; 19 knots, 952; 20 knots, 1,110.

Thus, it appears that to increase the speed of the ship one knot per hour from 8 knots to 9, requires that the power be increased from 71 to 101 horse-power, being an increase of 30 horse-power; but, to accelerate the speed one knot from 16 knots to 17, requires that the power be increased from 569 horse-power to 682 horse-power, being an increase of 113 horse-power, being 4-times the power required for the one knot increase from 8 knots to 9; and if we would double the speed of a steam-ship of given displacement, say from 8 knots to 16, we must increase the power from 71 horse-power to 569 horse-power, being 8 times the power; and as this increase of power must be effected without increasing the deep-draught displacement of the ship, the weight of remunerating cargo will be reduced by an amount equal to the increased weight of machinery, and the increased quantity of coal that will now be required for the passage on which the ships may be employed.

Further, in order to show the capabilities of this ship of 1,500 tons displacement on the type of the *Candia*, with reference to the conveyance of cargo on a given passage, say for 3000 nautical miles without re-coaling, we must assign some definite limit to the weight of coal consumed per hour per horse-power; and since, in my own experience, I am not aware of any steam-ship service fitted with condensing marine engines, as now generally in use, having been permanently prosecuted with a less consumption of fuel than at the rate of 4½ lbs. per indicated horse-power per hour, which is 18lbs. per hour per marine horse-power of the unit 132,000 lbs. raised 1 foot high per minute, therefore, I assume the consumption of coal at that rate, also the weight of the machinery and engine equipment is taken at 5 cwts. per indicated horse-power, or 1 ton per marine horse-power of the unit 132,000 lbs. raised one foot high per minute, and the weight of the hull and its equipment complete, exclusive of the engine department, being supposed to appropriate 40 per cent. of the deep displacement, we have results as follow:—

If the vessel of 1,500 tons deep displacement be powered for steaming at six knots per hour, the passage of 3,000 nautical miles without re-coaling would require 125 tons of coal, and there would be 745 tons of displacement available for cargo; the weight of cargo in this case being 49 per cent. of the deep displacement.

But if the vessel be powered for eight knots an hour the consumption of coals would be 222 tons, and the cargo would be 607 tons; the weight of cargo in this case being 40 per cent. of the deep displacement.

If the vessel be powered for ten knots per hour, the consumption of coal would be 347 tons, and the cargo would be 414 tons; the weight of cargo in this case being 28 per cent. of the deep displacement.

And if the vessel be powered for twelve knots per hour, the consumption of coal will be 500 tons, and the displacement available for cargo will be 160 tons; the weight of cargo in this case being only 11 per cent. of the deep displacement.

Hence, assuming steam-vessels, on the type of the *Candia* and other data, as specified, of 1,500 tons deep displacement as the size of steamers employed upon a commercial transport service on a passage of 3,000 nautical miles, it appears that if the vessels be fitted for the speed of six knots per hour, the displacement available for cargo will be 49 per cent. of the deep displacement; at eight knots per hour the cargo will be 40 per cent. of the deep displacement; at ten knots per hour, the cargo will be 28 per cent. of the deep displacement; and at twelve knots per hour, the cargo will be only 11 per cent. of the deep displacement.

Eighthly. The foregoing statement exemplifies the mutual relation of speed and cargo, as respects the sacrifice of dead weight of cargo consequent on increasing the rate of speed; but at the same time that cargo is reduced by increased speed the charges are increased, and, consequently, the commercial sacrifice consequent on increasing the rate of speed will be more comprehensively demonstrated if by any means we can form an approximate £ s. d. estimate of the prime cost expenses that attend the steam conveyance of mercantile cargo per ton weight of cargo conveyed.

For the details of such an inquiry I may refer to pages 76 and 77 of the second edition of the essay on Steamship Capability before referred to, whereby, including five per cent. per annum for interest on investment, ten per cent. per annum for upholding stock, and five per cent. per annum for insurance, the annual working charges in the ship department per ton of displacement (assuming the builders' tonnage and displacement to be equal) amounts to £6 11s. 2d., and the annual working charges of the engine department to £7 18s. per indicated horse-power, or £31 12s. per marine horse-power, exclusive of coals; the cost of coals being greatly dependent on the locality of the proposed service and state of the times, requires to be made a distinct item of charge; but for the purpose of exemplifying the proposed system of calculation, I assumed the cost of coal delivered on board ship at 40s. per ton.

For example, on this estimate, the annual prime-cost expenses attending the upholding and working a ship of 1500 tons deep displacement, fitted with engines of 140 marine horse-power of the unit 132,000 lbs. raised one foot high per minute, will, exclusive of coal, amount in the engine department, to £4,424 per annum, and in the ship or hull department to £9,837 per annum, exclusive of coal, harbour and other local dues, lights, and pilotage; and this annual charge against the ship of £9,837 for the ship department, and £4,424 for the engine department, is absolutely irrespective of the locomotive capability of the ship, or of the service that may be performed by the ship, and on which the earnings of the ship will be dependent. Now in consideration that a steamship may be expected to be at sea only, say, 200 days per annum, and that it is only at sea that she does the service which must meet the total annual expenditure, it follows that in the ship department the outlay must be rated at 8d. per day, sea time, per ton of displacement, and the expenses in the engine department at 3s. per horse-power per day, sea time, exclusive of coals, which may be rated at 40s. per ton. For example: On these data, the prime-cost expenses per ton weight of cargo conveyed on a passage of 3,000 miles, by vessels of 1,500 tons deep displacement, fitted for the respective speeds of 6, 8, 10, and 12 knots per hour, and supposing them to be at sea 200 days per annum, and to be fully loaded both out and home, may be estimated as follows:—

Passage, 3,000 nautical miles; ship, 1,500 tons deep displacement; co-efficient of locomotive efficiency that of the *Candia*, or $\frac{V^3 \times D^{\frac{2}{3}}}{H.P.} = 944$. Engine department rated at 3s. per horse-power per day, and coals at 40s. per ton. Shipping department rated at 8d. per ton of deep displacement per day.

| Speed in Knots. | Horse-power. | Assumed weight of Hull. | Assumed weight of Engine Department. | Assumed weight of Total. | Time. | Coal. | Cargo. | Deep displacement. | Items of Expense. | Expenses per Ton of Cargo. £ s. d. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tons. | Tons. | Tons. | D. H. | Tons. | Tons. | Tons. | | | |
| 6 | 30 | 600 | 30 | 630 | 20·20 | 125 | 745 | 1500 | Coal ................. ... | 0 6 9 | 1 17 3 |
| | | | | | | | | | Engine Department ... | 0 2 6 | |
| | | | | | | | | | Shipping Department . | 1 8 0 | |
| 8 | 71 | 600 | 71 | 671 | 15·15 | 222 | 607 | 1500 | Coal ..................... | 0 14 8 | 2 5 11 |
| | | | | | | | | | Engine Department ... | 0 5 6 | |
| | | | | | | | | | Shipping Department . | 1 5 9 | |
| 10 | 139 | 600 | 139 | 739 | 12·12 | 347 | 414 | 1500 | Coal....................... | 1 13 6 | 3 16 3 |
| | | | | | | | | | Engine Department ... | 0 12 7 | |
| | | | | | | | | | Shipping Department . | 1 10 2 | |
| 12 | 240 | 600 | 240 | 840 | 10·10 | 500 | 160 | 1500 | Coal....................... | 6 5 0 | 11 16 10 |
| | | | | | | | | | Engine Department ... | 2 6 10 | |
| | | | | | | | | | Shipping Department . | 3 5 0 | |

From the above table we observe, that with vessels of 1,500 tons deep displacement employed on a passage of 3,000 nautical miles, the rates of prime cost expenses per ton of goods consequent on steaming at the speeds of 6, 8, 10, and 12 knots per hour, will be £1 17s. 3d., £2 5s. 11d., £3 16s. 3d., and £11 16s. 10d.; which rates of prime cost freight charge are nearly in proportion to the numbers 100, 120, 205, and 638. It is to be observed that the total expense at 8 knots, is about 20 per cent. in excess of the 6 knots speed, while the saving of time is 25 per cent.; consequently, it may be advisable that the steaming capability of steamers should be not less than 8 knots per hour. We must, however, be cautious how we exceed the speed of 8 knots per hour; for, at 10 knots, the prime cost freight charges, under the circumstances of this case, become 70 per cent. in excess of the 8 knots speed; and, at 12 knots, the displacement available for cargo is so reduced that the prime cost freight charges per ton of cargo become five times greater than the expenses incurred at 8 knots.

Ninthly. We may now usefully enquire into the effects that will be produced by increasing the size of the ship. Suppose, therefore, that we employ a ship of double the

before-mentioned size, namely, 3,000 tons deep displacement, on the same 3,000 miles passage, and under the same conditions as to consumption of coal and other details of estimate, the results will be as follow:—

Passage 3,000 nautical miles; ship, 3,000 tons deep displacement; co-efficient of locomotive efficiency $\frac{V^3 D^{\frac{2}{3}}}{H.P.}=944$.

| Speed in Knots. | Horse-power. | Assumed Weight of Hull. | Assumed Weight of Engine Department. | Assumed Weight of Total. | Time. | Coal. | Cargo. | Deep displacement. | ITEMS OF EXPENSE. | Expenses per Ton of Cargo. Items. | Expenses per Ton of Cargo. Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tons. | Tons. | Tons. | D. H. | Tons. | Tons. | Tons. | | £ s. d. | £ s. d. |
| 6 | 48 | 1200 | 48 | 1248 | 20·20 | 200 | 1552 | 3000 | Coal | 0 5 11 | |
| | | | | | | | | | Engines | 0 1 11 | 1 14 8 |
| | | | | | | | | | Shipping | 1 6 10 | |
| 8 | 113 | 1200 | 113 | 1313 | 15·15 | 353 | 1334 | 3000 | Coal | 0 10 7 | |
| | | | | | | | | | Engines | 0 4 0 | 1 18 0 |
| | | | | | | | | | Shipping | 1 3 5 | |
| 10 | 220 | 1200 | 220 | 1420 | 12·12 | 550 | 1030 | 3000 | Coal | 1 1 4 | |
| | | | | | | | | | Engines | 0 8 0 | 2 13 7 |
| | | | | | | | | | Shipping | 1 4 3 | |
| 12 | 381 | 1200 | 381 | 1581 | 10·10 | 794 | 625 | 3000 | Coal | 2 10 10 | |
| | | | | | | | | | Engines | 0 19 1 | 5 3 3 |
| | | | | | | | | | Shipping | 1 13 4 | |

From the above table we observe, that with vessels of 3000 tons deep displacement (being the double of the size before referred to) employed on a passage of 3000 nautical miles, the rates of prime cost expenses per ton of goods consequent on steaming at the speeds of 6, 8, 10, and 12 nautical miles per hour, as compared with the expenses incurred with the 1500 tons ship, will be as follows:—namely,

£1 14s. 8d., £1 18s. 0d., £2 13s. 7d., and £5 3s. 3d., instead of £1 17s. 3d., £2 5s. 11d., £3 16s. 3d., and £11 16s. 10d., being a saving in favour of the large ship of 2s. 7d., 7s. 11d., £2 2s. 8d., and £6 13s. 7d. per ton of goods conveyed, or equivalent to 7 per cent., 17 per cent., 30 per cent., and 57 per cent., showing the advantage of the increased size according as the speed at which the service may be required to be performed shall be 6, 8, 10, or 12 knots per hour. Thus, we see the advantage of the larger ship in performing a *given service* under the *same conditions* of speed and distance to be run without re-coaling, provided that it be always fully loaded, and that its harbour services of loading and discharging cargo be performed with equal dispatch, and that neither mercantile, or local, or naval difficulties, subject the larger ship to inconveniencies not affecting the smaller.

Tenthly: on the other hand, however, let us suppose that the smaller ship of 1,500 tons avail itself of re-coaling at ports not accessible to the large ships of 3000 tons, and that instead of performing the whole passage of 3000 nautical miles direct without re-coaling, it divides the passage into 3 stages of 1000 miles each, re-coaling at the two intermediate stations. Under these conditions, the cost expenses per ton of goods conveyed the whole distance will be as follows:—

Passage, 3000 nautical miles, performed in 3 stages of 1000 miles each; ship 1500 tons deep displacement, co-efficient = 944.

| Speed in Knots. | Horse-power. | Assumed Weight of Hull. | Assumed Weight of Engine Department. | Assumed Weight of Total. | Time per Stage. | Coal per Stage. | Cargo. | Deep displacement. | ITEMS OF EXPENSE. | EXPENSE PER TON OF CARGO. Items per Stage. | EXPENSE PER TON OF CARGO. Total for Stage of 1000 N. Miles. | EXPENSE PER TON OF CARGO. Total for Passage of 3000 N. Miles. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tons. | Tons. | Tons. | D. H. | Tons. | Tons. | Tons. | | £ s. d. | £ s. d. | £ s. d. |
| 6 | 30 | 600 | 30 | 630 | 6·23 | 42 | 828 | 1500 | Coal | 0 2 0 | | |
| | | | | | | | | | Engines | 0 0 9 | 0 11 2 | 1 13 5 |
| | | | | | | | | | Shipping | 0 8 5 | | |
| 8 | 71 | 600 | 71 | 671 | 5· 5 | 74 | 755 | 1500 | Coal | 0 3 11 | | |
| | | | | | | | | | Engines | 0 1 6 | 0 12 3 | 1 16 10 |
| | | | | | | | | | Shipping | 0 6 10 | | |
| 10 | 139 | 600 | 139 | 739 | 4· 4 | 116 | 645 | 1500 | Coal | 0 7 2 | | |
| | | | | | | | | | Engines | 0 2 8 | 0 16 4 | 2 9 0 |
| | | | | | | | | | Shipping | 0 6 6 | | |
| 12 | 240 | 600 | 240 | 840 | 3·11 | 167 | 493 | 1500 | Coal | 0 13 6 | | |
| | | | | | | | | | Engines | 0 5 1 | 1 5 8 | 3 17 0 |
| | | | | | | | | | Shipping | 0 7 1 | | |

Thus, by re-coaling at two intermediate stations, the cost expenses per ton of goods conveyed, amount to £1 13s. 5d., £1 16s. 10d., £2 9s. 0d., and £3 17s. 0d., according as the speed is 6 knots per hour, 8, 10, or 12 knots, instead of £1 14s. 8d., £1 18s. 0d., £2 13s. 7d., and £5 3s. 3d., the expenses per ton of cargo incurred by

the larger ship of 3000 tons displacement, performing the passage of 3000 miles direct, without re-coaling at any intermediate station. Thus it appears the advantage resulting from the superior capability of ships of 3000 tons displacement, over ships of half the size, namely, 1500 tons displacement, on a passage of 3000 miles, becomes altogether neutralised, and the scale turned in favour of the smaller ship, simply by her taking advantage of re-coaling at two intermediate ports, thus dividing the passage into three stages, instead of performing the 3000 miles direct. In fact, it is the judicious adaptation of speed to the pecuniary rate of freight charges that the description of trade between any two ports will bear, and the judicious selection of the size of ships to be employed with reference to the amount of trade in both directions, and to the coaling stations which may be available, that constitute the very essence of steam ship direction, on which steam ship economy of transport is dependent.

On this point, namely, the relative dynamic or locomotive capabilities of large ships as compared with smaller, I am particularly anxious that I be not misunderstood before the Society of Arts: I do not only acknowledge, but I have also publicly endeavoured to demonstrate, the superior dynamic or locomotive capabilities of large ships for the performance of any given service under given conditions of steaming speed and distance to be steamed without recoaling; but what I would desire to inculcate is, that this mechanical, and, consequently, in a dynamic point of view, economic, advantage of large ships may very soon become sacrificed, if, on the strength of magnitude alone, we impose on the larger ship the obligation of steaming at a higher rate of speed combined with a greater distance without re-coaling, than we assign to the service of the smaller ship. My views as to the most available size of ships are professionally confined to the *mechanical* consideration of the case; I do not enter upon the mercantile and nautical questions by which, apart from engineering, the comparative advantages of large and smaller ships for any particular service, are regulated and limited; but, asserting as I do the superior capabilities of large ships in a dynamic point of view, I would also desire to point out the mechanical limitation of such superior capability, in order that the advantages attendant on size may be realised by vessels having such conditions of service only assigned to them as shall not exceed the limitations which they may be advantageously able to perform.

Eleventhly. The importance of subjecting steam-ship capability for transport service to the test of pecuniary arithmetical calculation, will be illustrated by our bringing into tabulated juxtaposition the £ s. d. prime cost expenses that would be incurred by performing a given service, under given conditions, with vessels of given size (say 3000 tons displacement), but of various locomotive qualities, as indicated by the differences of their dynamic coefficients. For this purpose I have made a selection of ten different types of construction, whose dynamic coefficients have been determined by the actual test trial performance of the respective ships, and calculating the £ s. d. prime cost expenses per ton of goods conveyed by ships of these types of 3000 tons displacement, on a passage of 3000 miles, at the speed of eight knots per hour. The results are as follow:—

Passage, 3000 nautical miles, displacement 3000 tons, speed 8 knots per hour. (*The purpose of this table is to show the mutual relation between the dynamic co-efficient and the £ s. d. cost of transport, the coal being rated at 40s. per ton, engines at 3s. per day per horse-power, and the shipping at 8d. per day per ton of displacement.*)

| TYPE OF CONSTRUCTION. | Dynamic (C) Co-efficient. | Speed. | Power. | Weight of Hull and Engines. | Time. | Coal. | Cargo. | Deep displacement. | ITEMS OF EXPENSE. | Expenses per Ton of Cargo. Items. | Expenses per Ton of Cargo. Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Knots. | Horses. | Tons. | D. H. | Tons. | Tons. | Tons. | | £ s. d. | £ s. d. |
| Candia | 944 | 8 | 113 | 1313 | 15·15 | 353 | 1334 | 3000 | Coal | 0 10 7 | 1 18 0 |
| | | | | | | | | | Engines | 0 4 0 | |
| | | | | | | | | | Shipping | 1 3 5 | |
| Rattler | 862 | 8 | 124 | 1324 | 15·15 | 387 | 1289 | 3000 | Coal | 0 12 0 | 2 0 9 |
| | | | | | | | | | Engines | 0 4 6 | |
| | | | | | | | | | Shipping | 1 4 3 | |
| Vulcan | 728 | 8 | 146 | 1346 | 15·15 | 456 | 1198 | 3000 | Coal | 0 15 3 | 2 7 1 |
| | | | | | | | | | Engines | 0 5 9 | |
| | | | | | | | | | Shipping | 1 6 1 | |
| Arrogant | 664 | 8 | 160 | 1360 | 15·15 | 500 | 1140 | 3000 | Coal | 0 17 7 | 2 11 7 |
| | | | | | | | | | Engines | 0 6 7 | |
| | | | | | | | | | Shipping | 1 7 5 | |
| Dauntless | 616 | 8 | 173 | 1373 | 15·15 | 541 | 1086 | 3000 | Coal | 0 19 11 | 2 16 2 |
| | | | | | | | | | Engines | 0 7 6 | |
| | | | | | | | | | Shipping | 1 8 9 | |
| Hogue | 602 | 8 | 177 | 1377 | 15·15 | 553 | 1070 | 3000 | Coal | 1 0 8 | 2 17 7 |
| | | | | | | | | | Engines | 0 7 9 | |
| | | | | | | | | | Shipping | 1 9 2 | |
| Conflict | 528 | 8 | 202 | 1402 | 15·15 | 631 | 967 | 3000 | Coal | 1 6 1 | 3 8 3 |
| | | | | | | | | | Engines | 0 9 10 | |
| | | | | | | | | | Shipping | 1 12 4 | |
| Termagant | 492 | 8 | 216 | 1416 | 15·15 | 675 | 909 | 3000 | Coal | 1 9 8 | 3 15 3 |
| | | | | | | | | | Engines | 0 11 2 | |
| | | | | | | | | | Shipping | 1 14 5 | |
| Ajax | 364 | 8 | 293 | 1493 | 15·15 | 916 | 591 | 3000 | Coal | 3 2 0 | 6 18 2 |
| | | | | | | | | | Engines | 1 3 3 | |
| | | | | | | | | | Shipping | 2 12 11 | |
| Amphion | 332 | 8 | 321 | 1521 | 15·15 | 1003 | 476 | 3000 | Coal | 4 4 3 | 9 1 6 |
| | | | | | | | | | Engines | 1 11 7 | |
| | | | | | | | | | Shipping | 3 5 8 | |

Thus we see that as the dynamic coefficient varies from that of the type of the *Candia* (944) to that of the type of the *Amphion* (332), the prime cost expenses of goods' transport will increase from £1 18s. to £9 1s. 6d. per ton of goods conveyed on the service referred to. No doubt many causes may contribute to this great difference of dynamic or locomotive economy; but, whether the cause be inferiority of type of build, inferiority of engine adaptation, defective condition of hull or engines, bad management, or all of these causes of inefficiency combined, the result is equally detrimental to the commercial interests concerned in the service of the inferior vessel. And further it is to be observed, that the economic advantages of a superior type of build may be sacrificed by an unnecessary weight of materials having been employed in the construction of the ship and engines, thereby encroaching upon the displacement otherwise available for cargo. Hence the advantage of knowing the displacement of a ship at her launching draught, and when fully equipped ready for cargo.

In the case of ships of war, the armament and personal and material equipment constitute a constant cargo, which may be called tons weight of "Naval Demonstration;" and it may possibly be said that the type of build of ships of war, with reference to their dynamic efficiency, is of secondary importance to their type of build, with reference to stability, sailing properties, capability for carrying guns at the bow and stern, and other essential naval requirements. Admitting the force of this argument, the question assumes the following form, namely:—In what naval respects are the types of form illustrated by the *Amphion* and the *Ajax* so superior to the types of the *Hogue* and the *Arrogant* as to compensate for the tons weight of "naval demonstration" in the types of the *Amphion* and the *Ajax*, being only 15 and 20 per cent. of the displacement of ships on those types of construction under the conditions of the assigned service, while the tons weight of "naval demonstration" afforded by the types of the *Hogue* and the *Arrogant* is 36 per cent. and 38 per cent. of their displacement under the same assigned conditions of service. And again, seeing that the types of the *Rattler* and the *Candia*, under the same assigned conditions of service, would carry "naval demonstration" amounting to 43 per cent. and 45 per cent. of their displacement, are we sure that the types of construction of the immersed hulls of the *Rattler* and the *Candia* do not admit of being approximately adopted as giving available immersed lines for ships-of-war. But further, embracing the £ s. d. consideration of the case, it may fairly be asked in what naval respects is the type of construction of the *Amphion* so superior to the type of the *Vulcan* as to make it practically worth while that the conveyance of naval demonstration on board the type of the *Amphion* on a passage of 15 days' duration, at 8 knots per hour, should cost £9 1s. 6d. per ton weight, whilst its conveyance by the type of the *Vulcan* is only £2 7s. 1d. per ton weight? What superiority of naval efficiency have we to show for the difference of transport expenses per ton weight of "naval demonstration," which ships of these types under the conditions of service referred to would respectively involve?

In conclusion, it may be hoped that the discussion of these matters before the Society of Arts, and the truths which such discussion may elicit, will lead to public attention being directed to the necessity of legalising some system whereby the gross tons weight of displacement of ships at the constructors' specified deep-load immersion shall be ascertained; also, that the measure of the unit of power to be denoted by the term horse-power be defined and legalised; and that the records of the Board of Trade embrace the gross tons weight of displacement at the constructors' specified load-line draught, in addition to, and not to supersede, the present record of internal roomage, which latter system of admeasurement may doubtless be necessary for the purposes of fiscal regulation. It is respectfully submitted for the consideration of the Society of Arts, that without some legalized definition of the standard units of ships' measurement and of marine engine power, by which steam ships are hired, bought, and sold, and on which their capabilities are dependent, the transport service of steam shipping can not be subject to regulation, or even be brought within the pale of pecuniary arithmetical calculation.

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NOTE.—As the consumption of coals is (*cæteris paribus*) proportional to the gross indicated H.P. actually worked up to, and as the speed is proportional to the distance divided by the time of passage, the locomotive performance of steam-ships may be comparatively tested by the following rule:—Divide the distance steamed (taken in nautical miles) by the steaming time (taken in hours), cube the quotient, multiply by the cube root of the square of the mid-passage displacement, and divide by the average 24 hours' consumption of coals expressed in cwts., the result will be the index number, or co-efficient, indicative of the locomotive performance of the steam-ship. By this rule, the economic operation of the boiler becomes included, and all reference to horse-power being obviated, the elements of this calculation are matters of ordinary counting-house record, and we thus obtain a mercantile rule, divested of engineering technicalities, for comparing the locomotive capabilities of steam-ships.

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## DISCUSSION.

The ASTRONOMER ROYAL, F.R.S., says, in a note to the Secretary, "I have made myself acquainted with the paper which is to be read by Mr. Atherton, at the meeting of the Society of Arts, on the 16th instant. I regret much that I cannot conveniently attend the meeting, as I consider the subject brought forward by Mr. Atherton to be very important, and the treatment of it appears to me admirable. I think that Mr. Atherton has most fairly and completely exposed the insufficiency of the usual methods of expressing tonnage and horse-power, and the practicability of substituting for them methods which would be reasonably accurate and generally sufficient. Perhaps I might not entirely agree with Mr. Atherton on the proposed mode of carrying out the substitution. It appears to me that the matter is hardly yet in a state in which any attempt at legalization can be made. It is best, in general, to confirm the adoption of standards by laws only when they have been pretty well established by usage. I should, therefore, turn my thoughts to the introduction of the proposed scales for displacement, or available space, and for effective horse-power, by endeavouring to introduce them to the customary usage of the parties who negotiate the most extensive contracts. I am not sufficiently acquainted with the course of commercial transactions, to say how far reference is made to such scales in the private arrangements of mercantile men, but I conjecture that they are used far more extensively in the contracts of the Government with shipowners than in any other agreements. If this be so, it appears most desirable that the state of the case should be distinctly laid before that branch of the executive government with whom the contracts for hired steamers principally rest; and I should think that if a system of simple rules, to be followed on occasions of contracting for steamers, were laid before the Government, it might be adopted at once by the Government, and might in no long time make its way into the merchant service generally. I have confined my remarks above to the subject of legalising the standards, because this is the principal subject, among those treated in this paper, which it is not in the power of every commercial man to carry out for himself, but I am far from considering this as the only matter of importance in the paper. The discussion of the advantages and disadvantages in the employ of large or small ships, and in the coaling for long or short voyages, appears to me excellent, and will tend, I trust, to remove some extensive delusions on these points."

Capt. J. M. LAWS, R.N., was induced to make a few remarks on the very important subject treated of by Mr. Atherton. There were now about 570 vessels propelled

by steam power, either the property of the state, or actually and actively employed by it, embracing an amount of power, capital, and skill, not only unsurpassed by any nation in the world, but unequalled by all nations in the world put together, nor could all the other nations on the earth supply this fleet (dispersed as it was) with fuel and other requisites to sustain its mechanical power. Now, on looking over the Navy List, which gives the nominal horse-power, and the naval demonstration by the number of guns, and also the Commercial List published by the Board of Trade under a recent Act of Parliament, which gives in this case the tonnage and the nominal horse-power, what did we find, why, out of 270 of her Majesty's ships, the force of which varied from 2 to 131 guns each, we have the nominal horse-power *per gun* varying from 175 to a gun to 3 to a gun, with like inequalities of steam power to military force only in degree less throughout the whole list. For instance, we might begin with the *Agamemnon* of 600 horse-power and 91 guns; the *Algiers* of 450 horse-power and 90 guns; the *Arrogant* of 360 horse-power and 46 guns; the *Aurora* of 400 horse-power and 50 guns; the *Argus* of 300 horse-power and 6 guns; the *Blenheim* of 460 horse-power and 60 guns; the *Brunswick* of 400 horse-power and 80 guns; the *Bull-dog* of 500 horse-power and 6 guns; the *Centaur* of 540 horse-power and 6 guns; the *Centurion* of 400 horse-power and 80 guns; the *Conflict* of 400 horse-power and 8 guns; the *Conqueror* of 800 horse-power and 100 guns; the *Royal George* of 400 horse-power, and 120 guns; the *Dauntless* of 580 horse-power and 33 guns; the *Cruizer* of 60 horse-power and 17 guns; the *Curlew* of 60 horse-power and 9 guns; the *Cyclops* of 320 horse-power and 6 guns; the *Curacoa* of 350 horse-power and 30 guns; the *Desperate* of 400 horse-power and 8 guns; and, lastly the *Duke of Wellington*, of 700 horse-power and 131 guns. It was unnecessary to pursue the list further, as similar discrepancies, in proportion to the number of ships, would be found under every letter of the alphabet. Some, for instance, the *Royal George*, of 120 guns and 400 horse-power, and the *Conflict*, of 8 guns and 400 horse-power, were both now and had been last year in the Baltic fleet, and the *Royal George* had always worked well, although not built for steam power of any kind. What the *Conflict* had done was not so well known, but had the engines of these two vessels been alike in all other respects, as well as in nominal power, it might have been supposed that she was kept in reserve to any of the line-of-battle ships with the same power; but no such arrangement was contemplated, for both engines and boilers were as unlike in pattern as a knife was to a fork. He would now refer to the two largest private royal companies, and see how they stood, possessing as they did in each case, as regards the number and magnitude of their ships and nominal power of engines, a capital that few if any other national fleets could produce. He would begin with the Royal West India Mail Steam Packet Company. In the last half-yearly report of that Company, just published, a list was given of the company's fleet, and the registered tonnage and nominal horse-power of each ship was stated, amounting, in the aggregate, to 43,524 tons and 11,140 nominal horse power. Now few things in the military or commercial world could be more extravagant than the discrepancies exhibited in this account. For instance, the *Parana*, a ship of 3,070 tons, and 800 nominal horse-power, cost the company £123,000, and was said to be a vessel of excellent qualities; while the *Tyne*, of 2,184 tons and 400 horse-power, was said to have performed a voyage of 3,000 miles or more, with a speed of 13½ knots per hour. Now compare what the best ship in Mr. Atherton's list would carry her cargo at that speed for, and what it would have cost at 10 knots, and then they could show the proprietors of steam-ship companies what they were undertaking in each case. It was desirable, also, that they should know whether the *Parana* had really more indicated or real horse-power than the *Tyne*, and whether it was profitable to carry passengers and mails goods to and from the West Indies at the same price for the one speed as for the other. The West India Mail Company certainly had, next to the Liverpool and New York, probably the best line of 3000 miles voyage that could be selected, but it was vastly more expensive, and involved extremely dangerous and difficult navigation, which the other was free from. In the matter of coals alone, on the New York line, they would not average above 25s. per ton, or they did not do so on the Collins line; and at Boston and Halifax on the Cunard line, ought not to exceed 35s. per ton. With these remarks on the Royal West India Mail Company, he would pass to the Peninsular and Oriental Company, which likewise possessed an excellent fleet. Here we might fairly infer there was a no less want of knowledge as to what was the meaning of nominal horse power. He had lately read an extraordinary account in the *Times* of the 3rd instant, headed "Paddle *versus* Screw," from which he would make the following extract:—

"PADDLE V. SCREW.—SOUTHAMPTON, Wednesday, May 2.—An experiment of an interesting nature, and attended with important results in connexion with steam navigation, has recently been made by the Peninsular and Oriental Steam Company, who, more fully to test the respective merits of the paddle and screw, have altered one of their fine steamers from a paddle-wheel to a screw. The steamer in question is the Sultan, an iron ship of 1200 tons burden, originally fitted with engines of 420-horse power. The alterations now made in the vessel have caused the old machinery to be entirely discarded, and in its place engines of only 210-horse power have been supplied by Messrs. Sumners and Day, of Southampton, with Lamb and Sumners' patent flue-boilers. An opportunity was here afforded of exhibiting the difference in speed caused by the alteration not only in the method of propulsion, but in the power of the machinery. The experiment has not only been successful, but the result is sufficiently extraordinary to merit the attention of scientific men. At the official trip of the Sultan in 1851 with paddle-wheel engines of 420-horse power, the average speed was 10.714 knots an hour. With the new engines, which are precisely half the power of the old ones, but driving a screw, the average speed under steam alone has been 10.4 knots, and, with a light breeze and the fore and aft canvas set, 11·004 knots, the former being very nearly equal to the speed gained when the ship was driven through the water by paddle-wheel engines of such enormously disproportionate force. The slight and almost insignificant difference in speed is not the only advantage gained by the novel change. In place of carrying only eight days' coals, as heretofore, the Sultan can now stow fuel for sixteen days' consumption, has greater accommodation for passengers, and can take 150 to 200 tons more cargo than it was possible to carry before."

Now, he would ask any reasonable man whether, if that account were true, there could be any longer a question as to which was the right mode of propelling ships, and whether the screw was not, as nearly as possible, 100 per cent. better than the paddle, even as regarded the application of power, and independent of the other advantages very justly claimed. He was much struck with this account, and feeling there must be some delusion in it, he took the liberty of addressing a note to Capt. Engledue, the highly and justly valued superintendent of the Company, at Southampton, and asked him whether the account was correct, to which that gentleman replied, that, except in one unimportant point, it was. He then asked for the draught of water, and the exact indicated horse-power under the two circumstances, or trials, in the years 1851 and 1855; from which it appeared that in 1851 the draught of water was 11 feet, while in 1855 it was 10 feet 10 inches, a difference of two inches only, it was true, but which in a large ship like the *Sultan* would materially alter the displacement. The reply as to the horse-power was not in terms that were intelligible to him (Capt. Laws), but assuming that the power was relatively the same in the 420 and 210 horse-power engines, what did this trial amount to? The speed, to be three-fourths of a knot faster with 40 tons less displacement in the first case than that of the late trial, would not give more than

70 per cent. difference in the relative power of the two sets of engines; that was to say 10 knots per hour would be attained with 80 per cent. of the power of 11 knots, and the difference of displacement at that speed would add at least 10 horse-power, thus reducing the per centage to 70 instead of 100 per cent. That advantage was enough to prove the superiority of the screw, which he never doubted, but he fancied that in these two cases the real power executed by the engines was very much nearer alike than was believed. In conclusion, he trusted that the Naval Department of the Government would establish some fixed rules or data to avoid the discrepancies that had been spoken of, and no longer continue to fight in the dark as to what they were paying for, and what duties could be performed by any nominal amount of horse-power.

Mr. J. Scott Russell, F.R.S., Vice-President, begged to join in the expression of the value which every member of this Society, as well as the noble lord in the chair, must attribute to the fact of Mr. Atherton having come forward to open the discussion upon a subject so important and so practical. When he remembered that Mr. Atherton was originally one of the mercantile engineers of this country, that he matured his knowledge in that service, that afterwards he gave to the government the assistance of his great experience and talent, they must feel that it was very kind on his part to come back, as it were, amongst them again, and repay to them some of the experience which he got when one of them, by applying his researches in an endeavour to settle and mature certain principles of determining the steam capabilities of merchant vessels; because, when he talked about transport service, whether for mercantile or for war purposes, was, of course, of very little importance. Now there were a very considerable number of points on which he admitted he agreed with Mr. Atherton; there were, also, a certain number of other points on which he would express his difference of opinion from that gentleman; but he hoped it would be understood that he did so not for the purpose of putting his opinion against that of Mr. Atherton, but of having the subject thoroughly and dispassionately discussed. There was one point on which, he thought, they must all agree—that was, the dreadful mess they were in with regard to "horse-power" and "tonnage;" and he did not think there was, with but one exception, perhaps, any one in that room who would not admit that on this 16th day of May, 1855, they were in a greater mess in regard to nominal tonnage than they ever were before. He would explain this. He had come from the Custom-house that day, after assisting in getting the register of a vessel. He had desired to get the register before the 1st of May, but he had not succeeded; but the result was, if he had succeeded in getting the vessel registered before the 1st of May, she would only have been registered as a ship of 480 tons, but that day he had got a register of that same ship as one of 543 tons; so that, whether tonnage was an imaginary quantity before *or* after, or whether it was an imaginary quantity before *and* after the 1st of May, must be a matter for the meeting to discuss on a future occasion. So much, then, for tonnage. With regard to horse-power they were much in the same difficulty, but he thought he saw something like daylight through this, if not exactly as Mr. Atherton had stated, yet in some such way; because, he observed in the paper, Mr. Atherton used the words "marine horse-power." Now, if they talked of "horse-power" in the old language, as 33,000 lbs., and then if they called the "marine horse-power" what it usually was, viz., 100,000 lbs.—because they knew that marine horse-power was actually three or four times the old fashioned horse-power—

Mr. Atherton—Make it what you like.

Mr. Scott Russell entirely agreed with Mr. Atherton as to the very great expediency, as soon as possible, of establishing some standard of reference, whether for government, or buying, selling, building, or chartering vessels—not by what they were called, but by what they would do. He knew of two vessels that had been chartered by the government—the one was called a ship of 1,450 tons and 300 horse-power.

Mr. Atherton—Is that builder's tonnage?

Mr. Scott Russell—Registered tonnage; which is nearly the builder's tonnage in this case—the vulgar tonnage before the 1st of May—what it was to-day he would not say. This vessel went from 8 to 9 knots an hour, and could carry about 600 tons. There was also another vessel which also went 8 or 9 knots an hour, which also carried 600 tons, but which was only propelled by 80 horse-power—which only burnt the coal of 80 horse-power, which only registered 480 tons; and, therefore, the 600 tons carried to Constantinople in the one vessel, would cost more than the 600 tons carried to Constantinople in the other vessel, in the proportion of 1,450 to 480, and would burn coal over that distance for the same speed, in the proportion of 300 horse-power to 80 horse-power. Well, then, it was quite plain, for building, and buying, and selling, there was something more to be considered than nominal tonnage and nominal power, and he would advise all shipowners never to buy or build a ship for the future either by nominal horse-power or by nominal tonnage. He had long since abandoned that, with those of his customers who would take his advice. The wiser plan was for the owner to pay the shipbuilder by the working capability of his ship. To say, "I want to carry 600 tons from Liverpool to Constantinople, at 9 knots an hour, with the consumption of so many tons of coals, and the same to be a good and serviceable and durable sea vessel, of the first class," and leave the details to the builder. He would thus get what he wanted, viz., a ship to do a given quantity of work, at a given sum of money; and that, he believed, was what his friend Mr. Atherton would desire to see accomplished. He would have them define the work to be done, and would buy and sell and pay for the vessel, as to whether she would do that work or not. He, therefore, agreed in getting some such ordeal to which to bring these vessels, and he had no objection to call it "effective duty," or "locomotive capability," or some phrase equivalent to that. There was, however, one point to which he must call Mr. Atherton's attention, which did not quite chime with what he had been saying, or what he (Mr. Russell) had himself just said, which was this—there was another element of locomotive capability which was applicable to transports and vessels of war. It was the question of accommodating passengers. That was bound up with displacement in another way, and yet was different from displacement. He did not think it entered much as an element into Mr. Atherton's paper, and, therefore, he called attention to it. He would go back again to the examples he had given of the two ships of 600 tons each, with such different rate of power and cost. He should say, the 1450 ton vessel, if hired for carrying troops instead of being hired for carrying dead weight, would have a very much higher value, and that value would probably be in proportion to her nominal tonnage. A vessel of 1450 tons would have a deck available to a large extent for the transport of troops; therefore, such a vessel for troops might be most economical and proper; and thus, in going into the question of troops or passengers, they must take care what formula they adopted, as it did not appear to be an element in Mr. Atherton's formula. The immediate object of his formula seemed to be merely the transport of a certain weight of goods, and he thought the omission must be remarked as very seriously affecting his conclusions. Another point was omitted in the formula, which must find a place in the head of any practical man, viz., the effect of the *change of form* of the vessel which was necessary in passing from a low speed to a high one. It must never be understood that a small, short vessel of small tonnage, when merely magnified to a large scale, was enlarged in the way it ought to be enlarged, if designed for the purpose of getting additional speed. For example, there was one case in Mr.

Atherton's paper, in which he said—a given vessel with a given form would take so much to propel her at 8 knots, so much at 9 knots, so much at 10 knots, and so much at 11 knots. In practice he (Mr. Scott Russell) should never do that. He should not attempt to make the vessel built for 8 knots, either go 10 knots, or 12 knots, or 15 knots, or put power into it to make it do that; because he knew, by dear-bought experience, that to attempt to make a vessel that was suited for 8 knots go 10 knots was a folly—that to attempt to make a vessel suited for 12 knots go 15 knots was another folly, and was a mere extravagant expenditure of force. Luckily he had the example of an experiment that he thought would convince Mr. Atherton that the point of form suitable to speed was a question that deserved to be looked into. When Mr. Atherton spoke of a vessel of 1500 tons displacement, he (Mr. Scott Russell) referred to an experiment of a vessel of exactly 1500 tons displacement, and this vessel was propelled 9·4 knots, with a consumption of coal of 12 cwt. per hour; and again, he had an experiment with the same vessel at 14 knots. According to Mr. Atherton's calculation, this 1500 tons ship at 9 knots would burn 16 cwt. of coal. Take that as the datum. She burnt in this case 12 cwt. of coals, but when he went to 14 knots with his (Mr. Atherton's) vessel, which was not calculated for 14 knots, then he got a combustion of 3 tons of coal per hour, whilst in fact he (Mr. Russell) only got a combustion of 30 cwt. at 14 knots with his own ship; but he begged to remark, that this was a vessel constructed with the specific form necessary to go 14 knots, and failing success she was to have been thrown upon the hands of the builder. That was the way he, as a merchant builder, was obliged to nail his flag to the mast. Say, for example, he bargained to build a vessel for £60,000, a vessel of 1500 tons to go 14 knots an hour, if she did not go that speed he might have to take off £10,000 from the price for every half-knot she went slower. This vessel being designed to go 14 knots, did it with a consumption of 30 cwt. of fuel. He stated this to show that if this vessel had been taken from a fixed type, only having 16 cwt. at 6 knots, she would, on Mr. Atherton's formula, have burnt three tons at 14 knots, whereas his (Mr. Scott Russell's) burnt only 30 cwt. on account of her better form. In the same manner he had another example of a vessel of 590 feet section going 9½ knots with 27 cwt. of coal. That was at variance with Mr. Atherton's data. Therefore he called attention to the fact, that he would require changed data if he transferred his inferences from a vessel of a given form to classes of vessels which varied in form according to the speed they were designed to go. With regard to any crotchet about the screw being so much better than the paddle, or the paddle so much better than the screw, it was not a point that ought to have been brought forward by engineers in a respectable newspaper, intended to be read by engineers, because he remembered the *Sultan* when she was first built, and she was certainly a very capitally built and fast vessel, with 450 nominal horse power, with the old-fashioned paddle-wheel engine. Her piston probably made 18 strokes per minute, and her safety-valve was loaded probably to 7 or 8 lbs., or, if the commander was a courageous man, perhaps to 9½ lbs. But here came a man who was driving these screw engines probably at the rate of 400 or 450 feet per minute, and he (Mr. Scott Russell) had no doubt he had as large a boiler behind these screw engines as would be found behind the paddle-wheel engines. With regard to the Royal West India Mail ships, that was the most remarkable case perhaps that had ever occurred of the want of recourse to some such investigation as Mr. Atherton had laid before them. He (Mr. Scott Russell) recollected the circumstances under which those large vessels were built. They had a fine contract, under which they were to carry the mails at the rate of 9 knots an hour. They succeeded in doing this with vessels of 1200 tons and 400 nominal horse power, but a new contract was entered into, requiring an accelerated speed of a knot, so that the mails should be carried at 10 knots per hour, and they then built ships of double tonnage, put into them engines of double horse power, but did not adapt the shape of the ships to a higher speed, and instead of obtaining, as with a double proportion of power, well bestowed, they might have obtained, 13 or 14 knots, they had, with double the size of ship, double horse power, and double consumption of coals, barely realised the additional knot, for which they had expended so much money. Such were some of the effects which went to show that investigations of this nature tending to clear away professional mysteries and to test men honestly by the work they had done, were very desirable. Investigations of this nature were of the utmost importance, because many might fancy it was the ship builder who controlled the design of a ship, but practically it was not so, but the owner of the ship who dictated her form. A builder was generally trammelled by conditions and limitations, that left him little choice, except to suit the preconceived notions of his customers; and therefore, unless the general public were enlightened, unless ship owners were enlightened, unless they took an interest in a good ship, in a handsome ship, with a good set of engines in her, and became critics of ship-building, they would not have that stimulus applied to the owners of ships which was the sole means of permitting the builders, or, if they liked it, of compelling the builders to obtain the best possible results. Therefore such discussions as this were highly important. He believed it was the want of a general diffusion of knowledge on this subject that led to such dreadful blunders, not in the Royal Navy alone, but wherever a number of people had to do something for which no one was responsible. He would make one observation in reply to the practical remarks which had fallen from the noble chairman at the beginning of the meeting. He was sure the meeting would duly appreciate the spirit in which those remarks were made; because, many of them being practical men, and all of them patriotic Englishmen, there was at this moment no conviction which weighed more deeply upon their minds than this—here are our practical men of business earnestly longing to do something for the assistance of the country in its present difficulties, and we could not do it for want of an organisation which would enable us to give the government the entire benefit of all our resources and our best services. They all longed to see some practical way in which some good could be done, in order to turn all the mechanical powers of England into the service of the government at this moment; and if that were done it would sweep away the resistance of any other country to us. But here was the difficulty, and he was afraid his lordship could not help them out of it. There were no people who knew better than the servants of the government this fact—that they could not, even when servants of the government, get the proper scope for their energy and talents; and the reason was this—"the want of personal responsibility." There were many eminent men present, of high official standing in the government, and he believed he gave expression to their private sentiments on this subject. He would venture to say, if the capable men in the service of the government were placed in their positions with their hands so free and unfettered that each man were permitted to do that which he knew he was most capable of doing for the service of the government, in the manner which he knew to be most effective for the public service, and were charged with the entire and personal responsibility of his own work, a rapid practical amelioration would take place in the execution of public business. The construction of a steamship for the government, if it were the sole work of one man, whose name was openly attached to it as solely responsible for its success, would run a very fair chance of success; but wherever such works were done by boards instead of by individuals, the difficulties in the way of success were nearly insuperable, because personal responsibility was at an end. Instead of this, it was "an office" that did the work, and not the individual. Out came the

office plan—the office plan was built. If it succeeded, there were twenty people ready to claim the authorship of it, but if it failed pity the poor gentleman who originally drew it. For success in steam navigation the name of one individual should be identified with each ship, as personally responsible for her, from the laying of the keel to her final repose in the breaker's yard, and with personal responsibility you would have good ships. If it were possible for the government of this country to make one individual publicly responsible for the success of every separate piece of work done, to attach the name of one individual who really had the doing of that thing to his work in so unmistakable a manner that he should have all the credit and all the discredit of doing that thing well or ill, —if it were possible that each working head of every department, down to the lowest, were personally responsible for all those below him, and these in turn responsible only to those immediately over them, then public works might be managed much in the same way as private works were conducted, and with equally good results. He feared, however, that our system of parliamentary government was hardly compatible with such a system of extensive personal responsibility. These remarks, perhaps somewhat foreign to the subject, were what he could offer in reply to the wish expressed by the noble chairman, that the services of such societies of men as the present might be rendered available to the assistance of certain departments of government. He begged to assure his lordship of the earnest desire of every man in that meeting to place any talents or powers he might possess at the disposal of government, for the great purpose of the defence of the honour of the country in which, probably, most of them felt even a deeper interest at this moment than in any of their private undertakings.

Mr. Andrew Murray said, at that late hour in the evening he would not enter upon the general subject of the paper. He agreed with the Astronomer Royal as to the difficulties in the way of legalising any definite excess of indicator over nominal horse-power, and that this must always depend upon the custom of the trade. The only other points to which at that moment it seemed important to refer, were those to which Mr. Scott Russell had taken exception, that the formula would not apply in the case of vessels employed in the carriage of passengers, nor to vessels with very fine lines built expressly for a high rate of speed. He considered that Mr. Russell must have overlooked the fact, that speed was essentially an element in the formula, and that the same law as to the slow speed being the cheaper speed, held good with passenger ships as well as with any other ships, with the exception, certainly, of feeding the passengers during the longer time of the slower passage, and this became merely a question whether the passengers or the boilers could be fed cheapest during that time. With respect to the second objection raised by Mr. Russell, that the formula was not adapted to vessels of a form designed for high velocities, the author had included in his calculations the vessel giving the highest co-efficient yet known to him or to the public while estimating the performances of the larger vessel. In the experiment referred to by Mr. Russell, a vessel with lines adapted to a speed of 15 knots would give a result at 9 knots superior to that generally obtained from vessels built for the slow speed, and if a large vessel were built with lines adapted for 15 knots, the result for her at 9 knots would be equally good, and the formula would show the full benefit of that result. He (Mr. Murray) contended that the formula was correct as a comparison between vessels of any size of similar character, and cited in support of this opinion the results of the *Duke of Wellington* as compared with the *Hogue*, both being *sailing* ships of good form, and both having had their sterns judiciously altered to receive screw propellers. The velocity of the *Hogue*, with a displacement of 3,050 tons and 813 indicator horse-power, was, upon trial, 8·328 knots per hour. Taking this as a datum for the speed to be expected from the *Duke of Wellington*, the result for her with a deep displacement of 5,070 tons and 2,016 indicator horse-power, ought by the formula to be 9·808 knots; the result on trial was 9·891 knots, showing an error by the calculation of less than one-tenth of a knot. If Mr. Russell, therefore, could produce a moderate-sized vessel giving a higher result or a higher co-efficient than any hitherto obtained or known, he would be perfectly justified in claiming that the performances of the large ship now building by him should be judged of on the datum of this superior ship. Mr. Murray called on Mr. Russell to give the displacement and indicator horse-power of the ship referred to. The question of the amount of coal consumed which had been given by Mr. Russell, though equally important, was not the question at that moment under discussion, but the result that could be got out of a ship by indicator horse-power. Some years ago Mr. Murray had attempted to draw attention to the importance of testing the relative efficiency of different steam-ships, and he came to the conclusion that the number of tons register carried at a uniform speed of 10 knots per hour by one ton of coals, was a criterion sufficiently correct for mercantile purposes, and that if a more minute comparison were wished, the number of tons displacement carried at the rate of 10 knots per hour by 100 indicator horse-power should be taken. This proposal had been published,* and it appeared to him to put the matter in a more tangible or practical form than that mercantile men should quote an "Index Number" as a co-efficient of a ship that they might desire a builder to construct for them; consumption of coals per hour to be taken instead of indicator horse-power, if it be desired to test superiority of engine power at the same time as superiority of the form of the ship, combining the engine-maker with the ship-builder.

Mr. Chatfield (master-shipwright, Deptford dockyard) said, no one had listened with greater pleasure than he had done to the paper which had been brought before them, and no one was more convinced of the great importance of the objects in view. He felt, however, that the government departments had been rather roughly handled by some of the gentlemen who had spoken, and that the impression on that Society would, he feared, be that very little attention had been paid on the part of government officers to the subjects of displacement and tonnage; that the naval construction of the country was based upon very slender grounds; and that the published tables of the Admiralty were of very little value. With respect to builder's tonnage, the term, though not definite, was used conventionally, but it did not express the tonnage of displacement. In a brig, for example, the builder's tonnage had an approximation to load displacement; but in a frigate, the displacement would be about one-fourth more; in a two-decker, it would be about one-half more; and in a first-rate, or three-decker, about three-quarters more. These were rough proportions—mere generalisations—nevertheless they were worth knowing. The following table gave the exact proportions in four vessels of different sizes:—

| Names and Armament. | Builder's Tonnage. | Displacement in tons. | Ratio of Builder's Tonnage to Displacement. |
|---|---|---|---|
| Caledonia ......120 | 2698 | 4720 | 1 : 1·75 |
| Cressy ......... 80 | 2537 | 3676 | 1 : 1·44 |
| Thetis ......... 36 | 1524 | 1911 | 1 : 1·25 |
| Espiègle ...... 12 | 439 | 466 | 1 : 1·06 |

Everything with government contractors had relation to number and quantity, and they took *displacement* (not builder's tonnage) as the basis of their operations. He could tell the motive *sail power* of any class of ships, in proportion to the area of midship section or displacement in tons—the elements upon which Mr. Atherton had laid

* "Rudimentary Treatise on Marine Engines." By Robert Murray, C.E., pp. 129. Weale, 1852.

so much stress, as the fundamental properties by which horse-power in steam-vessels could alone be properly regulated. In reference to proportions he (Mr. Chatfield) would quote the following tabular form :—

| Names and Armament. | Area of Sails in square feet. | Area of Mid-ship Section. | Ratio of Sails to Mid-ship Section. | Displacement in Tons. | No. of square feet of Sail Surface to a ton of Displacement. |
|---|---|---|---|---|---|
| Caledonia ......120 | 25619 | 1056 | 24·2 : 1 | 4720 | 5·4 : 1 |
| Cressy ............ 80 | 28102 | 850 | 33.0 : i | 3676 | 7·6 : 1 |
| Thetis ............ 36 | 19762 | 531 | 37·0 : 1 | 1911 | 10·3 : 1 |
| Espiègle ......... 12 | 8060 | 229 | 35·2 . 1 | 466 | 17·3 : 1 |

This, he said, would show that they did not take builders' tonnage as the groundwork of their calculations. He had understood Mr. Atherton to say, why not take the type of build of the *Candia*, which had performed so well, in preference to the type of construction of the *Amphion?* He (Mr. Chatfield) thought it would be impracticable. The *Amphion* was a ship of war, and reqnired a certain amount of *beam* to impart stability, and to afford room for working the guns. He believed that the length of the *Amphion*, in proportion to her breadth, was about as 4 to 1 ; whilst that of the *Candia* was as 7 to 1 ; and perhaps they were both well-proportioned for their respective services. He felt confident that if Mr. Atherton persevered in his system, he would soon establish valuable formulæ adapted to varied circumstances; and he (Mr. Chatfield) entertained a sanguine hope that his friend Mr. Atherton would be the means of effecting a reform in the term "Marine Horse-power," and that that important subject which he had so ably handled this evening would be improved by his knowledge, experience, and untiring energies.

Mr. Andrew Henderson said, for the last seven or eight years he had given a great deal of attention to the subject before the meeting, with a view to bring before the public the absurdity of using builders' tonnage and nominal horse power, as measures of the size, capacity, or efficiency of ships and steamers. He brought the subject before the Institution of Civil Engineers in 1849, and from that time up to the present he had been endeavouring to collect in the archives of that Institution, the statistics of ships and engines of modern construction, but except from the surveyor's department of the Admiralty, he had found very great difficulty in obtaining the particulars which he was desirous of collecting; ship builders and engineers were disinclined to furnish the required information, whilst shipowners and steam ship companies were unable to do so. No doubt, as was stated by Mr. Chatfield, in her Majesty's dockyards everything in connection with naval construction was based upon the most scientific calculation of the displacements and other elements of stability, resistance, &c. Notwithstanding the difficulties, he had persevered in obtaining a record of the size, proportion, form, and engine power of the principal steamers, as well as the speed actually realised over an extended mail service; for he considered that actual service at sea was the only guide in the application of science to the improvement of our shipping. He obtained, through Lord Jocelyn's Committee on Steam Communications, a return of six years' mail service between England and India, and found, as had been stated of the West India mail steamers, that those to the East fell far short of the contract speed. The following were some of them :—the *Haddington* ran over 114,000 miles, at an average speed of 8·94 knots per hour; the *Precursor* made the same speed over 38,000 miles; the *Hindostan* and *Bentinck* less than 9 knots: and on an aggregate of 1,271,000 miles, the speed realised only averaged 7·945 knots per hour. The Parliamentary Return, No. 693, Session 1851, gave the speed realised by each vessel, including some of the Royal Navy and of the Indian Navy. The speed realised, as compared with the displacement and working power of the engines of these vessels, would be a fair criterion of their relative efficiency, but it was most difficult, in consequence of the terms "tonnage" and "nominal horse-power" being, as stated by Mr. Atherton, "absolutely indefinite." Moreover, in short runs, both the displacement and engine-power were constantly varying quantities, so that the average speed on very long runs was a great desideratum towards a fair comparison of the locomotive capabilities of different ships. He considered we owed much to Mr. Atherton for the able manner in which he had brought forward this most difficult question, and particularly its classification under different heads of inquiries. His (Mr. Henderson's) information was derived from practical experience at sea from a very early age. He should confine his observations to questions that had been brought under his notice through his connection with merchant shipping. With respect to the first three points discussed in Mr. Atherton's paper—the tonnage and displacement—the nominal and effective horse power—and the relations between them, they had been the subject of much inquiry by him. In a tabular statement which he had prepared there was given an analysis of some 30 steamers, which he submitted to the consideration of Mr. Atherton and those interested, as containing information and results as to the dimensions, displacement, weight, elements of resistance, engines, and steam power, and speed realised. Some particulars were also given as to the different modes of measurement for tonnage, together with diagrams of the midship sections of many of the principal vessels, on paper ruled to a scale, by which it was intended to show the practicability of ascertaining the actual displacement and area of midship section immersed (or resistance) at any draft, by a scale. This met two of the requirements of the paper. The Tonnage Committee of 1821 considered some fourteen plans of measurement for tonnage, and in their report in 1828 they recommended the displacement measurement of Mr. Parsons, which, by a very simple rule, measured the external bulk of the ships. But it was not carried out, being objected to by the Custom-house, and the old rule was in operation for some ten years, when it was altered to the system of internal measurement of four depths and five breadths. This was again modified in 1845, but was so unsatisfactory as to cause the appointment of the Committee of 1849, of which Lord John Hay was chairman. This Committee recommended the external measurement in cubic feet to the height of deck as the basis of tonnage register, and to approximate the old tonnage on which the Custom-house returns of trade and shipping, as well as the Board of Trade statistics throughout the country were based. Experimental measurements of the external bulk (or displacement to the upper deck in cubic feet), were made of some thirty vessels, and these were compared with their old tonnage. The result of this average gave the factor of 27 hundredths of the external bulk, representing an approximate tonnage by the old tonnage. In 1849 the Tonnage Committee, including Mr. Parsons, Mr. Morsom, some shipowners and naval officers, reported, "that the equitable basis of charges for dock, light and other dues, was the entire cubical contents measured externally to the height of the upper deck, by the use of diagrams and curves of areas." In 1850 a bill was brought into Parliament to carry out this recommendation, as it would give a scale of displacement by which the real capacity for cargo would be known. The bill was opposed by the owners of light timber-built ships and the builders of iron ships, both of whom desired to continue the internal measurement. The builders of iron ships obtained a larger tonnage by internal measurement than the external displacement on tonnage, as had been described by his friend, Mr. Scott Russell, who was himself amongst the number of objectors to external measurement. The

subject was again discussed in 1852, when he (Mr. Henderson) said, if they wanted to ascertain the tonnage they must take both the external and the internal measurements, and the mean of those two should be the basis of the tonnage. No other committee was appointed, and Mr. Morsom's plan of internal measurement was adopted. The builders of iron ships obtained a larger tonnage than timber ships by internal measurement. In 1850 he brought before the Board of Trade a proposal to adopt the recommendation of the committee, that the mean of the external bulk and the internal space should be taken as the basis of register tonnage. In 1852 it was again discussed, and in November of that year he repeated his proposal to the Board of Trade, accompanying the suggestions by plans and forms showing the facility with which the measurements could be made. He also added a scale of displacement and of capacity. The certificate of survey should give a plan and specification of the ship, so as to afford information as to the efficiency of the ship. A change of ministry taking place, as had been observed by the noble chairman, these and other practices and improvements were disregarded, and the question taken up in the routine of the Custom-house business. In 1853-54 the Merchant Shipping Bill included the tonnage on a plan of internal measurement proposed by Mr. Morsom, which was but a slight improvement on the old plan; and it came into operation on the 1st of this month. His friend Mr. Scott Russell had just explained the mode in which it worked, that it increased the tonnage so considerably that the difference must cause additional cost to the public for the transport service. There were so many important questions before the Society that night, that at that very late hour he could not presume to occupy any more time, but he trusted that either the discussion might be continued at an adjourned meeting, or that some other opportunity would be afforded of stating the results of their experience on the subject which had been brought forward.

The Noble Chairman having proposed a vote of thanks to the author of the paper,

Mr. Atherton rose and said, that he had to thank his lordship and the meeting for the sentiments that had been expressed with reference to the cause which he had endeavoured to bring under notice that evening. He also begged to acknowledge the liberality of the Council in having received from himself, not previously a member of the Society, the paper which he had been permitted to read, thus giving the cause he advocated the advantage of that widely-spread publicity which this Society alone could command, for the proceedings of this meeting would engage the immediate attention of no less than 392 Institutions associated for purposes of public utility. And surely financial economy in the conveyance of goods by steam-ships, whether for the purposes of commerce or of war, was a subject which, perhaps, more than any other single object at the present time, vitally affected the prosperity and the national prowess of Britain, and the great interests dependent thereon. The exposition of steam-shipping anomalies which he had brought forward to substantiate his views, and the calculations which he had advanced, were such as might be expected to arouse the expression of discordant, but independent, and equally honest views on the part of others, as regards both theory and practice in naval construction. Suffice it to say, that he disclaimed being the discoverer or the ultra-advocate of any particular theory, even of that on which his calculations had been based. He had adopted that theory because he believed it to be the most generally received, the most easily understood, and practically the most useful of all the theories devised for the purpose referred to; but still he regarded it only as an approximation to Nature's hidden law; nevertheless he accepted it, and he submitted that we should adopt this theory till some other rule, more practically applicable for determining the mutual relation of displacement, power, and speed, should be discovered and established. All that he laid claim to was simply this—that, taking the received law of resistance to floating bodies as he found it already laid down by recognised authority, and which he believed to be trustworthy and closely approximate to fact, he deduced by its aid an *inquisitorial* system of steam-ship financial arithmetic, whereby the agents, managers, directors, in short, the trustees in charge of public or private shipping, might test the merits of their steam-ship stock, discriminate in regard to the skill and attention of their officers in charge, calculate the cost, and, consequently, the financial remuneration required in consideration of the services performed, and contract obligations in which they might engage, and in like manner, in their turn, be themselves held responsible for their stewardship by the proprietors for whom they acted. The introduction and establishment of such a system of inquisitorial arithmetic might be a formidable task, but the requirements of the public good originated the idea, and a conviction of being right in the prosecution of a useful object impelled him to persevere, and in this labour he hoped for the continued co-operation of the Society of Arts.

The Chairman said he had observed throughout the whole of this debate the apparent general assent of the meeting as to the necessity for some great change with regard to better defined calculations for tonnage, speed, and power to carry weight, than existed at the present day. He had observed in this meeting a very great disposition to accept the paper read by Mr. Atherton as, if not a perfect and entire mode of fixing and arranging the improved method of calculation, at all events an approximation so closely to a useful change in the present system of calculation, that it might be accepted as a great step towards improvement in that particular. He might be permitted to express his own conviction that the change was not only necessary, but he had been astonished at the mode of calculating tonnage which had existed so long with regard to steam ships. He was convinced that for the uses of steam ships, the means of calculation would so much enhance the value of steam, comparatively, by cheapening the purchase of the article, that any one would be able more conveniently to set at rest this question, so intricate and difficult, as the settlement of what description of cargo should be carried, and what speed should be obtained under the present mode of calculation. There were many points in the discussion to which he should have alluded had the time been more fitting for it, although he could have added nothing to the subject in a scientific point of view. Mr. Scott Russell in his remarks, had touched upon a subject which he (the chairman) thought was not altogether fitting for a Society like this to indulge in. He was satisfied the meeting would feel that they saw Mr. Scott Russell in the right place when they saw him sitting at that table and giving them instruction in ship-building and engineering. He believed there was no man, judging from the fame of his exploits, who was better placed in the position he holds; and he would say long might he continue to enjoy that wealth and high character which his great name had established for him, and which the constitution and the people of this country would not only give him the greatest amount of freedom to enjoy, but the people of this country would continue to respect his name and character in proportion to that degree of excellency and ability which he had at all times exhibited in his employment They also saw the right man in the right place in his friend on the left (Mr. Atherton). He was a gentleman whom Mr. Russell claimed as one of his own. He (the chairman) must on his part also claim him as one of his own, for he was a wrangler at Cambridge, over which county he (the chairman) had the honour to preside, and which was his native place. He was not only a wrangler at Cambridge, but he worked his way practically through the business of his profession, and he was now in the service of his country. There was also another man present—Mr. Chatfield—whom he had known all

his lifetime, and he was one example of those who ought to have risen more rapidly to the place he now holds, because as time and space bear a large proportion to the powers of the body, so if in early life he had had that position which he now holds, and which he was fitted for and ought to have had long before, his talents and merit would have been recognised in his appointment as surveyor of the navy. He would conclude his observations by repeating that it gave him great satisfaction to have had the honour of being in the chair that evening, for he looked forward with hope that from that meeting there might spring a change in the system of calculation —a change in the general system of mercantile management, which would very much tend to better the condition of that class of commerce and of that description of sea-going tonnage.

Mr. SCOTT RUSSELL proposed, and Mr. T. WINKWORTH seconded, a vote of thanks to the chairman, which was carried by acclamation.

The Noble CHAIRMAN briefly thanked the meeting, which was then adjourned.

The Secretary announced that the paper to be read on the evening of Wednesday next, the 23rd instant, was "On the Mutual Relations of Trade and Manufactures," by Professor Edward Solly, F.R.S. On this occasion there will be no discussion, as the Council believe the members will prefer to adjourn to the model room, to examine the collection of Animal Produce and Manufactures, being the first step towards the formation of a General Trade Museum.

## USE OF LIME-WATER IN THE FORMATION OF BREAD.

To neutralise the deterioration which the gluten of flour undergoes by keeping, bakers add sulphate of copper or alum with the damaged flour. Professor Liebig, however, has conceived the idea of employing lime, in the state of solution, saturated without heat. After having kneaded the flour with water and lime, he adds the yeast, and leaves the dough to itself; the fermentation commences, and is developed as usual; and if we add the remainder of the flour to the fermented dough at the proper time, we obtain, after baking, an excellent, elastic, spongy bread, free from acid, of an agreeable taste, and which is preferred to all other bread after it has been eaten for some time. The proportions of flour and lime-water to be employed are in the ratio of 19 to 5. As the quantity of liquid is not sufficient for converting the flour into dough, it is completed with ordinary water. The quantity of lime contained in the bread is small—160 ounces of lime require more than 300 quarts of water for solution; the lime contained in the bread is scarcely as much as that contained in the seeds of leguminous plants. Professor Liebig remarks that "it may be regarded as a physiological truth, established by experiment, that corn flour is not a perfectly alimentary substance; administered alone, in the state of bread, it does not suffice for sustaining life. From all that we know, this insufficiency is owing to the want of lime, so necessary for the formation of the osseous system. The phosphoric acid likewise required is sufficiently represented in the corn, but lime is less abundant in it than in leguminous plants. This circumstance gives, perhaps, the key to many of the diseases which are observed among prisoners, as well as among children whose diet consists essentially of bread. * * * The yield of bread from flour kneaded with lime-water is more considerable. In my household, 19 pounds of flour, treated without lime-water, rarely give more than 24½ pounds of bread; kneaded with 5 quarts of lime-water, the same quantity of flour produces from 26 pounds 6 ounces to 26 pounds 10 ounces of well baked bread. Now as, according to Heeren, 19 pounds of flour furnish only 24 pounds 1½ ounces of bread, it may be admitted that the lime-water bread has undergone a real augmentation."—*Annalen der Chemie und Pharmacie*, and *Chemist*, March, 1855.

## Home Correspondence.

### ON PUBLIC WORKS FOR INDIA.

SIR,—I confess myself somewhat disappointed at the small amount of practical information elicited last evening at the adjourned meeting of the Society to discuss Colonel Cotton's paper, for, as was well observed, the object of the Society of Arts is the eliciting of facts, and not mere declamation. We desire, for instance, to know what has actually been done as regards public works in India, what is intended to be done, and what might be done. Colonel Cotton has supplied us with much valuable data, but he has not addressed himself to the whole question of improved public works, and has spoke mainly of works of water communication, and those confined chiefly to the Madras Presidency. It is not, as was remarked by one speaker, a mere question of controversy between advocates of railways and canals—of supporters or opponents of the policy of the Court of Directors. The subject rests upon a more wide and important basis, viewed in any of its varied aspects—socially, morally, commercially, or politically. The interests of Great Britain and the people of India are bound up with it. Improved communications are calculated to effect a great revolution in the agricultnre, in the commerce, and in the general habits of the natives. Already we have seen, in the traffic returns of the Bombay and East Indian Railways, how largely the natives have availed themselves of them. It was, I well remember, urged by opponents to their introduction that the poverty and prejudice of the natives would deter them from travel, and yet we find that, contrary to the experience of all other countries, the third-class passenger traffic is that which forms the main element of profit.

Instead of desultory discussion and vague generalisation on topics on which all were agreed, I should have liked to have heard some more complete details as to the road communications in particular districts, an abstract or *resumé* of the progresss of construction, cost, and returns of some of the Indian works—a list of the works completed and those in construction, or planned, and required. Surely, some of the old Indians present could have given us these interesting details, and corroborated or disputed Colonel Cotton's arguments, without throwing the whole of the labour and onus of this research and explanation on him. In the absence of this data I may be excused for making a few remarks, and adding the opinion of some of the leading Indian journals just received.

The difficulties in the navigation of the Godavery appear to be more formidable than Colonel Cotton has supposed. The latest report on this subject is furnished by the officer at present employed on the operations, which has recently been published in the *Madras Spectator*.

The editor of that journal, who is a great patron of the Godavery improvements, is so impartial as to confess that, after reading the report, Sir Henry Pottinger's doubts regarding the practicability of the undertaking no longer appear surprising. The cost of the necessary operations, it seems, will be very serious, and an application is to be made to the Government to sanction the outlay of double the amount already granted, half a lakh of rupees being found quite insufficient. The substance of the report is as follows:—

"In the whole distance over which the navigation will extend, 429 miles between Dowlaishwarum and Chandah, the total rise of the water surface is 491 feet; no figure to alarm one, we grant, if the ascent were distributed with anything like equality along the river's course, but a formidable amount of elevation has to be overcome, when occurring chiefly at a few points, which is the

case on the Godavery. For the space of 112 miles upwards from Dowlaishwarum the rise is gradual enough, but then a steep pitch is suddenly met with, between Cintral and Purnesalla, where rocks impede the stream for four miles together. There must here be considerable rapids. Between Purnesalla and Enchumpully, however, a further distance of 78 miles, no obstructions appear to exist, the ascent being easy until we reach the last named place, where the surface level is over 200 feet above that at Dowlaishwarum Anicut. But here again difficulties present themselves, in the shape of a mass of rocks extending over fourteen miles, and comprehending a rise of nearly thirty feet. This is immediately succeeded by an obstacle more serious still, at Punkina, where occurs an abrupt rise of above twenty feet, seemingly a downright fall of the river from that height. Surmounting that formidable interruption the course of the stream continues placid and our navigation easy till we arrive at Dewulamurre, 97 miles higher up, where the water level is 320.1½ above the Anicut, and here we once more meet with roaring rapids, bristling with rocks, for the continuous space of forty miles, and comprehending a rise of nearly 143 feet. That portion of the work of freeing the river channel will prove very arduous and expensive, but it is happily the last hindrance that the engineers are called on to encounter, the Godavery having then a quiet course as far as Chandah, 73 miles above Darnoor, where navigation, we suppose, will cease."

Such is the latest description of the difficulties which impede the navigation of the Godavery, and they have naturally induced even those who have no interest whatever in the question of River *versus* Rail Conveyance in this case, to question whether the Godavery is, after all, so well adapted for bringing down the cotton of the Berar Valley to Coringa, for exportation to England.

The *Friend of India*, one of the best informed of the Indian journals on modes of communication and general statistics, thus speaks on the transit by Bombay:—

"As at present advised, the Great Peninsular Railway Company, who have their line as far as Poona sanctioned, are likely to continue it from that point through Ahmednuggur, Dowlutabad, Boodwur, and Omrawutty to Nagpore. Such at least appears to be the present aspect of the direction it is likely to take. This would carry the rail into the very heart of the cotton districts in the valley of Berar, and afford facilities for the conveyance of the cotton wool to the western port of embarkation in twenty-four hours, and it will probably have the effect of securing the whole of the cotton traffic to that presidency. As regards the cost of transport, it would of course be premature to speak with any degree of precision at present. The charge for the conveyance of goods must necessarily depend on the cost of the line. Colonel Cotton assumes that the Bengal rail has been constructed at a charge of £20,000 a mile, but we think he will find the average expenditure as low as £10,000. The scale of rates for goods traffic on the colliery line just opened is now before us, and as it is not likely that the rail in the western presidency will be more expensive than our own, we may reasonably conclude that the tariff of charges will bear a very close resemblance. The tariff for the first class of goods at this presidency, which includes coal, coke, iron, lime, minerals, sand, and stone, is one eighth of a pie per maund per mile, which will be a trifle above a *farthing* a ton a mile. The charge for the second class, in which is included the article of cotton wool, is two-thirds of a pie a maund a mile, that is, a little in excess of *two farthings* a ton a mile. If screwed bales of cotton should be conveyed, therefore, from the cotton districts to Bombay, at our lowest rate—the distance being estimated at 400 miles—the charge would be at the rate of 37s. a ton, if at the next higher rate, at double that amount. But we think we shall not be very wide of the mark if we assume that when the Bombay rail reaches the centre of the cotton districts, and its returns depend in a great measure on cotton wool, the railway company will be no losers by conveying it from the place of its growth to the port at the rate of 50 shillings a ton, which will be at the rate of about a farthing and a quarter a pound. The question therefore, for consideration is, whether the cotton dealers will prefer sending their cotton down a difficult navigation, open for scarcely more than six months in the year, or by rail at all seasons, and at the rate for freight which, in either case, the article of cotton wool can well support. But, even if the expectations now held out of obtaining facilities for the conveyance of cotton by water to the port of Coringa, should not be realised, still, the opening up of the communication by the Godavery and the Wurda, generally, into populous and opulent districts, is a question of such paramount importance that it would be a dereliction of public duty to neglect it. We are not the partizans of either mode of communication. We care not whether the cotton is exported to England from Coringa or from Bombay. We intend to bestow our editorial commendation on that line, whether by steam or water, which shall deliver the cotton at the cheapest rate, and in the best condition, on board ship, to be conveyed to England. All that can be desired at present is, that the proposal to open the navigation of the Godavery shall not be allowed to interfere with the construction of the rail at Bombay, and that the construction of the rail on one side of the peninsula shall not damp the operations on the Godavery on the other side."

The construction of all works of communication, whether they be canals, roads, or railways, will necessarily lead to a much better knowledge of the geology of the country. Mineral discoveries will take place. For instance, there are three points on the southern frontiers of the Madras territories where coal is known to exist—one in Cuttack, on the Bahmanee river, one in the Hyderabad dominions at Kotah, on the Godavery, and one on the Nerbudda territory about Juddulpore. Another extensive deposit has recently been discovered near the Turcah hill, a situation intermediate between the before-named coal-basins.

A scientific survey should be made of all the Guzerat rivers, the Taptee, the Nerbudda, the Kini, the Dadur, the Myhe, the Karee, the Saburmuttee, the Badur, and the numerous small streams in the Gogo pergunnah, and then something would exist to work upon. But without systematic inquiry by competent officers irrigation in the Province of Madras will remain at a stand-still.

The demand for water may be estimated by the assiduity with which the natives resort to well irrigation. But then there comes a physical difficulty in the way, which all the parties seem to have overlooked—the influence of the tide is felt in the Nerbudda 60 or 70, and in the Taptee 40 or 50, miles from the sea, the gradient of the rivers never exceeding a foot a mile until they get beyond the Delta land altogether. The land itself again slopes more rapidly than the water, the banks increasing in elevation as we ascend the stream. Near Domus it is from twelve to fifteen feet above low-water; at Surat, it is thirty two; at the village of Veriow, four miles above Surat, it is thirty-six feet; and at Rustumbagh, twenty miles upward by the river, it is close on forty feet. The Nerbudda is still more untractable, the gradient of the stream being less, and that of its banks greater. At Broach it is about thirty feet, at Jenoore, twenty miles up the river, the northern bank is about eighty feet; the southern one slopes, so that there is some space washed by inundation, but in less than half a mile it attains an altitude of above thirty feet, and the whole region betwixt the Taptee and the Nerbudda is certainly fifty feet above the level of the streams. Mr. Mackay admitted this difficulty, but suggested that the canals should only be cut deep enough to be filled by the inundation, and that this should be reserved as a store for the remainder of the year, the canal becoming a gigantic tank. He forgot in this case that as the floods hardly ever exceed twenty-six feet the canals must be thirty feet deep before any water would enter them, that if they were made forty feet deep nearly the whole of their contents would be drawn off by evaporation, which in Guzerat amounts to from eight to ten feet.

It appears, from the *Madras Spectator*, that 28,773*l.* were expended on the repairs of tanks and water-courses in 1853-54, and that the estimate for the current year for the same purpose is 29,400*l.* The outlay of about 25,000*l.* had been sanctioned for making and improving the cotton roads of Tinnivelly and Ramnad, of which about 13,000*l.* had been already expended. The rise in the rates of labour, and the great scarcity of labourers, had rather retarded the progress.

The *Friend of India* states:—"For the last two years more especially, the Government of India has entered upon

schemes of public works to an extent altogether unprecedented. The public authorities have apparently passed at once from the extreme of parsimony to the extreme of prodigality. Thus, in the year 1853-54 the expenditure on public works amounted to £2,515,389, and the estimated expenditure for these works in 1854-55 amounts £2,974,300, which is thus distributed—For works in the Bengal and Agra Presidencies, in the Punjaub, and in Pegu, £2,058,703; at the Madras Presidency, £623,100; Bombay, £295,500. The sum devoted to roads and canals does not fall short of £88,000, and under this comprehensive sum are included the Ganges and the Baree Doab canals, the great bridges over the rivers in the lower section of the great trunk road from Delhi to Lahore, and from Lahore to Peshawur, which is now urged on with the utmost vigour; the important roads which are to connect the great towns in the Punjaub with each other, the great Decan road, the Bombay and Agra road, the Gya and Patna road, the Arracan road, and the roads which have been projected in Pegu."

There is no doubt of the value of artificial works of irrigation and navigation, of the construction of canals and the improvement of rivers, but who is to find the capital. If these works are to yield such large profits, why are they not undertaken by private enterprise. There is always abundance of capital in England, seeking safe and remunerative investment—something beyond the 3 or 3½ per cent. which the funded securities afford. I can, however, call to mind few Indian Commercial Companies, with the exception of banks, that have proved profitable investments. The Indian Steam Navigation Companies, Insurance Companies, and other Joint Stock Associations, have usually proved unfortunate speculations to the shareholders. It is only now, after 16 years' labour and a large expenditure, that the Assam Tea Company is beginning even to pay a dividend.

The great value, expediency, and importance of canals across the two principal isthmuses, Panama and Suez, have been repeatedly urged. Explorations havebeen made—engineering difficulties asserted to be mere trifles by those who surveyed, and the prospects of remuneration for the outlay of capital reported to be considerable. But when the matter came to be closely investigated by practical men, it was found impossible to carry them out, and railways, although so much decried, are, therefore, supplying the means of transit, perhaps not so thoroughly effective, but, nevertheless, forming useful mediums of communications.

What the Court of Directors seem anxious to effect is, to draw British capital to India, to encourage public enterprise, to give facilities to Joint Stock Associations, and these will assuredly find out practicable and profitable undertakings, and the best channels for investment. Thus we find an Oriental Gas Company lighting up the city of Calcutta. The Western India Canal and Irrigation Company, with a proposed capital of 500,000*l.*, with such men as Mr. F. C. Brown, Mr. Frith, Mr. Kennedy, Colonel Grant, and Dr. Buist, identified with it, extending its operations into Scinde. These gentlemen consider it "the interest of England to look to India as a field for permanent investment, and for India to look to England as the source whence her means of local improvement and commercial enterprise are to be derived."

The projectors further state, after various calculations, that "in the North West Provinces, such canals produce 28 per cent. clear profit, those in the Punjaub are estimated to produce 26 per cent., and that those in the Madras Presidency, where the water appears to be charged at a rate much more commensurate with its real value to the cultivator, the profits are from 70 to 140 per cent. on the total outlay;" and yet, with such brilliant prospects before them these gentlemen stand out for their pound of flesh—they would make assurance double sure—for as a proof of their want of confidence in their own estimates, they are "applying to the Court of Directors for a 5 per cent. guarantee, and unless this guarantee is obtained, the company will not go on."

During the discussion on this subject before our Society very heavy and grave charges of indifference and of gross neglect in the great matter of public works have been preferred against the East India Company, and not a word in reply has been uttered by any of the many gentlemen connected with India present, who must have known something of the matter. Colonel Sykes was the only speaker who met the charges, by a statement of figures—which was most unaccountably omitted in the *Journal* in its proper place.*

I have no desire to become the apologist for the Court of Directors. As a journalist I have had frequent occasions to speak of their shortcomings and political mismanagement, but in this matter of public works I think the charges advanced against them are much too sweeping and too general to be successfully maintained, and could, I believe, be fairly met and replied to. They may have pooh-poohed or snubbed Colonel Cotton—as he informs us—they may have thrown cold water on his magnificent canal and irrigation schemes—they may have expended less money than they ought to have done on the works of the Madras Presidency—but it does not necessarily follow that they have been totally regardless of their own interests, and the general interests of the various presidencies in a total neglect of public works. Some allowance should be made for the nature of a vast country split up into a variety of acquired states, having separate feelings and separate interests—where governors die off or are changed before they have time to become even partially acquainted with the wants of the district, or the best system to be pursued to supply these wants. Political disturbances, again, in various quarters, and new acquisitions of territory, have from time to time distracted attention from that steady progress which can only be made in times of prosperity and tranquillity.

But have the East India Company done nothing to improve India? Have they done nothing to give a character to the Indian navy? Have not their steamers been the pioneers of commerce and improvement on all the great rivers of the east? Have not steam and electricity even been carried into the very wilds of Burmah, literally verifying the native proverb supposed to be expressive of the perpetuity of the kingdom—"When a ship can ascend the Irawaddi against the wind and tide, without sails or oars, then shall the Burmese empire fall."

During the whole course of the discussion not a word in respect of the important department of public works recently organised for India was mooted, save the brief allusion to the loan of two millions and three quarters sterling raising for that purpose, made by Colonel Cotton in the postcript to his paper.

And yet, sir, a twelvemonth ago, this great subject of public works appears to have been occupying the attention of the Indian Government; and the able and practical Governor General, who is so thoroughly conversant with these subjects, has given his mind fully to the subject, and seems to have required no prompting from Colonel Cotton. The various minutes from the governors of the presidencies, with the accompanying comments by the Court of Directors, are published in full in the last Indian journals, and certainly deserve a passing notice.

This new public works loan is apportioned to the several presidencies and lieutenant-governorships as follows:—

| | |
|---|---|
| Bengal.................... | 1,250,000 |
| Agra and the Punjaub........ | 700,000 |
| Bombay .................. | 500,000 |
| Madras.................... | 300,000 |
| | £1,750,000 |

* This omission was supplied in the succeeding Number.—Ed.

The *Friend of India* remarks that the large scale on which public works have been commenced since the impulse given by the discussions on the India Bill has rendered it necessary for the government to induct on the funds of the community for the means of carrying them forward. With a deficit of a million sterling in the public finances it was obviously impossible to continue these material improvements upon the basis now adopted without such subsidiary aid. Two proposed works will absorb nearly 20 lakhs of rupees (£20,000). These are the great Gya and Patna road, now under the management of Lieutenant Peile, the estimate of which is 13 lakhs of rupees, and the stone bridge across the Barakar, for which Major Knyvitt has long been collecting materials, and which he has instructions, we believe, to commence without delay, at a cost of six lakhs of rupees more.

A comptroller of public works for India has been appointed, with three assistants, one of whom is to preside over irrigation, one over roads and canals, and one over buildings and other works. The whole system is thus at once to be reduced to order, and public works throughout India will become a great separate branch of internal administration, conducted upon settled principles, and with the advantage of the best scientific and professional advice. Does this look like neglect and indifference ?

The newly-appointed Secretary for Public Works in India is to have 3,600*l.* a year, and an appointment for five years, with an assistant secretary. The new establishment is to be made fully adequate to the duties it is to discharge, and for this purpose the Engineer corps has been augmented by one battalion. Young officers of the engineer corps are to receive a longer course of civil engineering before they leave England. A complete system of instruction is to be provided at Madras for every class belonging to the department of public works, Europeans, East Indians, and natives, whether artificers, foremen, overseers, surveyors, or civil engineers. The government are also about to establish a class of assistant civil engineers for employment on the public works in the provinces, open to all qualified, whether European or native, the salaries being fixed at from four to six hundred rupees a month, whilst the highest species of engineering accomplishments do not seem to be insisted on.

The control of this department of Public Works has been transferred to Colonel Waddington as chief engineer, who is instructed to prepare annually, for submission with the estimates, the following series of sketch maps, besides the standard one :—

1st. A map of all existing roads, showing the *actual condition* of each at the date of preparation, which date is to be inserted in the map.

2nd. A map such as No. 1, but containing, also, in distinctive colours, any additional roads *sanctioned* at the same date.

3rd. A map containing all that is shown in No. 2, and in addition (shown distinctively) those lines of road which it is proposed to submit for the sanction of the government of India with the annual estimates to which this whole series of maps will be a continuous illustration.

The Court agree with Mr. Grant, that a geographical division of duty is the best arrangement. The works of each great division would thus be brought under one view; and every properly qualified engineer should be equally competent in every branch of his profession. All the branches of it are, indeed, dependent on each other; canals of navigation may also be canals of irrigation; they must have lateral embankments, transverse bunds, bridges where they intersect roads, and possibly aqueducts. So with all other public works; and those of one class, if they are not simultaneously considered, may either be inconveniently interfered with, or not properly connected with those of another.

The general principles relative to the vast public benefit to be derived from the maintenance and extension of works of irrigation, and from facilitating and improving the means of internal communication throughout the country, are fully recognized by the Government, and are to be vigorously acted upon.

For the purposes of giving effect to these principles, a requisite portion of such surplus revenue as may accrue is to be applied to the construction of public works; and if there shall be no surplus revenue, such public works are nevertheless to be carried on by means of loans, to be raised by the Government of India for the purpose. The Directors remark upon this :—

"We have in our despatch of the 5th of July last directed the application of the requisite sums for the completion of public works of importance in all our presidencies, from the balances now in the treasuries of India (which arise principally from sums contributed to the open loans), and we have therefore already recognized the principle involved in this proposal. In case of its being necessary hereafter to raise any specific loan for this purpose, our previous sanction must be given."

An able writer in the first number of a new and well-written Indian periodical, the *Bombay Quarterly Review*, in noticing the late Mr. Mackay's book, after alluding to the facilities which were given him in the prosecution of his inquiries by the Indian government, the assistance and the information afforded him by the local authorities, access to all public records, &c., points out the common errors which he and all other generalisers falls into :—

"Not a thought is bestowed on the difficulties of the position of the East India Company—its debt—its limited revenue—the few European servants it can afford to keep up for civil employ in the districts, or the state in which the country was when it came into the possession of the British. But all Mr. Mackay's efforts are directed to show, and to convince his mercantile constituents, that the Indian government ought to double its expenditure and give up one half its revenue; a government already in debt, and with little or no surplus revenue as it is! How this is to be accomplished, and the public treasuries are to answer the call of those who attend on the first of the month for their salaries, we are left to divine. It is worse than puerile for one who is drawing up articles of impeachment against the East India Company, to reason in this fashion. Any person can easily point out what India wants, and can, with irresistible logic, make out that the country has been scandalously neglected—if the pecuniary part of the matter may be left entirely out of consideration."

With the perfect freedom of the press existing in India for the last twenty years—where neither stamp, censorship, nor shackle of any kind prevails—every want, every grievance, is speedily made known, discussed, and commented upon. To the influence of the press must be attributed the great improvement in the recent charter granted to the East India Company, and which will tend greatly to the benefit of the people of India.

An intelligent native gentleman, in a lecture recently delivered at Bombay, pointed out some of the advantages which had been conferred in India. The admission of natives into the covenanted services of the East India Company—the improvement and extension of courts of justice—the increased impetus to the cause of education, and the establishment of universities in the different presidencies—the formation of native associations in Bengal, Madras and Bombay—the exposition of the Baroda Khutput—the improvement of the cultivators in the interior of the country—the introduction of railways and electric telegraphs in India—the abolition of the shop and stall tax at Bombay—the publication and opening of government records—the commission for inquiring into torture cases—the abolition of the horrid and inhuman practices of infanticide and suttee—the abolition of the slave trade in Travancore and Malabar—the effectual prevention of human sacrifices in Gondwana—the suppression of thuggee which prevailed from the Himalayas to Cape Comorin—the introduction of a uniform system of postage—the introduction of female education,—all these, and the formation of many societies for the social and moral amelioration of the people of India, owe their origin in a great degree to the unfettered

advocacy of the press, and certainly the East India Company has been the instruments of carrying them out.

However much cause therefore there may be for blame owing to apathy and slow progress, the field is not all barren. The Court of Directors may want, as all governments occasionally do, the propelling voice of public opinion and popular discussion, like the policeman's lanthorn and staff, requesting them to "move on." And it is therefore from this cause that scientific inquiry and free publicity may do good, by stimulating to greater exertions for the advancement of the general welfare of India.

Apologising for these crude remarks,

I am, sir,

Your obedient servant,

P. L. SIMMONDS.

5, Barge-yard, May 8th, 1855.

## To Correspondents.

ERRATA.—In No. 127, 1st column, 13th line, for "making, read "many;" 2nd column, 3rd line, for "one" read "an;" 3rd column, 18th line, for "representation" read "representative;" 3rd column, 21st line, for "our change" read "overcharge."

*** The Secretary begs to state, that owing to the length to which the proceedings of the weekly meetings have lately run, he has been reluctantly obliged to omit numerous letters and articles, including a paper by Mr. Andrew Henderson, "On the Past and Present History of Life Boats;" letters by Mr. Hugo Reid, on "Reformatory Schools;" by Mr. S. A. Good, on "Decimal Coinage;" by Mr. S. Sidney, on "Mr. Chadwick on Indian Irrigation;" and by Colonel Cotton on "Public Works for India."

## MEETINGS FOR THE ENSUING WEEK.

MON. Architects, 8.
Chemical, 8.
Statistical, 8. Mr. H. R. Lack, "On the Mining Resources of France." Rev. R. Everest, "On the Distribution of the Emigrants from Europe over the surface of the United States."

TUES. Royal Inst. 3. Dr. Tyndall, "On Voltaic Electricity."
Meteorological, 7. Anniversary.
Civil Engineers, 8. Mr. G. Herbert, "On Stationary Floating Batteries;" and Mr. G. Baillie, "On Volute Springs for the Safety Valves of Locomotive Boilers."
Med. and Chirurg., 8½.
Zoological, 9.

WED. Society of Arts, 8. Prof. Edward Solly, "On the Mutual Relations of Trade and Manufactures."
Microscopical, 8.
Royal Soc. Literature, 8½.

THURS. Linnæan, 1 p.m. Anniversary.
Royal Inst. 3. Mr. G. Scharf, jun., "On Christian Art."
Numismatic, 7.
Antiquaries, 8.
Royal, 8½.

FRI. Ethnological, 3. Anniversary.
Philological, 8. Anniversary.
Royal Inst., 8½. Dr. Hofman, "On Ammonia."

SAT. Royal Inst., 3. Dr. Du Bois Reymond, "On Electro-Physiology."
Royal Botanic, 3¾.
Medical, 8.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 7th May*, 1855.

Par. No.
140 (6). Civil Service Estimates—Class 6.
190. Metropolis Local Management—Return.
105. Bills—Customs Duties (amended).
106. Bills—Religious Worship.
107. Bills—Weights and Measures.
108. Bills—Intestacy (Scotland) (as amended by the Committee, and on Consideration of Bill, as amended).
Poor Law Board—7th Annual Report.
The Crimea and Scutari (State of the Hospitals of the British Army)—Report.

*Delivered on 8th May*, 1855.

215. Staff Officers (Crimea)—Return.
220. Medical Department (Navy)—Treasury Minute.

*Delivered on 9th May*, 1855.

201. Spirit of Wine—Copies of reports.
221. Assaults on Women and Children (Dublin)—Return.
224. Railway and Canal Bills Committee—4th Report.
99. Bills—Piers and Harbours—(Scotland.)
104. Bills—Infants Marriage.
109. Bills—Registration of Births, &c.—(Scotland)—(amended.)
111. Bills—Sewers—(House Drainage.)
Subdivision of Parishes—3rd Report of Commissioners.

*Delivered on 10th of May*, 1855.

204. Army (Crimea)—Return.
223. Army—Return.
211. Troops in "Seringapatam"—General Sutherland's Report.
218. Army before "Sebastopol"—3rd Report from Committee.
Eastern Papers (Negotiation at Vienna)—Part 13.
Turnpike Trusts—4th Report by the Secretary of State.

*Delivered on 11th of May*, 1855.

219. Poor Relief (Ireland)—Return.
225. Home-made Spirits—Account.
110. Bills—Burial Grounds (Scotland) (amended).
112. Bills—Nuisances Removal, &c. (Amended by the Select Committee).
Public General Act—Cap. 18.

*Delivered on 12th and 14th of May*, 1855.

216. Public Offices (Subjects of Examination)—Returns.
222. Merchant Seamen's Fund—Account.
226. Carnatic Debts—Returns.
227. Polling Papers—Return.
229. Tithe Commutation—Returns.
230. Railway and Canal Bills Committee—5th Report.
233. Naval Prize, Bounty, &c.—Account.
208. Savings Banks—Return.
117. Bills—National Gallery, &c. (Dublin).
118. Bills—Spirit, &c., Duties (Excise) (Amended).
119. Bills—Sewers (House Drainage) (Amended).
113. Bills—Jurisdiction of the Stannary Court Amendment.
114. Bills—Lunatic Asylums (Ireland) (Advances) (Amended).
116. Bills—Alterations in Pleadings.
115. Bills—Victoria Government.

*Delivered on 15th May*, 1855.

Education—Minutes of the Committee of Council.

*Delivered on 16th May*, 1855.

234. Legacy, &c., Duties—Return.
235. Militia—Return.
121. Bill—Rating of Mines.
Turnpike Trusts—5th Report by the Secretary of State.

## PATENT LAW AMENDMENT ACT, 1852.

### APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, May 11th*, 1855.]

*Dated 15th February*, 1855.

343. B. Gower, Stratford—Ordnance and projectiles.

*Dated 30th March*, 1855.

707. W. Crozier, Sunderland—Extinction of fire.

*Dated 14th April*, 1855.

825. J. Armstrong, Normanton Station, and J. Livingston, Leeds—Permanent way.
827. J. A. Herbert, Guilford—Conical propellers.
829. T. Kennedy, Kilmarnock—Propellers.

*Dated 16th April*, 1855.

831. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Felted tissue. (A communication.)
833. R. Husband, Manchester—Hat plushes.
835. E. H. Bentall, Heybridge—Harrows.
837. G. Beard, Birmingham—Label and stamp setter.

*Dated 17th April*, 1855.

839. A. W. Callen, Camberwell, J. West, Guernsey, and G. W. Lewis, Bristol, U.S.—Tents.
841. P. A. Devy, 10, Old Jewry-chambers—Swing looking-glasses. (A communication.)
843. G. F. Wilson, Vauxhall, and W. De la Rue, Bunhill-row—Fluids for lamps.
845. E. E. Allen, 376, Strand—Steam engines.
847. R. C. Clapham, Ardrossan—Salts of baryta and artificial iron pyrites, &c.

*Dated 18th April*, 1855.

849. H. Woodhouse, Stafford—Railway crossings.
851. L. Dameron, Paris—Carriages.
853. J. Kay, Bonhill, N.B.—Printing textile fabrics.
855. J. H. Johnson, 47, Lincoln's-inn-fields—Moulding and casting fusible or plastic materials, and covering articles with same.—(A communication.)
857. W. Madeley and T. Hanlon, Manchester—Looms.
859. F. Russell, 13, Cumberland-market, Regent's-park—Hanging window sashes.
861. W. V. Edwards, Swindon—Portable boiler and cooking apparatus.

*Dated 19th April, 1855.*

863. T. Lees, Birmingham—Metallic pens.
867. W. Bishop, Old Fish-street-hill—Ornamenting writing papers.
871. P. Lear, Boston, U.S.—Horizontal submerged propellers.
873. W. Savory, Gloucester—Crushing grain and cutting chaff.
875. J. H. Johnson, 47, Lincoln's-inn-fields—Articles of hard india-rubber or gutta-percha, or compounds, &c. (A communication.)

*Dated 20th April, 1855.*

877. J. C. Pearce, Bowling Iron Works, Bradford—Pipe joints.
879. W. Ryder, Bolton-le-Moors—Slubbing and roving machinery.
881. C. L. V. Maurice, St. Etienne—Carbonizing steel.
883. J. Lord, Rochdale—Temples for power looms.
885. H. Allen, New York—Valves.
887. W. L. Bennett, Wolston—Seed drills.
889. J. Drury, Paddock, near Huddersfield—Preventing explosion of steam boilers.

*Dated 21st April, 1855.*

891. W. Gerhardi, Manchester—Preventing straps lapping round shafts.
895. W. P. Sharp and W. Weild, Manchester—Spun or thrown silk thread.
897. J. H. Johnson, 47, Lincoln's-inn-fields—Spinning machinery. (A communication.)
899. W. A. Edwards, 87, Brook-street, Lambeth—Separating metals from metallic substances.
901. S. Walsh and J. Brierley, Halifax—Belt, band, or strap fastener.

*Dated 23rd April, 1855.*

903. J. Whitworth, Manchester—Ordnance fire-arms and projectiles.
905. J. Orr and J. Templeton, Glasgow—Figured fabrics.
907. A. V. Newton, 66, Chancery-lane—Separating substances of different specific gravity. (A communication.)

*Dated 24th April, 1855.*

910. J. Taylor, King-street, Westminster—Propelling vessels.
911. W. W. Richards, Birmingham—Revolving fire-arms.
912. J. Horsfall, Manchester—Mitreing sashes.
913. J. and G. Hunter, Leysmill, Forfar—Stone-cutting machinery.
914. F. Mc Kenna, Salford—Power looms.
915. F. J. Utting, Wisbeach—Land rollers and clod crushers.
916. M. A. Muir, Glasgow—Railway chairs.
917. C. P. Smyth, Edinburgh—Astronomical and geodetical instruments.
918. C. Jordan, Newport—Discharging cannon.

*Dated 25th April, 1855.*

921. L. A. Avisse, Paris—Lubricating revolving shafts.
923. J. Wallace, jun., Glasgow—Cleansing textile fabrics.
924. M. Mason, Dukinfield—Metallic sole-tips and heels.
925. J. J. Victory, Henrietta-street—Marking out curved lines upon wood and stone, and boring and sawing wood.
926. J. Black, Hampstead-road—Axles, shafts, and bearings.
927. J. Hunter, Liverpool—Distillation of turpentine, &c. (A communication.)
928. A. E. L. Bellford, 32, Essex-street—Planing screw nuts and bars. (A communication.)
929. A. E. L. Bellford, 32, Essex-street—Gas regulator. (A communication.)
930. A. E. L. Bellford, 32, Essex-street—Seamless garments, &c., of felt. (A communication.)
931. A. E. L. Bellford, 32, Essex-street—Weighing machine. (A communication.)
932. J. B. Wilkin, Helston—Stamping and dressing ores.
933. A. E. L. Bellford, 32, Essex-street—Chaff-cutting machine. (A communication.)
934. A. E. L. Bellford, 32, Essex-street—Lock for sliding doors. (A communication.)
936. S. Draper, Lenton, Nottingham—Stopping railway trains.
937. J. Jeffreys, Kingston-hill—Raising, diffusing, or injecting fluids.
938. E. Frankland, Manchester—Treatment of alums and products therefrom.
939. G. A. Huddart, Brynkir, Carnarvon—Motive power.
940. J. Peabody, Old Broad-street—Haymaking machine. (A communication.)
941. J. Silvester, Smethwick—Spring balances to steam valves.
942. G. A. Huddart, Brynkin, Carnarvon—Motive power.

*Dated 26th April, 1855.*

943. J. Elce and J. Bond, Manchester—Protecting revolving shafts and mill work.
944. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Preventing escape of fluids. (A communication.)
945. A. E. L. Bellford, 32, Essex-street—Slide valves. (A communication.)
946. W. Shears, Bankside, Southwark—Gunpowder magazines.
947. T. H. Burley, Ohio—Making dovetails.

*Dated 27th April, 1855.*

948. Capt. R. P. Coignet, Paris—Rendering tissues waterproof.
949. P. A. le Comte de Fontaine Moreau, Paris—New material for bearings. (A communication.)
950. A. Crosskill, Beverley—Turning cut grasses or hay.
951. T. Page, Middle Scotland-yard—Ordnance.
953. J. C. G. Massiquot, Paris—Lithographic presses and inking apparatus.
955. H. Collett, 12, Grosvenor-street, Islington—Pumps.
956. E. Myers and J. W. Potter, Rotherham—Stoves.
957. R. Clark, Strand, and J. T. Stroud, Birmingham—Lighting.

*Dated 28th April, 1855.*

958. T. and J. Knowles, Manchester—Steps and bolsters for spinning machinery.
959. D. Warren, Exmouth—Motive power.
960. F. J. W. Packman, M D., Puckeridge, Herts—Projectiles.
961. A. V. Newton, 66, Chancery-lane—File-cutting machinery. (A communication.)
962. W. E. Carrett, Leeds—Motive-power engines.
963. J. Marsh, 13, Store-street—Pianofortes.

*Dated 30th Aprll, 1855.*

965. E. Acres, Waterford—Dessicating and cooling air.
967. W. Johnson, 47, Lincoln's-inn-fields—Gas regulator. (A communication.)
969. H. Francis, 456, West Strand—Boots and shoes.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed May 11th, 1855.*

2412. Samuel Pearson, Woolwich—Improvement in the manufacture of gun barrels, pipes, and tubes.
2424. George Henry Ingall, Throgmorton-street—Improved method of communication between passengers and guards, &c., for the prevention of loss of life and accidents on railways.
2425. Peter Knowles and Edward Kirby, Bolton-le-Moors—Improvements in machinery for opening, cleaning, and preparing cotton and other fibrous materials.
2429. Samuel Henton, Lambeth—Improved saddle.
2431. John Platt, Oldham—Improvements in machinery or apparatus for making bricks.
2433. William Low, Lloft-Wen, near Wrexham—Improvements in ventilating mines.
2437. James Higgins and Thomas Schofield Whitworth, Salford—Improvements in apparatus for moulding for casting shot, shells, and other articles.
2444. William Coulson, Fetter-lane—Improvements in machinery for morticing, tenoning, and boring.
2449. Edouard Belmer, 8, Macclesfield-street, City-road—A new manufacture of apparatus for warming rooms and workshops.
2502. John Clarke, Leicester—Improvements in the manufacture of looped fabrics.
2520. William Taylor, Howwood by Paisley—Improvements in steam boiler and other furnaces.
2526. Edward Briggs and William Souter, Castleton Mills, near Rochdale—Improvements in machinery and apparatus for gassing yarn and thread.
2528. Julian Bernard, Club chambers, Regent-street—Improvements in the manufacture of boots, shoes, or other protectors for the feet, and in the machinery or apparatus connected therewith.
2614. William Chippindale, Leeming-bar, near Bedale, and Leonard Robert Sedgwick, Crakehall, near Bedale—Improvements in steam boilers.
144. Robert Martin, High-street, Tottenham, and Jacob Hyams, Union-street, Bishopsgate—Improvements in goloshes or overshoes.
231. Henry Davis Pochin, Salford—Improvements in the treatment of certain compounds of alumina, and the application of the same in printing, dyeing, tawing, paper making, and such like purposes.
374. Lieut. Frederick Blacket Edward Beaumont, R.E., Upper Woodball, Barnsley—Improvements in fire-arms called revolvers.
406. Benjamin Looker, junior, Kingston-upon-Thames—Improvements in ventilating stables and other buildings.
608. Edmund Reynolds Tayerman, 79, Pall-mall—Improvements in portfolios for holding papers.

*Sealed May 15th, 1855.*

2415. Jean Marie Chevron and Charles Victor Frederic de Roulet, Paris—Improvements in machinery for manufacturing textile fabrics.
2513. John Moore Hyde, Bristol—Improvements in iron steam ships and in boilers and machinery for propelling the same.
2568. Joseph Phelps, Croydon—Improvements in apparatus for damping postage and other stamps, labels, and like articles.
2618. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improvements in sewing machines.
2700. Louis Joseph Frederic Margueritte, Paris—Improvements in the manufacture of sulphuric acid.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3716 | May 12. | Fastenings for Stays, and other Articles of Dress | George Waide Reynolds ... | Birmingham. |
| 3717 | " 15 | Self-acting Trap for Catching Rats and Mice | Colin Pullinger | Selsey, near Chichester. |

Journal of the Society of Arts.

*FRIDAY, MAY* 25, 1855.

## FOURTH ANNUAL CONFERENCE AND 101st ANNIVERSARY DINNER.

The Council beg to announce that it is intended that the Fourth Annual Conference of the Representatives of the Institutions in Union should take place early in the first week of July. Also that the One Hundred and First Anniversary Dinner should be held on or about the same day.

Detailed particulars will be published next week.

## TWENTY-THIRD ORDINARY MEETING.

Wednesday, May 23, 1855.

The Twenty-third Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 23rd inst., Sir William Cubitt, F.R.S., one of Her Majesty's Commissioners for the Great Exhibition of 1851, in the chair.

The following Candidates were balloted for and duly elected :—

| | |
|---|---|
| Coote, Thomas | Granville, Walter Long Bozzi |
| Edwards, Rev. David | Wanostrocht, Vincent |

The following Institution has been taken into Union since the last announcement :—

394. New Swindon, Mechanics' Institute.

The following paper was read on the opening of the Animal Department of the Trade Museum :—

### ON THE MUTUAL RELATIONS OF TRADE AND MANUFACTURES.

By Professor Edward Solly, F.R.S.

In proposing to consider so comprehensive a subject as that announced for this evening, in the short space of a single paper, I shall perhaps be deemed somewhat presumptuous; but as it has been determined to-night to throw open to the members of the Society the collection of Animal Produce and Manufactures formed under the joint sanction of the Society and the Royal Commissioners for the Great Exhibition of 1851, and designed to form the first division of a general Trade Museum, I am anxious to take the opportunity of drawing your attention to a few more widely-spread subjects of consideration, than those immediately connected with the formation of the Trade Museum.

I do not intend, however, to enter at all into the examination of those great and important questions of political economy which relate to the mutual bearing of trade and manufactures, and the importance of these two sources of national wealth as contrasted with agriculture; I shall confine myself to drawing your attention to the mode in which either progress or decay in the one, has always influenced, and ever must influence, the prosperity of the other; the evils which throughout have arisen from unfair monopolies, and from the wilful or accidental ignorance of technical matters in those by whom restrictions and protective enactments have been framed; and in conclusion, I shall briefly remind you of the nature and objects of the proposed Trade Museum, and point out some of the ways in which I conceive it will prove of national utility, serving at the same time to illustrate the history of past industry, to indicate the sources of present prosperity, and to suggest the best and most desirable objects for the exertion of future energies.

On looking back to the past history of the commerce and manufactures of the world, it is impossible not to be struck with observing, how greatly the progress of individual nations has fluctuated from century to century, and in many cases how little their commercial prosperity has resulted from the wisdom or energy of their rulers. In most instances, a good deal has depended on the active and persevering habits of the people themselves; and in many cases the most important changes and modifications in the commerce and manufactures of a country, may be traced to causes in operation at a distance, and at first sight apparently wholly unconnected with it.

The increase of any one branch of manufacture—that is to say, the production of any article in much larger quantities than the producing nation is able to consume—always of necessity leads to a corresponding increase in commerce and navigation, though it by no means follows that the producing nation shall reap the whole benefit of the commerce thus caused. Prosperity from manufacture, and prosperity from trade and navigation, may occur at the same time and enrich the same persons, but there is obviously no necessary connection between the two; for we often find that whilst one country becomes rich and prosperous from certain branches of manufacture for which it possesses peculiar advantages, another nation may derive profit from the sale of those same manufactures to people inhabiting distant parts of the globe. The cases of Tyre and Carthage, in olden time, and the sea-port towns of Italy and Holland in later periods, are familiar illustrations of wealth acquired by commerce almost wholly independent of manufacturing skill or prosperity. These cities were chiefly, if not entirely, marts in which the productions and manufactures of other countries were sold and exchanged. We hear of merchants and traders, but not of manufacturers; and as in the brief, but highly descriptive account of Tyre given in the book of Isaiah, we are told,—"Her merchants are princes, and her traffickers are the honourable of the earth;" so also, in searching for the causes which led to the prosperity of more modern cities, such as Antwerp, we find that it was the resort of traders from all parts of the world, and that its merchants traded in the productions of France, Spain, Italy, England, and Germany; and exchanged the manufactures of these countries with the spices and other tropical productions of the Indies, China, and Africa. The merchant traders were thus collected together in particular cities, which became general emporiums of the trade of the whole world; and we read of them as living in palaces, surrounded with costly furniture, and all the magnificence and luxury which wealth could procure or the most cultivated tastes desire; whilst the manufacturers and artisans, with the produce of whose labours they traded, were spread abroad and scattered over large tracts of country; and hence, whilst we easily recognise the wealth of the merchants of the great trading sea-port towns, we are apt, to some extent, at least, to overlook the wealth amassed by the isolated and more widely-settled manufacturers. In every case, however, there exists an intimate relation between the two classes; and whenever merchants prosper, we may surely trace a corresponding and proportionate amount of prosperity in the producing classes, either in the same country or at a distance.

When the martial habits of the Romans began to decline, and when the wealth acquired chiefly by conquest and plunder was made to minister to the artificial wants of society created by luxury, we find them employing the productions of the most distant parts of the globe, and a demand sprung up for many substances which were before unknown, or regarded as useless by their more warlike ancestors. Thus, in the time of Aurelian, silk was sold for its weight in gold; for the taste for rich garments of silk had continued to increase amongst the people, in spite of the law previously passed by the senate, "that no man should disgrace himself by the effeminate delicacy of silken apparel." The Romans were not then a trading people; their foreign luxuries were all brought to them by other nations, and for their supply of silk they were wholly dependent on the Persians. It is plain that the producers in China must have been paid a remunerative price for their silk, and it is well known that the Persian traders, who bought the silk of the Chinese and sold it to the Romans, made great profit by the traffic; whilst the latter people, at whose expense all this was done, had nothing to do with the production, manufacture, or commerce of silk. They scarcely knew whence it came, and they were ignorant of its nature, and the mode in which it was obtained.

Early writers make special mention of the extortionate charges of the Persian merchants, and point out how this led to the final destruction of the trade in which for several centuries they had enjoyed a monopoly; for in the year 450, the Emperor Justinian, seeing how the ever-increasing trade in silk tended chiefly to enrich the Persians, was led to try and introduce the cultivation of that article into Constantinople—an attempt eventually successful, though in the first instance nearly frustrated by the avarice of the Emperor, who assumed to himself the entire monopoly of the production of silk, and sold that made in the imperial manufactory at a price nearly eight times as high as that previously paid by his subjects to the Persian raders.

The history of the silk and woollen manufactures, and the trade in articles made from those substances, afford a number of interesting illustrations of the mode in which most manufactures have spread, and the vicissitudes to which commercial prosperity has ever been exposed. In the first instance, we generally find a particular place or country celebrated for some special kind of manufacture; gradually it becomes an article of export to other countries, and the exportation is profitable. Then ingenuity is set to work to improve the manufacture or to simplify the processes; and these improvements, by diminishing the cost of production, increase the exportation and render the trade still more profitable. After a while competition commences: the profitable trade leads others to try and compete with the first producers; and a more active people, a more favourable climate, cheaper labour, or increased mechanical skill, form powerful rivals. Sometimes they only act as a stimulus to call forth more energy and more active exertion; but often the original manufacture is destroyed, and its seat transported to another country. Sometimes, too, the same result is brought about by political or religious revolutions; and occasionally we find a trade suddenly ceasing in consequence of the demand for an article being altogether destroyed, and some new material substituted for the purpose to which it had previously been applied. There is a remarkable instance of this in the manufacture of Chamois leather for military clothing, with which England supplied most of the European armies at the close of the last century. The material was excellent in time of peace and worn on parade and in ordinary garrison service, but it was not fit for active warfare. This was found out in the course of the Peninsular war. The use of leather clothing was discontinued not only in the English army, but also in that of most other European countries, and the English manufacture of Chamois leather was almost abandoned.

If we study the commercial history of the whole world, we are enabled to trace out the gradual development and steady increase of each branch of manufacture in a manner which, for the reason just mentioned, it is hardly possible to do if we confine our inquiries to the history of a single country. The intelligence and technical knowledge of mankind is ever on the increase, though the skill and prosperity of particular nations may decrease. Now and then a special process or even an entire branch of art is lost; but this is more than compensated by the advance which is constantly taking place in other arts. The power-loom, the Jacquard-loom, and the stocking-frame, were each of them immense improvements on the modes of manufacture previously in use; but if we trace their effects on any one single country alone, we obtain a very partial and imperfect idea of the real influence which they have exerted on manufacturing prosperity generally.

The mutual relation of manufactures and trade is shown by the manner in which anything which increases the facilities of transit or navigation, by facilitating commerce, acts as a stimulus to manufacture; just as on the other hand every great improvement in manufacture as necessarily leads to an increased development of commerce. Writing on the influence of cheap and rapid transit on commerce, Adam Smith remarked in 1775, that in order to convey four tons of goods from London to Edinburgh and back, a broad-wheeled waggon, attended by two men and drawn by eight horses, would be employed for six weeks, a fact which serves well to illustrate the effect of railways, as the same work is now easily performed in two days. Changes such as these not only modify existing commerce, but also call into existence many new sources of trade. For example: a traffic in fish, eggs, fruit, and fresh provisions, could easily be carried on between places as far distant as London and Edinburgh with the facilities of railway conveyance, which, with nothing but the old broad-wheeled waggon, would be obviously impossible.

So also the gradual improvement in the monetary system of nations. The establishment of systems of exchange —banks and bills—has had a most important bearing on the prosperity of manufactures and the spread of commerce. In the time of Homer the current coin of the realm was oxen, and we are told that whilst Diomede paid nine oxen for his suit of armour, that of Glaucus cost him one hundred head of cattle; now there can be no doubt that the introduction of a suitable and more divisable mode of payment must have greatly facilitated the buying and selling of merchandise.

From the very earliest periods of history, commerce has received the especial attention of kings and governments, and commercial laws and enactments are to be found amongst the most ancient statutes on record. Legislative influence has been brought to bear on trade and manufactures in various forms; the chief being the imposition of duties levied as a means of revenue, —protective duties, ordained with a view to protect certain branches of industry against other branches, or against the importation of cheap foreign wares,—patents, bounties, privileges, and other kinds of special encouragement, granted with a view of fostering and assisting in the improvement of particular trades.

On carefully studying the commercial history of the world during the last seven centuries, one is led to question whether on the whole legislative interference has not done more harm than good. Certainly, if it be assumed that the various enactments made were faithfully drawn up, and honestly intended to benefit arts and commerce, it is lamentable to observe in how many instances they have frustrated the very objects they were enacted to assist. In most instances we find that whilst vested rights, having powerful friends at court, were assisted and protected with fines and duties, the true interests of the nation as a producing, manufacturing, and exporting country were left to chance, or sacrificed to ignorance and cupidity.

We must, however, not include in this general criticism, those promises of bounty and encouragement, which in the history of each country we find the wisest and most intelligent monarchs offering to the ingenious artizans of other nations, as inducements to come and settle in their dominions, and thus introduce those arts for which they have become celebrated in their own countries. Frequently, from some political or religious disturbance, the inhabitants of a manufacturing district have been led to emigrate, carrying their families, work-people, and factories with them; and, in such cases, the neighbouring monarchs have often endeavoured by promises of patronage and protection, to induce the fugitives to seek a new home in their dominions. Thus, for example, in 1331, on the occasion of disturbances in the Low Countries, Edward III. granted a special letter of protection to any workers in wool, who would come over and settle in England. His invitation was accepted by about seventy Walloon families, and we may even to this day trace the influence and effects of the new blood thus introduced into the woollen manufactures of the country. Again, two centuries later, when the cruel tyranny of the Duke of Alva induced the inhabitants of Antwerp and other cities in the Netherlands to fly from their native country, the wise policy of Elizabeth caused many of them to come over into England; and then again our woollen manufactures received a most important impetus and advancement.

But the species of legislative interference with manufactures to which I have referred is that which we find in such Acts of Parliament as, for example, the Act of 1571, passed to favour the knitted cap makers, who had become jealous of the new felt hats, then recently introduced, and which seemed likely to replace the knitted caps altogether. It was, therefore, enacted that every person above the age of seven years, should wear a woollen cap of English make on Sundays and holidays, on pain of forfeiting 3s. 4d. a day, if they neglected to wear such a cap—lords, knights, and landed gentry, being of course, excepted—or, again, in the Act of 1721, enacted out of compliance to the wishes of the silk button makers, wherein it was ordained, that no one should henceforth wear buttons covered with wool, or cloth, on any pretence whatever. Acts of this sort tended to injure trade, and though in many instances the penalties were very heavy, they hardly ever fulfilled the purposes for which they were passed, because they were generally evaded. Thus, the Act of 1566 against the importation of live sheep—passed, partly with the idea that the English sheep was the only kind in the world bearing wool suited to the manufacture of broadcloth—the penalty was for the first offence forfeiture of a man's entire substance, imprisonment for a year, and the loss of his left hand; whilst the second offence was made felony, without benefit of clergy. In those days, it is well known, many an illegal act was allowed to pass unnoticed, if the transgressor was able and willing to pay a handsome sum by way of fine; and, moreover, smuggling existed to a very large extent.

Two chief reasons have from time to time been advanced in justification of these, and a thousand similar enactments: the one was, protection to native industry, —the other preservation of the balance of trade. The time has now come, when it is pretty generally acknowledged that protection of one class implies injustice to another, and that a trade which needs protection to guard it from the rapid advances of some other branch of industry, considered in a national point of view is seldom deserving of protection. The so-called balance of trade is also fast becoming a matter of history; though we may trace the evil influence caused by its introduction into commercial legislature to a very recent period; it is now generally admitted that a trade in order to be lasting must be profitable to those who carry it on, and that if the exportation of a certain quantity of goods does not bring back in return goods of still greater value to the country so exporting, such a trade would soon cease to be worth carrying on.

The trade between this country and France has for centuries suffered from the measures taken to preserve this imaginary balance, which have often led to the most unwise and injurious restrictions. Invariably, we find that the imposition of prohibitions and high protecting duties on the importation of foreign manufactures has had a depressing effect on our own manufactures; and on the other hand, benefit has nearly always arisen from the reduction, or abolition, of such duties. When in 1628, King James, observing how large a quantity of undyed broadcloth was exported to Holland, the Dutch being more skilful dyers than the English, determined to prohibit the exportation of undyed cloth; he endeavoured at the same time to improve the art of dyeing in England, and to secure to himself a revenue from the sale of home-dyed cloth, of which he proposed to retain a monopoly. The attempt wholly failed, for, as might have been expected, the Dutch and most other importing foreign nations at once prohibited the importation of dyed English cloth, and King James's project had to be relinquished.

Again, when in 1824, it was determined to admit French manufactured silks into England, it was ordained that a period of two years should elapse before the new law came into operation, under the supposition that this time was necessary to enable our manufacturers to prepare for the competition to which they would then be exposed. But the time thus permitted to elapse was employed by the French manufacturers in preparing large stocks of goods ready to be introduced into England as soon as the new duty came into operation; and hence our manufacturers again took fright, and a new and most illiberal enactment was made. The silk manufacturers of France were all in the habit of making their goods to a certain length; to prevent, therefore, the importation into England of any of the large stock of goods manufactured for the English markets during the two years between the passing of the Act of 1824 and its coming into operation in 1826, a fresh Act was passed just before the latter period, enacting that no silk goods should be imported unless they were of a length somewhat longer than the standard length adopted by all the French manufacturers. It is curious to observe how this illiberal and unwise Act, in fact, increased the very evil it was intended to obviate. It at once produced an immense increase of smuggling, and in place of having to compete with French goods imported under a moderate protective duty, our manufacturers had, in fact, to compete with the same goods brought in without paying any duty at all.

Another good example of the same effect is afforded by the policy of the French government towards England early in the present century. With a view of injuring the commerce of England they prohibited the importation of a considerable number of articles of merchandise into France; this completely interrupted the whole system of European international trade, and led the Swiss to abandon some of those branches of industry which they had hitherto carried on, and to enter largely into the silk manufacture. Thus the attempt of the French to injure the cotton trade of England led to the establishment of a formidable rival to their own silk trade.

In many of these enactments it is remarkable how much want of knowledge is shown; it is evident that party favour and patronage were the real causes which led to a large number of them; but independent of this, and where no unfair partiality was intended, it is plain that those in power not only did not possess the information necessary to lead them to form correct judgments respecting the interests committed to their supervision, but that in fact it was not in the power of any one to supply them with such knowledge. I have already mentioned the fact that the Romans were ignorant of the source of silk, believing it to be a vegetable production—and as an illustration of this, the passage in the second book of Virgil's

Georgics is often quoted, in which he speaks of the Indians as combing the soft fleeces of the bough, an expression also used by Herodotus and Theophrastus. An error such as this is hardly to be wondered at when we remember the tedious and uncertain communication which then existed with so remote a country as China; we need not, however, go so far back in history for examples of commercial ignorance far more remarkable than this. It is difficult to believe that scarcely two centuries since the following was gravely stated by Isnard as the mode of rearing silkworms:—

"Take a cow about to calve, and feed her on mulberry leaves alone till she has calved, and continue to feed both her and the calf on the same food for eight days; then kill the calf, and chop it up entirely into mincemeat, and place this in a wooden trough at the top of a house, in a garret or loft; when the whole is thoroughly corrupted, numerous small worms will be found in it, which must be carefully picked out and fed on mulberry leaves; this is an infallible receipt."

This extraordinary story was gravely copied by both Pomet and Lemery, writers of no inconsiderable repute at the end of the seventeenth century, though the latter, it must be added, appends by way of commentary, that the receipt needs confirmation.

Another curious illustration of how little was known of the true nature of the most important articles of commerce is afforded in the history of cochineal. So recently as 1724, a Dutchman, named Reusscher, publicly stated that this dye-stuff was, in fact, the dried body of a small insect; his statement was denied by one of his townsmen, who asserted most positively that it was the seed of a plant; and the dispute was carried to such a length that a commission was appointed to investigate the matter in Mexico, and the legal documents establishing the animal nature of cochineal arrived in Amsterdam in October, 1726. It is stated by Beckman that the advocate of the vegetable origin of cochineal was so confident of the truth of his view of the subject that he had bet the whole of his fortune on the result of the inquiry.

Another curious illustration of want of knowledge in framing legislative enactments is shown in the proclamation issued by King Charles I., in 1630, ordaining, amongst other things, that no silk shall be dyed in the gum, or before it has been entirely removed by boiling; yet, eight years after, we have a counter-proclamation in which this restriction was removed, the proclamation stating that the king had now become better informed on the subject, and understood that silk so dyed was proper for the manufacture of taffetas, figured satins, ribbons, and ferrets; but our admiration at the unusual candour of this edict has hardly passed away before we find the same monarch ordaining that no person should be admitted into the Weaver's Company unless he was a member of the Established Church of England.

The progress of improvement was, however, more often impeded or retarded by protective enactments arising from the influence of existing interests than from mere ignorance; thus it is curious to observe the violent opposition which indigo met with on its first introduction as a substitute for the old Saxon dye-stuff woad. It is stated by Schreber, in his history of that substance, that, on the introduction of indigo, the German Diet, in 1577, strictly prohibited all persons, under the severest penalties, from using the "newly invented, pernicious, deceitful, eating, and corrosive substance called the devil's dye;" which enactment was confirmed and continued by this Diet again in 1594 and 1603, and still more strongly by Duke Ernest, the Elector of Saxony, in 1650; nay, so far was this persecution of indigo carried, that in Nuremberg a law was passed compelling all dyers to take a yearly oath that they would not use indigo, and the custom of taking this annual oath so far became one of the acknowledged habits of the trade that it was kept up long after the value of indigo was generally acknowledged, and its use universal amongst dyers.

In France, too, a similar war was declared against indigo, and it was not till so recently as 1737 that dyers were permitted to make use of it without restriction.

In our own country the same kind of legislative interference took place with regard to logwood. The ground on which it was declared objectionable was, that the colours dyed with it were fugitive and uncertain, hence in the twenty-third Elizabeth, 1581, an Act of Parliament was passed, prohibiting the use of logwood by dyers, on the ground that "the colours thereof be false and deceitful to the Queen's subjects at home, and discreditable beyond sea to our merchants and dyers;" and, because this Act had not the desired effect, and the use of logwood continued to spread, two additional ones to the same effect were passed in 1597 and 1630, and the restrictions were not repealed till 1661, when, by the thirteenth of Charles II., it was set forth, that "the ingenious industry of these times hath taught the dyers of England the art of fixing the colours made of logwood," and therefore permission was given to make use of it.

It is curious to observe how in all these edicts against the use or introduction of any new substance care was taken to make out as good a case as possible by loading the denounced import with many hard names and evil epithets. King James's proclamation on the uses of tobacco is a remarkabble instance of this; for he has ingeniously contrived not only to describe the tobacco itself as noxious and unwholesome, but he has, at the same time, managed to cast a slur upon all those who ventured to smoke. It runs thus:—

"Whereas, tobacco, being a drug of late years found out, and brought from foreign parts in small quantities, was taken and used by the better sort, both then and now, only as a physic, to procure health; but it is now, at this day, through evil custom and the toleration thereof, excessively taken by a number of riotous and disorderly persons of mean and base condition, who do spend most of their time in that idle vanity, to the evil example and corrupting of others, and also consume the wages which many of them get by their labour, not caring at what price they buy that drug; by which immoderate taking of tobacco the health of a great number of our people is impaired, and their bodies weakened and made unfit for labour; besides that also a great part of the treasure of our land is spent and exhausted by this only drug so licentiously abused by the meaner sort—all which enormous inconveniences we do well perceive to proceed principally from the great quantity of tobacco daily brought into this our realm," &c.

It is probable that in no instance has any great improvement been absolutely prevented by these species of enactments, though there can be no doubt that many have been greatly retarded. Upon this subject Beckman truly observes:—

"Legislators are neither almighty, omniscient, nor infallible; with the best views, and a firm determination to discharge their duty, they may recommend things hurtful, and prohibit others which might be attended with advantage. Were their commands and prohibitions inviolable, insuperable, and inscrutable, they would often confine the progress of the arts and sciences, and render useful inventions impossible. But the people, when they have not entirely become machines, know how to elude, even at great personal hazard, faulty regulations, and by prohibited ways to obtain greater advantages than those which formed the object of the orders issued by their government."

Such laws for the regulation of particular arts are as unserviceable and as quaint as the enactment of King James, in 1617, "that all noblemen, knights, and country gentlemen should depart out of London, within twenty days, and go to their country houses, for the exercise of hospitality, and for the comforting of their neighbours."

Whilst, however, we thus find numerous instances of the evil produced by restrictions on the freedom of manufacture, at the same time we also find curious examples

of the waste of money and energy in attempting to foster and establish arts to which the country, from physical circumstances, is unfitted; thus, for example, when at the close of the sixteenth century, the silkworm had been successfully introduced into the whole of the south of France, King James determined to introduce it into England, and with this view issued a circular letter in 1608, established a mulberry garden at St. James's, and made special reference to the cultivation of the silkworm in his speeches from the throne. In the preamble to his circular, he states that, "in a few years, our brother the French king hath, since his coming to that crown, both begun and brought to pefection the making of silk in his country." Here the difference in climate between the two countries was altogether overlooked, and the conditions necessary to success in such an experiment were completely forgotten.

In most of the large experiments of this sort, as in the protective enactments which, from time to time, have been ordained, the subject has been treated in a circumscribed and limited manner, and hence the unsatisfactory results to which they have so often led. The manufactures and the commerce of the country have been dealt with in an isolated manner. Instead of taking into consideration the position, resources, and activity of other countries, it seems to have been too often forgotten that our enactments did not influence our own country alone, but must at the same time also affect other countries. Our legislation was, in fact, for the whole world, but the data on which that legislation was based were drawn from considerations connected with a single country, and, in fact, often connected with individual interests. In dealing with our colonies the same course has been pursued. We have acted as though there were no other nations on the globe but England and her colonies; and hence altogether overlooked the influence which foreign countries could not fail to exert on the true balance of trade, the relative manufacturing and commercial prosperity of all the countries of the world.

The history of all great national improvements in manufactures is highly curious and instructive. In the cases to which I have recently referred, where the government of the country has directly interfered to aid and encourage a particular branch of industry, we find many instances like that of King James, which necessarily failed for want of the most simple and necessary elements of success,—true principles, and favourable natural conditions; but there are many others in which entire or partial failure was caused in consequence of the mode in which such interference took place. Thus, in the reign of Henry IV. of France, when the introduction of silk culture was first attempted, the government formed large nurseries, and freely gave mulberry cuttings and silkworm eggs to all persons willing to receive them, and even went to the cost of transplanting the mulberry-trees to the gardens of the peasants. This excess of liberality entirely defeated its object, and the whole thing fell into disrepute. After a few years the system was altered; rewards were given to those who had successfully established silk plantations; and the leading manufacturers who had carried on the manufacture longer than twelve years received patents of nobility.

I shall not now attempt to go into the subject of patents for inventions, or consider in how far the creation of such monopolies has aided the progress of manufacturing ingenuity, though this question is doubtless intimately connected with the matter under consideration. Theoretically, improvements in manufactures may be said to arise either from increased commerce calling for an increased supply of the manufactured article, or from a hope of obtaining increased profit by diminishing the cost of production. The practical fact, however, is, that most of the great improvements in manufactures have been the result of accident rather than of design, and have, in many instances, been originated by very different motives; hence, the ideas suggested have been taken up by others, and brought to perfection, whilst the original designer has too often died in misery and disappointment.

The invention of the stocking-frame, or loom, in the early part of the seventeenth century, by Lee, which, in fact, created a new and most important branch of manufacture, is an example of this. Lee was the son of a country gentleman, a Master of Arts at St. John's College, Cambridge, and apparently in no way connected with trade. The idea of making a knitting-machine, it is said, came simply from his seeing a country girl at work, knitting stockings with needles. Having completed his loom, and established works near Nottingham, he applied to Queen Elizabeth for aid and encouragement, and, receiving none, but rather being impeded, he left the country, and accepted an invitation from Henry IV. to settle at Rouen. The assassination of the King put an end to Lee's prospects of encouragement, and he soon after died in the greatest distress. However, the invention was perfected; it continued to spread in both England and France; and on the revocation of the edict of Nantes, in 1685, when the artizans of France were compelled to seek refuge in other countries, the stocking-loom was carried into all parts of Europe.

Few inventions have had greater influence on the progress of our manufactures than the power-loom; yet this was designed and brought to perfection in 1787, by the Rev. Dr. Cartwright, a man not only wholly unconnected with manufactures, but even quite ignorant of the mode of weaving by hand. It is notorious that Dr. Cartwright expended nearly £40,000 in introducing the power-loom; that he was met with all the delays, annoyances, and opposition which narrow-minded prejudice could raise, and that he finally received a sum of £10,000 from the nation, by way of compensation.

It is a curious historical fact that the general scheme of the power-loom was communicated to the Royal Society, and published in their Transactions, in 1678, more than a century before the date of Cartwright's invention; yet the idea seems to have been regarded, by practical men, as quite impracticable, and by scientific men as unworthy of a trial. At all events, no attempt seems to have been made to test its value.

It would be easy to multiply instances, but I have said enough. I will only remind you that the Jacquard-loom was invented by a straw hat maker, whose attention was first turned to weaving by the premium list of this Society, which accidentally fell into his hands; that the man who practically founded the cotton manufacture of the country, by the invention of the spinning rollers, was not a cotton spinner, but a barber; and that James Watt, when he first turned his attention to the improvement of the steam engine, was a disappointed spectaclemaker.

We see, then, that the progress of commerce and manufactures has gone on, in a manner, wholly independent of the laws and regulations of man. The enactments of governments, intended or professed to aid them, have in many instances failed, and not unfrequently produced results of the most opposite character to that which was intended; whilst the greatest advances have been caused by religious, political, and social revolutions in the first instance, in no way connected with either arts or trade; or have arisen from the accidental discoveries of persons engaged in perfectly different pursuits.

I have hitherto chiefly adverted to the influence possessed by government enactments, because the power thus exerted, whether beneficial or otherwise, is to a certain extent immediate and absolute. The edict comes out with full authority; it becomes at once the law of the land, and must be obeyed; and hence, whilst wise and sound government interference is above all things valuable, so ill-considered and partial measures are peculiarly injurious; they fetter and cripple honest trade, though they never prevent the exercise of dishonest ingenuity.

In looking, however, at the various influences which bear upon the prosperity of manufactures and trade, we

must not pass over the very important influence possessed by those occupied in the arts and commerce themselves. This influence is necessarily very great, and is shown in a number of different ways. There are, however, only two of these to which, for the object now before us, I desire to draw your attention; and these are, adulteration and mystery. From the very mode in which trade is carried on, and from the number of hands through which most articles pass, great facilities are given for careless preparation and skilful adulteration of the raw produce; and it is very difficult for the manufacturer who consumes it to persuade the producers that it would be to their advantage, as well as to his convenience, if such practices were discontinued. Unfortunately, too, even in many branches of manufacture carried on in our own country, adulteration, and admixture of inferior materials, is practised to an enormous extent. These are evils almost beyond the power of government interference, and can only be well remedied by the men themselves who carry on these manufactures; and for this a certain amount of combination and unity of purpose amongst them is needed, which, unfortunately, seems hardly compatible with that competition and rivalry which many consider inseparable from trade. Why is it that adulteration is not only permitted, but even encouraged in many instances? Why, for example, should feathers, hair, sponge, and many other articles, be openly and confessedly adulterated, so that when brought over in a clean and pure state they are looked on with suspicion, or even rejected as not marketable? I do not mean to refer to the adulterations too often carried on by retail dealers, but to the wholesale adulteration of the raw material itself, which necessarily depreciates its value, and renders a process of purification the first stage in any art in which such materials are employed. It is bad enough when such admixtures are made in this country; but the evil is more than doubled when it is carried on in a country thousands of miles distant, as then the article adulterated has to bear the cost of freight of the impurities thus added, in addition to the cost of the process necessary for purifying it.

On the subject of trade mystery I will only observe, that I am convinced that it would be far more to the interest of manufacturers if they were more willing to profit by the experience of others, and less fearful and jealous of the supposed secrets of their craft. I am perfectly well aware that there are cases in which it is perfectly necessary that each man should keep his own counsel; as, for example, when a new market for a particular article has been opened to an enterprising firm, it would clearly not be to their interest to communicate this new source of profit to their neighbours and rivals; this, however, is not the secretiveness to which I refer, it benefits some, but does not in any way injure others; whilst the tendency to mystery amongst manufacturers and artisans in truth benefits no one, and, at the same time, retards the progress of ingenuity, and fetters the development of national industry. In the course of the last few months the extensive intercourse which I have had with practical men, has led me to feel the truth of this strongly; for, whilst I have often found them to a great extent ignorant of the progress of their art in other parts of the world, they have, with few exceptions, been anxious to guard from others various practices and processes which, in truth, were no secrets at all. It is a great mistake to think that a successful manufacturer is one who has carefully preserved the secrets of his trade, or that peculiar modes of effecting simple things, processes unknown in other factories, and mysteries beyond the comprehension of the vulgar, are in any way essential to skill as a manufacturer, or to success as a trader. How have the great manufacturers of England acquired their reputations and amassed their fortunes? How have our Bramahs, Cubitts, Fairbairns, Holdsworths, Salts, Marshalls, Gotts, and a hundred others, attained that world-wide reputation which they so well deserve? Was it by the petty mysteries of trade, and by a jealous preservation of the secrets of their forefathers? or, was it not rather a necessary result of a very simple combination of circumstances? The employers were men of unwearying energy, inflexible honour, and sterling integrity; their work-people were well-selected, well-trained, well-treated, well-directed, and well-paid! These, I believe, are the true secrets of trade prosperity; but they are secrets which no one need fear to communicate to his rivals.

I now turn to the more special object of to-night, namely, the Trade Museum; and having briefly stated its objects, and what I conceive it ought to contain, I shall endeavour to show you how it would possess a most important influence on the manufactures and commerce of this country and our colonies.

The Trade Museum should contain samples of the productions of all parts of the world, both raw and manufactured; there should be samples of the leather, wool, silk, woods, gums, oils, dye-stuffs, drugs, stones, ores, and other productions, whether wild and indigenous, or the result of cultivation; so that a visitor could at once compare the silk or wool of France, Russia, Sweden, Italy, or England, with that of Canada, the United States, Persia, China, the East Indies, South Africa, or New South Wales. Again, if he wished to see the productions of any country, he should find arranged together in proper order the produce of each country, so that he could at once know those which form articles of commerce, and those not at present imported. These are two perfectly distinct kinds of information, and the Museum ought to afford them both.

Secondly, there should be illustrations of all manufactures, from the collection or raising of the raw produce, through every stage or operation to which it is subjected, down to the most finished products; and these should be so complete as to exhibit all the more important variations in the processes employed in different countries. Thus, we should not only be able to compare the broadcloth of our own country with that of France, Germany, Belgium, and other countries, but we should also have the means of simultaneously comparing them in every stage of manufacture, beginning with the raw wool, its scouring, combing, carding, spinning and weaving, dyeing and dressing. For this purpose the tools, implements, and machinery should be shown, accompanied by working specimens showing progress, and illustrating the advantages and disadvantages of each process. For example, the dressing of broadcloth of necessity involves the illustration of the means used in raising the surface, the use of teazles both by hand and by machine, and the convenience and faults of the various mechanical contrivances which are employed as substitutes.

Thirdly, the Museum should show progress. It should contain specimens of raw and manufactured articles of known age, for the purpose of comparison with those of the present time, in order that the precise kind of improvement effected may be accurately known and estimated—an element which is quite essential in any attempt to generalise, or to arrive at correct conclusions as to the future progress of any art.

It is almost superfluous that I should point out the necessity of good arrangements in such a Museum, or that I should insist on the importance of the specimens being properly shown, properly preserved, and carefully labelled; it is obvious that much of the practical value of the Museum would depend on these matters. The labels in particular are all important; they should at once express clearly and distinctly the nature and state of each article, and the specimens should be accompanied by maps and drawings illustrating those matters which cannot otherwise be explained. Thus, the cultivation of rice, tobacco, and sugar, needs drawings to show the peculiar modes of tropical farming, and the methods adopted for irrigation; whilst the Sea Island cotton, in addition to these, should be accompanied by maps showing the peculiar geographical conformation of the lands in which it is grown. Lastly, the information conveyed by the

specimens and their labels should be extended and completed by a good descriptive catalogue, which should contain all those further commercial, scientific, and statistical facts necessary to the complete elucidation of the history of each substance, its production, and its uses.

In order to be practically useful, such a Museum should be situated in London, within reach of merchants and others likely to desire that information which it would be calculated to give; but I conceive, in order to render it thoroughly useful, it ought to be made a centre for the dissemination of technical knowledge, and for aiding local museums in all parts of the country, and indeed in the colonies also. When, for example, a specimen of any new sort of produce was received, it should, if possible, be divided into several portions, one to be preserved in the best possible manner for future reference, whilst the remainder should be employed in practical experiments, and sent to other similar establishments in the manufacturing towns and elsewhere.

It would be difficult perhaps to obtain at all a completed collection in illustration of the progress of any of the older arts and manufactures, though a vast number of valuable illustrative specimens might no doubt be collected; it would, however, be easy to record the present state of the arts, and the specimens collected for this purpose would soon become historical, and the work which now might be completed with comparatively little trouble, would in a few years become as difficult as it now is to collect records of the progress of the last century.

I conceive that the Museum should be essentially progressive: that it should always show the most recent improvements in each art; but that the illustrations of the progress of past years should be carefully preserved for reference, as in many instances most valuable information may thus be derived.

In this brief detail of the chief objects which I conceive should be borne in mind, in carrying out the formation of a General Trade Museum, I am aware that the scheme is a large one, and one involving much labour and considerable expence; but I feel that the objects contemplated are all of importance, and that though it would be of much value if only part of it were carried out, yet that while collecting materials for one portion, a very little more trouble would enable us at the same time, also, to collect those for all the other departments of the Museum. Such an establishment would be of the greatest practical value to merchants and manufacturers, and would supply them with information, the importance of which can hardly be too highly rated. I have, during the past few months, had many examples of the superiority of illustrative specimens over mere printed descriptions; for I have had many visits from practical men, who, though in the outset they have said, "*your Museum would be of no use to us*," have, nevertheless, after a little discussion, and above all after examining specimens in illustration of special arts, gone away in a very different spirit, saying—"*I have learned some practical facts which I never knew before, and which will be of considerable use to me.*"

But it is not only to merchants and manufacturers that such an establishment would prove of value; let me remind you of the innumerable technical questions which have arisen during the past year alone, respecting the productions of those countries which border on the Baltic and the Black Sea. How valuable a complete collection of the coals of Asia Minor, accompanied by scientific and statistical information, would have been, when first the question of supplying our steam fleet in the Black Sea with coals was under consideration; and how useful would the Trade Museum have been, when the relative value of different kinds of preserved and portable food was being discussed, had there existed an authorised establishment in which specimens of these various articles had been deposited and exposed to varied circumstances for a definite number of years?

In conclusion, let me state very briefly what has been done towards the commencement of such a Museum. You are aware that the Council acting with the sanction and co-operation of Her Majesty's Commissioners for the Great Exhibition, determined to form a collection of animal produce and illustrations of those arts in which animal substances are employed, and in this work I have for some months been busily occupied. A portion of the collection is now arranged in the model room, and will remain open to the members of the Society, and to the public, for some time, during which, I trust some determination will be arrived at as to the future progress and destination of the Trade Museum of which this forms the commencement.

I must remind you that the state of affairs, both political and commercial, all over Europe, for the last year, has been peculiarly unfavourable to the collection of foreign produce and manufactures, and that I have had great difficulties to contend with in the collection of specimens and the formation of anything approaching to a tolerably complete series of the chief animal substances used in the arts. As regards the collection now in the model room, it has been arranged with extreme haste, the late exhibition of inventions having rendered it impossible to commence the disposal of the animal collection till a few days ago, whilst the very limited accommodation afforded by the room, has rendered it necessary to exclude a very large part of the collection, some portions being altogether unrepresented. The specimens must be considered as being only temporarily grouped together, and not arranged as they would be in a permanent museum. The collection is numerous, and complete enough to show the practical nature of such a museum, and to illustrate some of the kinds of knowledge which it would convey, and some of the purposes to which it might be applied: and I would only, in conclusion, express an earnest hope that the commencement thus made by the Society will be taken up with spirit, and prosecuted with energy. That the Museum will be thoroughly appreciated ere long by practical men, I entertain no doubt whatever; and I may truly state, that the most difficult part of the undertaking, the formation of a nucleus, is now accomplished; it will be far less trouble to supply the deficiencies in the animal series, and to complete the other departments of the Museum; and from the numerous and increasing promises of aid which have lately been made, I feel confident that there will be no difficulty whatever in fully carrying out the formation of the General Trade Museum, as soon as the permanent establishment of such a collection, and its location in a suitable place shall be decided on.

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Dr. Lyon Playfair, C.B., said, he had great pleasure in rising to propose a vote of thanks to Professor Solly for his interesting paper, and they would, he was sure, consider it as a vote of thanks well due to him when they had seen the interesting collection down stairs, and which he was informed was only a small part of the collection which was already the property of this Society jointly with the Commissioners for the Great Fxhibition of 1851, for he had been told by the Secretary, that out of 400 cases, only about 160 were represented down stairs, owing to the circumscribed space which was available for the Exhibition; so that after they had inspected what was enabled to be displayed, they might form an idea of the value of the remainder of the collection. The great importance of such a museum must be apparent to all. In this great metropolis they had two museums, one representing the economic applications of minerals to the useful purposes of life, situated in Jermyn-street, and designated the Museum of Practical Geology, and the other, representing the economical applications of botanical substances, situated at Kew. They were sadly wanting in a museum which should represent the industrial applications of animal products, and this was the first time that desideratum had been supplied in this or in any other country. It was to be remarked in the

first place, with regard to the scientific collections of this country, that they were scattered and separated, and in the second place, they did not bear upon the industrial application of the products exhibited; and, therefore, to all those who wished to study first the science and secondly the industrial applications of the products, so that they might be enabled to make the comparison necessary in such a pursuit, some means of collecting these products together in a convenient form, and in a suitable place, was of very great importance. Our museums might be said to have out-grown themselves; and it was, therefore, indispensable that they should have a centre in which science should lead on to the industrial applications, to the useful purposes of life. This had been one of the greatest wants of the country, and one which this Society had now the opportunity of putting their shoulders to the wheel to remedy, for in about six weeks time they would be called upon to say what was to become of the very interesting museum down stairs. He had only gone over the collection cursorily, but he was astonished at it. Knowing much of the skill and ability of Professor Solly, he had expected much, but he had formed no idea of so complete a collection as he (Mr. Solly) had succeeded in realising. He thought it promised to be one of the greatest importance, and Professor Solly deserved the highest credit; but, as he had before said, in less than two months—as the Society would then require their room again for other purposes—they would be called upon to decide whether it was to be packed up and stowed away in a damp cellar to rot, as had been the case with some other collections, which he need not now specify. The consequence was, that if they did not look after this collection, all the great amount of labour that had been bestowed upon it would be lost to the public; and, therefore, it was essential that they should find some means of making this collection not only available to the public, but giving it good house-room; and he did not know how that was to be had unless the public moved in the matter. As to the importance of the museum he would not say a word, except to point attention to the skilful manner in which Professor Solly led from the raw material to the manufactured products, and the care which he took of the waste products, exhibiting the various shapes in which those hitherto waste products were again brought into the useful purposes of life, so that nothing was, in fact, waste—which was the great point for science to attain. They would shortly have an opportunity of witnessing this collection, and he would therefore conclude with moving a vote of thanks to Professor Solly for his interesting paper, and they would also consider it as a vote of thanks for the great success which had attended his efforts to establish the first museum of the useful products of animal life.

Sir John Boileau, Bart., said he had been asked to second the vote of thanks to Professor Solly, and he did so with great pleasure, because he thought nothing could be more desirable than that the opening of a Trade Museum should have been prefaced by a paper such as they had just heard. That paper pointed out to the public, in the first place—and it must reach to all governments—that the most desirable thing for trade was that it should be left free and unfettered; that any attempts at prohibition on the part of foreign countries, on the one hand, or to prop up trade by favourable circumstances in our own country, on the other hand, were sure to cripple energy, and in the end be hostile rather than beneficial to the true interests of trade and commerce in any country. He thought they were much indebted to Professor Solly for having brought before the notice of manufacturers that they were best serving their own interests when they did not lend themselves to mystery and concealment; but when they threw open every circumstance connected with their trade, by which information was gained for themselves, and their own ends were forwarded. He believed the Society of Arts had gone to a considerable expense in raising this Trade Museum, and with the funds at their disposal they could not be expectad to go beyond what they had done. What could be done had been done fairly and with very great energy and great zeal on the part of Professor Solly, aided by the Council of this Society; but he (Sir John Boileau) feared, with the learned gentleman who had proposed the vote of thanks, that unless some great exertion was made, all the results would ultimately perish, because it was impossible that such articles as composed the collection below could not but be injured unless they were placed in some proper and favourable locality. He was not there to say where that locality should be or how it was to be obtained. Had he the power to do so he would be very glad to exert it. He only wished to press upon the meeting that they ought to make an exertion, if possible, to obtain from the government some place where this exhibition might form the nucleus of a more extended museum, and if they could not succeed in that, he would express his individual hope (for he had no authority to make any statement on the part of the Society), that the known liberality which existed throughout this country, and in the strong desire which prevailed to forward that which was beneficial to the public, individuals would come forward and find some locality, in the event of the government failing to do so, where this great step in the advancement of the trade of the country should not perish, but should remain and increase, and prove a permanent benefit to the public at large.

The vote of thanks to Professor Solly, having been carried by acclamation, was presented to that gentleman by the chairman in the name of the meeting.

The Secretary announced that the paper to be read on Wednesday next, the 30th inst., which would be the last ordinary meeting of the present session, was "On Earth-Boring Machinery," by Messrs. Mather and Platt.

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After the meeting the members and visitors proceeded to the Model Room to examine the collection, of which the following is an

## EXPLANATORY MEMORANDUM,

*Descriptive of the Selections of Samples of Animal Produce and Manufactures, now exhibiting in the Model-room of the Society of Arts, and forming part of the* Trade Museum, *Animal Department, undertaken by the Society with the sanction and co-operation of Her Majesty's Commissioners for the Great Exhibition of* 1851.

The collection is designed as the commencement of a general Trade Museum, or collection in illustration of the productions, industrial resources, manufactures and commerce of all countries. The portion now brought together is confined to Animal products alone. In consequence of the extent of the collection, and the limited space which could be devoted to it, it has been found necessary to exclude many articles altogether, and leave out many important illustrations in each series. The following brief memorandum is prepared for the purpose of given a general idea of the scope and nature of the collection, and the order in which the specimens have been arranged. The division employed is merely a technical one, adopted for convenience of classification; the mode of arrangement was necessarily suited to the form and appliances of the room. The series commence at the south-east corner of the room.

### 1.—Wool Series.

Extending along the whole of the south and west sides of the room, and including fleeces and samples of all the chief varieties of Wool, British, Colonial, and foreign; illustrations of the manufacture of most woollen fabrics, dyeing of wool, samples of broad and narrow cloths; tweeds, Tartans, flannels, felts, cords, &c.; Coburgs, merinos, lastings; alpacca and mohair fabrics, plush, moreen, damask, carpets, fancy wools, &c. Pilots, peter-

shams, witneys, shoddy manufactures, manufacture of woollen paper, and flock paper.

2.—Silk Series.

Arranged along the north side of the room; including the silk-worm and its economy; the wild silk-worms of India, allied moths, cocoons. Raw silk, British, Colonial, and foreign—organzine, thrown, and tram silks; silk-dyeing—weaving plain silks, Persian, sarcenet, gros de Naples, watered silks; satins, velvets, fancy weaving, the Jacquard loom, fancy silks, silk poplins, silk damasks, ribbons, silk laces, trimmings, small wares, buttons. Manufacture of waste silk—silk hat making. Historical specimens showing the progress of silk-weaving.

3.—Skin Series.

Arranged at the north-east corner of the room; consisting of raw skins, the various astringent substances used in tanning; specimens of the chief varieties of leather; tanners' tools, leather dressers' tools, tools used in currying leather. Uses of leather—boot and shoe making; manufacture of lasts by hand and by machinery; leather, silk, and satin boots and shoes. Bookbinding, tools used; illustrations of bookbinding, showing the progress of the art. Glove-making. Saddlery,—saddlers' and collar-makers' tools. Manufacture of parchment; tools used, and process employed. Gold-beaters' skin. Manufacture of glue.

4.—Horn and Bone Series.

Grouped together on the east side of the room; including the horns of the ox, buffalo, deer, rhinoceros, &c. Manufactures of horn; comb-making, drinking-cups, buttons, &c. Tortoiseshell, its manufacture, tools used, &c. Bone, manufacture of tooth-brushes. Teeth. Ivory, fine and common turning. Narwhal and other tusks used as substitutes for ivory, &c.

5.—Fur Series.

Placed south of the horn and bone series. Specimens of some of the chief furs used for ornament, clothing, or furniture; illustrations of their uses.

6.—Bristle Series.

Immediately below the fur series; including the chief varieties of bristles imported; and illustrations of their use in brush-making. Household brushes, hair brushes, of wood and ivory, tooth brushes, artists' brushes, painters' brushes and tools. Illustrations of different modes of brush-making.

7.—Feather Series.

Arranged on the central horse-shoe table beginning at the north-east pillar. Samples of all the chief kinds of feathers used in upholstery; illustrations of their purification. Manufacture of writing quills. Manufacture of artificial flies for fishing. Use of feathers for ornament, feather flowers.

8.—Horsehair Series.

Placed on the centre horse-shoe table at the south-east pillar. Horsehair, of all kinds, as imported. Illustrations of its chief uses, manufacture of horsehair seating, dyeing of horsehair, horsehair for brushes, horsehair buttons, horsehair pressing cloth, crinoline, and stock stiffening. Horsehair ornaments.

9.—Lac Series.

Arranged on the cross table between the two south pillars. Samples of all the varieties of lac, as imported. Manufacture of lac dye, bleaching of lac, manufacture of sealing-wax, preparation of lake, &c.

10.—Wax Series.

Placed opposite the fur series. Wax of all countries, bee-hives, and bees, bleaching of wax, manufacture of wax candles, colouring of wax, artificial wax flowers. Chinese wax, &c.

11.—Oil Series.

Adjoining to the wax series; including the chief oils and fats used in the arts. Their purification; manufacture of soap and candles, stearine, stearic acid, &c.

12.—Shell Series.

Placed opposite the horn series. Mother-of-pearl shells, as imported, and the same cut and polished. Uses of shell for ornament, inlaying on papier-maché, &c.

13.—Refuse Matters.

Arranged on the shelves adjoining to the shell and oil series. Refuse animal matters derived from the previously illustrated arts, showing the uses to which they are applied. Manures; manufacture of ammonia, prussiate of potash, phosphorus, &c.

*** Several of the minor series are not exhibited for want of space.

## SUPPLY OF CAOUTCHOUC.

Mr. Thos. Hancock, in a letter to the *Gardener's Chronicle*, calls attention to the vast and increasing consumption of caoutchouc, owing to the numerous new applications of it both here and in other countries. He says:—"The supply has hitherto been equal to the demand, but as the best quality is obtained from South America, and I believe from the *Siphonia elastica*, I beg to inquire whether this plant may not be cultivated in Jamaica and the East Indies, and if so whether attention should not be called to it in due time, since any chance that may obstruct the trade or diminish the supply, if obtainable only from one source, may cause great inconvenience. * * * It is clear that whether obtained in the solid or liquid state, this substance is destined to take an important place in the manufactures of this country;" and he desires to direct the attention of competent persons to the cultivation of the plant in our own colonies and elsewhere.

## TEMPERING OF STEEL.

In the discussion on Mr. Sanderson's paper, "On the Manufacture of Steel," an inquiry was made as to the kind of steel suitable for particular articles, and how its quality might be tested. This gave rise to the remark that the tempering of steel depended on the skill and experience of the workman. Mr. Harry Scrivenor, of Liverpool, has, however, obtained from a clever workman the following memoranda on the subject:—

"I received your letter inquiring what steel was best for different kinds of manufactures. I should say cast-steel, if it can be applied; double shear for hatchets, or any kind of edge tool that cannot be well made of cast-steel. The temper to be as follows:—

"1st. For boring cylinders, turning rolls, or any large cast iron, let it be as hard as water will make it, minding not to heat it more than a cherry red.

| | Degrees. Fahr. |
|---|---|
| 2nd. Tools for turning wrought iron, pale straw colour | 430 |
| 3rd. Small tools for ditto, shade of darker yellow | 450 |
| 4th. Tools for wood, a shade darker | 470 |
| 5th. Tools for screw taps, &c., still darker straw colour | 490 |
| 6th. For hatchets, chipping chisels, brown yellow | 500 |
| 7th. For small rimers, &c., yellow, slightly tinged with purple | 520 |
| 8th. For shears, light purple | 530 |
| 9th. For springs, swords, &c., dark purple | 550 |
| 10th. For fine saws, daggers, &c. dark blue | 570 |
| 11th. For hand and pit saws &c., pale blue | 590 |

"The temper greatly depends on the quantity of carbon that is in the steel—this the practical man soon finds out, and he tempers or draws down his tool accordingly."

## Home Correspondence.

### REFORMATORY SCHOOLS.

Sir,—Having been obliged to leave on Wednesday evening before I had an opportunity of speaking, I hope you will favour me with space for a few remarks.

The terms *harsh* and *vindictive* were much employed by some, in reference to the infliction of punishment on young persons convicted of crime, before they are sent to a reformatory school. I think, sir, that these terms ought not to be so applied. No one proposes that punishment should be administered in a vindictive spirit. If such views ever were entertained by any, they are now universally abandoned. All are agreed that the only legitimate object of punishment inflicted by man is, to deter from the commission of crime. And so also with the terms *cruel, harsh;* no one desires that punishment should be in the least degree more severe than is necessary to effect its object; no one desires to injure the health, bodily or mental, of the individual subjected to punishment; our only objects are to prevent him who is punished from repeating the offence, and by the example of his punishment to deter others. I conceive, therefore, that while it may be a fair subject of question, whether certain kinds of punishment may not be unnecessarily severe or injurious to health, the use of such terms as "harsh" and "vindictive," is a complete misrepresentation, or begging of the question.

Much stress is also laid on this argument—that it is unjust or unfair to punish young persons who may be considered as having acted without discernment, and who have been placed in circumstances in which it was next to impossible to avoid being led into crime. This ground appears quite untenable if we view the object of punishment rightly, as simply preventive. Our proper inquiry, then, is, not whether the individual was or was not conscious he was acting wrong, not whether he could or could not have avoided committing the offence, but whether punishment is not necessary for the protection of society, by deterring the individual himself, or others. Even if it can be shewn that the youth convicted of crime could be thoroughly reformed without the infliction of any punishment, society is still justified in punishing for a breach of its laws, if the absence of such punishment may lead others to crime. We are continually led astray in such questions by the endeavour to carry out certain refinements, suitable for some, but as yet very unfit for the generality—by the endeavour to push certain abstract principles into summary operation, and make them override considerations of expediency in existing circumstances. Society condemns to hard labour, to perpetual imprisonment, or takes away life, in its own protection; we deliberately inflict pain on the unintelligent brute creation with the view of training them to or from certain habits; the tender parent uses the same apparently harsh means to bring the unintelligent infant to a right course of conduct; surely, when we consider these things, we must admit that however reasonable and humane it may be to make every possible allowance for circumstances which have forced a child into crime, it is rather going too far to urge society to abandon, on such grounds, a powerful means of preventing crime. Abstract natural rights are given up, as Burke says, when men enter into society, and "the whole organization of government becomes a consideration of convenience."

Connected with this subject, it was asserted by one of the speakers that the notion is fast dying away that it is impossible to conduct schools without "this sharp punishment," referring, I suppose, to corporal punishment. This is not the place to discuss this subject, but I do not think the notion alluded to is dying away. Schools are now, happily, conducted without that frequent, violent, and barbarous corporal punishment which prevailed in old times; and some select schools, I admit, may be successfully conducted without this sharp means of maintaining discipline. I believe, however, the generality of teachers will agree with me, that in most schools where corporal punishment is entirely abandoned, the discipline is lax, the progress of all (except a few of the best) inferior, and the tear and wear of the teacher very great.

We are in this dilemma, sir, as to reformatory schools. If we desire to effect a thorough reformation, we must touch the heart by a kind parental treatment; if made thus agreeable to the inmates, they operate as an inducement to the commission of crime.

That a kindly treatment is necessary, if we desire to produce a thorough reformation, is proved alike by theory and by experience. If we inquire into the circumstances of those children of all classes that do not become criminal, we shall find that they are placed above the reach of want, that their time is occupied by some useful pursuit, that religious influences are brought to bear on them, and that they are operated on individually by the influence, advice, conversation, and example of affectionate and intelligent parents. These are the causes which, acting during a long series of years, generate a character and habits which preserve our youth from vice. Is it not reasonable to suppose that if we place young offenders in similar circumstances, as nearly as may be, we may reclaim very many of them, and send them forth to be useful and creditable members of society? And accordingly, experience confirms this opinion. At the great reformatory institutions of the Rauhen-haus, near Hamburgh, and at Mettray and Petit-Bourg, in France, it is found that from 80 to 90 per cent. of those sent out have been thoroughly reclaimed, not more than 10 to 20 per cent. relapsing into vicious courses; and as these institutions are but in their infancy, it is not unreasonable to hope that they may in time be attended by a still larger measure of success. They have attained the great success that has hitherto characterised them by making the nearest possible approximation to the method of a well-regulated family,—a small number of youths (from 12 to 20) being under the direction of one "father," or "chief," and constantly under his eye. Education for a few hours daily, industrial occupation, religious training, and unremitting friendly or fatherly influence of the "father" or "chief," continuing from periods varying from two to five years, with assistance in procuring a situation at leaving, and the continuance of friendly intercourse afterwards by correspondence and occasional visits, are the means by which, in these celebrated institutions, four-fifths of the youth trained in them have been permanently reclaimed from vicious courses, and rendered useful and respectable members of society.

There cannot be a doubt, from the experience of these institutions, and of our own reformatory schools, that the preceding reformatory methods may be rendered thoroughly efficient for their purpose; and the great fact is thus established, that young offenders may be reclaimed; and it is further established, that this may be done at an expense very far below what they will cost the country if permitted to run their usual course of vice and crime.

But there is too much reason to apprehend, with Mr. Symons, that the comfortable and happy condition of the inmates of these reformatory institutions may operate as direct inducements to the commission of crime. No satisfactory answer seems to have been given to what was so forcibly stated by Mr. Symons and Mr. Elliot on this head. Lord Lyttelton, indeed, urged that it is "in itself a punishment to a child who had been brought up all his life in lawless habits, to be taken to one of the reformatory institutions, where he was obliged to conform to habits of regularity, and to pursue a system of hard labour only." And in an able article on the subject in the last number of the *Edinburgh Review*, this is the only answer given to the objection in question,—a very insufficient reply, for it is only a conjecture at best; and it is certainly at variance with everything we know

of human nature to suppose that numbers of those in the wretched and precarious condition which tempts to crime, will not look with longing eyes on the secure, comfortable, and happy homes which the reformatory institution holds out; that is, if it be one such as I have spoken of as alone capable of effecting a thorough reform.

The evil, I apprehend, cannot be entirely removed. As a measure of economy, policy, and humanity, we must have reformatory institutions; and to do their work well, they must be made, on the whole, agreeable to the inmates. To palliate the evil of the temptation to crime thus held out, only two means appear likely to have any considerable effect,—*first*, "a due prefatory period of punishment for the offences of which they are convicted," as advocated by Mr. Symons; *secondly*, wherever it is possible, holding the parent responsible for the child, and making him contribute to its maintenance in the reformatory institution.

In conclusion, I would urge upon all who are interested in this subject the study of the methods that have been so successful in Switzerland, Hamburgh, France, and Germany. It is not in large establishments, with hundreds under a few teachers or superintendents of work, on the wholesale principle of "slumping 'em all together," that the work of reforming the heart and habits can be carried on. In this great and difficult task, we must operate on the individual by placing a few under the constant, kind, and anxious care of one who acquires their love and esteem. It is thus that in the family children are preserved from vice; it was thus that Wichern and Demetz met with their extraordinary success; and we must follow these great examples if we would not lose our time, and pains, and cost, by sending them forth half-reformed, ready to relapse into vice on the first temptation.

I am, Sir, yours, &c.

HUGO REID.

Greenwich, May 7, 1855.

## PRINCIPLE OF A DECIMAL COINAGE.

Sir,—An opinion is widely spread, even amongst those who are friendly to an alteration in our currency, that the adoption of a decimal system will require the use of *decimal fractions* by those who keep accounts. That this opinion is unfounded will be seen from the following observations.

A *perfectly* decimal notation of money, weights, and measures should be identical with that of abstract numbers, only adding the word cash, weight, length, surface, or solid, &c.

NOTATION TABLE.

| | | |
|---|---|---|
| Unit........................... | 1 | a cash, a weight, &c. |
| Ten ........................ | 10 | ten cash, ten weights, &c. |
| Hundred ............... | 100 | a hundred cash, &c. |
| Thousand............... | 1,000 | a thousand cash, &c. |
| Ten thousand......... | 10,000 | ten thousand cash, &c. |
| Hundred thousand | 100,000 | a hundred thousand cash, &c. |
| Million ............ | 1,000,000 | a million cash, &c. |

Instead of *several* units of cash, weights, or measures, there ought to be in accounts but *one* unit, to correspond exactly with the preceding table.

The *coinage*, on this principle, should be adapted to the notation, instead of the notation being made to agree with any particular system of coinage.

The unit of cash being determined on, every piece of money should be stamped with *the number of cash* it represents, as 1-cash, 5-cash, 10-cash, &c. Arbitrary names for coins are unnecessary, since all accounts would be legally rendered *in one denomination only*, namely, "cash." The names pound, shilling, &c., would still be popularly applied, but would appear in calculations as so many "cash;" for example, 1000-cash, 50-cash, &c., respectively.

The *coins* should severally represent the simple factors of 10, or multiples of them by the powers of 10; as 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, &c.

The stumbling block in the way of decimalising our present currency is the impossibility of obtaining a unit which will comprise the penny and the pound in the same system, without altering the value of one or the other. It will be seen in Table I., that if the penny be left unaltered, the pound sterling will have to be excluded from the decimal system, and also the present silver and gold coinage will have to be withdrawn.

Table II. shows that but a slight alteration in the value of the penny sterling is required, to include decimally not only the pound, but nearly all the other existing coins.

TABLE I.

12 pence = 1 shilling; 240 pence = £1.

Existing relation between *penny* and *pound* undisturbed.

| 1. | | | 2. | | | 3. | | |
|---|---|---|---|---|---|---|---|---|
| Units. | s. | d. | Units. | s. | d. | Units. | s. | d. |
| 1 | 0 | $0\frac{1}{4}$ | 2 | 0 | $0\frac{1}{5}$ | 5 | 0 | $0\frac{1}{4}$ |
| 2 | 0 | $0\frac{1}{2}$ | 5 | 0 | $0\frac{1}{2}$ | 10 | 0 | $0\frac{1}{2}$ |
| 5 | 0 | $1\frac{1}{4}$ | 10 | 0 | 1 | 20 | 0 | 1 |
| 10 | 0 | $2\frac{1}{2}$ | 20 | 0 | 2 | 50 | 0 | $2\frac{1}{2}$ |
| 20 | 0 | 5 | 50 | 0 | 5 | 100 | 0 | 5 |
| 50 | 1 | $0\frac{1}{2}$ | 100 | 0 | 10 | 200 | 0 | 10 |
| 100 | 2 | 1 | 200 | 1 | 8 | 500 | 2 | 1 |
| 200 | 4 | 2 | 500 | 4 | 2 | 1000 | 4 | 2 |
| 500 | 10 | 5 | 1000 | 8 | 4 | 2000 | 8 | 4 |
| 1000 | 20 | 10 | 2000 | 16 | 8 | 5000 | 20 | 10 |
| 960 = £1 | | | 2400 = £1 | | | 4800 = £1. | | |

TABLE II.

50 farthings = 1 shilling; 1000 farthings = £1.

Relative value of farthing reduced 4 per cent.

| 4. | | 5 | | 6. | |
|---|---|---|---|---|---|
| Units. | | Units. | | Units. | |
| 1 | 1f. | 2 | 2f. | 5 | 1f. |
| 2 | 2f. | 5 | $2\frac{1}{2}$f. | 10 | 2f. |
| 5 | 5f. | 10 | 5f. | 20 | 4f. |
| 10 | 10f. | 20 | 10f. | 50 | 10f. |
| 20 | 20f. | 50 | Sixpence | 100 | 20f. |
| 50 | Shilling | 100 | Shilling | 200 | 40f. |
| 100 | Florin | 200 | Florin | 500 | Florin |
| 200 | 4 shillings | 500 | Crown | 1000 | 4 shillings |
| 500 | Half sov. | 1000 | Half sov. | 2000 | 8 shillings |
| 1000 | Sovereign | 2000 | Sovereign | 5000 | Sovereign |
| 1000 = £1. | | 2000 = £1. | | 5000 = £1. | |

By increasing the value of the copper money twenty per cent. a third table might be formed, which would give 100 units = 6d., and 1000 units = a crown.

It will be easily seen that every "system" which has been proposed approximates more or less to one or other of the above schemes. The late Mr. Laurie's plan will be recognised as a near approximation to Number 2. The balance of advantages, however, seems decidedly in favour of Number 4, which requires no alteration in the coinage. We have only to recollect, in popular terms, that the penny-piece is to count for *five farthings*, and a shilling for *ten pennies*. Thus we have the following:—

SCHEME FOR A DECIMAL CURRENCY, TO INCLUDE THE EXISTING COINAGE.

The unit of account (a "cash") to represent $1\frac{3}{4}$ grains of silver. Its copper substitute to weigh 40 units, *i.e.*, 70 grains.

100 Cash to make 1 Cent, or Florin.

10 Cent to make 1 Mil, or Pound.

| COINS. | | VALUE. |
|---|---|---|
| COPPER— | | |
| Farthing | May remain current, and count as . . | 1 Cash. |
| Halfpenny | | 2 ,, |
| Penny-piece | | 5 ,, |

| | | |
|---|---|---|
| SILVER— | | |
| 10-Cash piece, to count as | 10 | „ |
| 20-Cash piece | 20 | „ |
| 50-Cash (Shilling) | 50 | „ |
| CENT* (FLORIN) | 100 | „ |
| 2-Cent piece | 200 | „ |
| GOLD— | | |
| 5-Cent (Half Sovereign) | 500 | „ |
| MIL (POUND) | 1000 | „ |

The "sixpence," halfcrown, and crown may continue in circulation as temporary coins, counting 25, 125, and 250 respectively.

Since the copper tokens merely serve as counters, with little or no relation to the intrinsic value of copper; the penny-piece being made to count for *five*, instead of *four*, would cause no pecuniary disturbance, while the advantage, decimally considered, would be immense. Two half-pence, or four farthings, will still represent a penny *sterling*.

I remain, sir,
Your obedient servant,
SAMUEL A. GOOD.

H.M.Dockyard, Pembroke Dock, April 30, 1855.

* The application of the words "cent" and "mil," as brief synonyms for "hundred" and "thousand" respectively, might be extended with advantage to weights and measures as well as to cash, *e.g.*,

100 weights make 1 cent.
10 cent make 1 mil.

So that, adopting the *unit of weight* proposed by me in the Journal of the 2nd of June last, a "mil-weight" would equal 4 oz.; and four "mil-weights" a pound avoirdupois. A uniform mode of expression might thus be made to prevail throughout the whole decimal system.

## REMARKS ON MR. EDWIN CHADWICK'S VIEWS ON INDIAN IRRIGATION.

SIR,—Colonel Cotton applied a very happy and strictly parliamentary epithet to Mr. Ayrton's crude notions on irrigation, when he called them "curious," but the Indian lawyer was outrun by Mr. Edwin Chadwick's closing speech on the same subject. Mr. Chadwick gravely proposes that the main and lateral channels of Indian irrigation works, when not used for navigation, should be arched over, or turned into tubular drainpipes, and that the water should be applied to the land by a hose and jet, worked, I presume, by steam-power where the power of gravity is not sufficient; and he takes his examples from South American and Persian valleys, and two or three strictly exceptional fancy farms in this country. Why, even if the system were (except in dairy farms) profitable, he might just as well recommend that the Indian peasantry should be clothed in high-lows, leather leggings, and smockfrocks, and that half-a-dozen of Howard's ploughs, and one of Crosskill's clod crushers should be supplied to every five hundred acres in the Godavery delta before any cultivation was permitted.

It is quite clear to me, who have seen the best specimens in England of irrigation by water meadows and liquid manuring by hose and jet within the last twelvemonths that Mr. Chadwick's ideas on the subject are derived from experiments on the smallest scale in flower-pots and cucumber-frames with a hand squirt.

Just look at the magnitude of the undertaking—twelve hundred thousand acres of flat land are irrigated in the delta of the Godavery in less than two days by minor streams led from one thousand miles of water communication. With no other help than their rude ploughs and hoes the Indian cultivators manage to lead the water through every yard of their fields—this water, heavily charged with alluvial soil, acts both as manure and refreshing rain for grain crops, seeds, trees, &c. The land is simply moistened from time to time, *for rice it is essential to keep* the ground covered with a thin stream for many successive weeks.

To water 1,200,000 acres would take something like 7,000 miles of drains and pipe, joined and laid most skilfully at the exact inclination required for a continuous flow. If it were possible to find the money, and the pipes, and the workmen, the pipes would be filled up in less than a month in numberless directions by the soil in solution which forms the manure. Instead of the Indian with his hoe, leading the stream as he wanted it, there must be forty or fifty steam engines, and the native peasant, who can with difficulty be induced to use a European corn mill or wheelbarrow, or any European instrument, is to have, instead of a hoe, a hose and jet put into his hand. At present the whole delta can be watered in two days; how long it would take to squirt the water required through an inch bore pipe, I must leave the Board of Health to calculate. But after all, no pipes, hose, and steam jets, however perfect, can supersede the water meadow system for rice meadows or for grass meadows, because quantity and covering are essential. As to India, it is quite unnecessary to discuss the question. To do anything on a large scale we must work with the tools of the country, and although we may introduce into main channels of irrigation, any works suggested by the modern lights of science and experience, we must let the Indian cultivators work in their own way if they are to raise any crops at all.

The probability is that Mr. Chadwick, whose ability no one can dispute, although it is lamentably dimmed by the credulity with which he accepts any evidence from any quarter favourable to his views, was not thinking seriously of India at all, but of England, where for some ten years he has been labouring, without making any real progress, to substitute liquid manure for solid, and town sewage for the portable manures we owe to the guano islands and the discoveries of our chemists. This inference is borne out by his having inserted in the report of his speech a table, which has already done duty in the collection of fallacies issued by the Board of Health as "minutes on the subject of sewer water and town manure." This table can have no possible bearing on Indian irrigation, where the style of agriculture is as different from English agriculture as the cost of labour of coal and iron are from English prices.

This table was prepared by Mr. Superintending-Inspector Lee, in December, 1851, since which many remarkable changes have taken place. I have followed in Mr. Lee's footsteps over some of the principal farms mentioned, and have found his calculations, and still more his conclusions, based on statements as hypothetical as those of a traffic-taker for an intended railway. As this table has been circulated in the *Journal of the Society of Arts* as an "official document," when it really deserves no more weight than as the opinion of an engineer in the employ of the Board of Health, I have a right to dissect it.

First, then, the Duke of Sutherland's Trentham farm, quoted as an example of hose-jet irrigation, was incomplete, and had produced no results when Mr. Lee visited it, consequently, his calculations of the expense are mere guess-work. Mr. Lee has put down just what he pleased for machinery, coals, and wages of labour, so of course he obtains exactly the annual expense he requires. The next instance is Halewood, Mr. Neilson's farm, and there I will be content with saying that none of Mr. Neilson's friends will think of referring to Halewood as an instance of successful farming. Next comes Liscard. I was at Liscard last year. The whole arrangements of that farm —a pretty fancy farm—were designed and executed under the direction of a friend of mine, Mr. William Torr, the well-known short-horn and Leicester sheep breeder, of Aylesby, in Lincolnshire.

At Liscard liquid manure is only employed for growing Italian rye-grass, distributed by hose and jet. Not a drop is applied to corn, although it might with ease. Mr. Littledale largely employs solid farm manure, guano, and phosphates, on his. Mr. Torr has laid out several

other farms, besides two which he farms himself at Aylesby, where he has remodelled and rebuilt all the farm buildings. He has not, either in his own or in those he has designed for others, adopted the pipe and jet system, because, he told me, "it would not pay, except for growing a mass of green crops for a dairy." Now Mr. Torr is not only a modern improving farmer, but a very clever mechanic. For further particulars I refer your readers to the discussion on the subject of the cost of liquid-manure irrigation, at the Royal Agricultural Society's Rooms, last year, when the late Sheriff of Lincolnshire reported on the cost of irrigation on the Scotch farms.

As to Mr. Lee's capacity to form an opinion on agricultural irrigation, I will only mention one illustration of it. I was at Exmoor water-meadows, mentioned in his report, three years after his visit. There a spring, brought from a hill above the farm, has been made by my friend, Mr. Robert Smith, to irrigate about eighty acres of a sloping hill behind the grange, after imbibing the manure of the farmyard and house, with admirable effect on the grass. Eighty acres are flooded in a quarter of an hour with no other machinery than a man, two boys, and three spades, as the water flows always down hill. Mr. Lee, like Mr. Chadwick, has such a superstition in favour of tanks, pipes, and hose, that he actually recommended Mr. Smith, much to his amusement, to substitute elaborate machinery for his effective rivulet running down a hill. He repeats the same suggestion in the report I have been dissecting. It must be noted that Mr. Smith confines his liquid manure stream to grass crops—roots and oats he treats with solid. In the report on Somersetshire, published by Mr. Thomas Acland, a member of this Society, and one of the Editors of the Journal of the Royal Agricultural Society, he describes water meadows made at from 20s. to £5 per acre.

The official reports of the Board of Health, quoted by Mr. Chadwick with an authority to which they have no title, would lead to the conclusion that the use of liquid manure, underground pipes, hose, and steam-jet are rapidly superseding water-meadow irrigation, solid farmyard manure, and the portable manures of Peru and of chemists. This is not the case. Never was there a time when farmers more readily and more rapidly adopted real improvements, whether chemical or serial; but the use of sewage manure is not making progress, because the chemists and the guano merchants have beaten, and will beat, night-soil out of the market in every shape. Green crops are the only crops to which the hose-and-jet application of liquid manure has proved decidedly economical. An excellent paper was read on this subject at the Farmers' Club in March last, by Mr. Morton, of the *Agricultural Gazette*. I have taken this opportunity of expressing opinions unanimously held by a large body of agricultural friends, who see with regret your *Journal* made the medium of disseminating the errors of a Commission which is virtually irresponsible.

Yours, &c.,
SAM. SIDNEY.

Central Farmers' Club, Blackfriars.

## PUBLIC WORKS FOR INDIA.

SIR,—The time of the meeting of the Society on the 7th instant was unfortunately so much taken up by gentlemen speaking on matters that did not at all affect the great question under consideration, and by the same gentlemen who on the previous evening occupied so much time in discourses on the advantages of high-speed railway, which nobody denied, that only one or two of the gentlemen who wished to speak on the real question had an opportunity of doing so. I had also reckoned upon an opportunity of making some further remarks on the main points I had brought forward, but, in consequence of the turn matters had taken, it seemed to me that there was no alternative, at so late an hour, but for me to make merely such remarks as were required to show the entire ignorance of the whole subject of Indian civil engineering which the speeches of my opponents displayed.

I beg now, therefore, to add a few things which I could have wished to have said at the meeting.

I must first premise that not one word was said by either Colonel Sykes or by the railway men, that in the least degree met my main positions, viz., 1st, that nothing like a complete system of works had been yet executed or even proposed in India; 2nd, that it was a most grievous mistake to spend £10,000 a mile upon communications, while the same money and time would produce 50 or 100 times as much useful effect if spent upon the natural openings for improvement which the country presented; and 3rd, that the railways could neither carry the quantity nor at the cost that the country required, and that could be carried by other means. Colonel Sykes had, as usual, mentioned various works, and then said, "and yet Colonel Cotton had said in his paper that nothing had really been done towards two great objects, viz., irrigation and opening up the resources of India." But this did not dispose of the notorious fact that I had brought forward, viz., that those were only isolated works, and that the great mass of the country, nine-tenths of it, was still untouched. Let us take, for instance, Madras. A railway is commenced, which gives one line of communication through 5 districts out of 24, of which Madras consists Does this provide even the districts it passes through with communications, and how does it affect Ganjam, for instance, which is from 500 to 700 miles from the nearest end of it. Again, will the irrigation and water transit in the deltas of the Godavery and the Kistnah, provide for the district of Bellary in the centre of the peninsula.

Again, I gave an instance of the effect of money laid out in a more judicious manner in the delta of the Godavery, stating the enormous results already obtained, before the works have produced one-tenth of their proper effects, before they were even finished, and pointed out how insignificant, compared to that, would have been the effects of the same money laid out in such works as are at present constructing. The only sort of answer attempted to such unanswerable facts as these, was Mr. Ayrton's curious theory that, whatever it *did*, irrigation *ought* not to prevent famine. When, in reply to this, I stated to the meeting what Indian irrigation was, Mr. Ayrton answered that he had not been speaking of deltas, but of the upper country; he did not know that the sketch I gave of river irrigation was of universal application, and was just as much suited to the upper country as to deltas. So dangerous is it for men to meddle with matters about which they are not at all conversant, that their very explanations only show more distinctly their want of knowledge of the matter. Further, I stated the cost of transit by different modes, and showed the cost to which transit might be reduced by means of steam and water, compared with the cost on railways if worked at high-speed.

No answer could be given to these things, which were the real points on which the subject turns; so all my opponents were under the necessity of wiling away the principal part of the evening in talking of the advantages of railways, &c., which nobody denied. They are certainly excellent things in the abstract, and consequently they are so in their proper places, but where they prevent our doing what is really wanted, they are, properly speaking, mischievous. Two years ago the following passage was written: "If a railway on an important line is constructed on so expensive plan as to require a high rate of charge to enable it to pay a good interest, an irreparable evil will have been done; and the whole power of an influential body, (influential and powerful just in proportion to the amount of capital expended) will be brought to bear on that line, *not* in order to secure cheap transit, but to prevent cheap transit ever being obtained on it." How exactly this has been fulfilled these discussions have proved; the moment a man proposes cheap means of obtaining cheap transit, the old tribe of opponents to im-

provement are almost entirely pushed aside by the vehement railway men, in their anxiety to throw dust in men's eyes and prevent the subject being investigated.

I must not, however, omit to allude to one real answer to one of my positions, viz., that brought forward by an eminent engineer, who has had experience in Indian public works, Sir Frederick Abbott. His question was, Can Indian rivers be improved? This is an intelligent and fair question, and *must* be answered. I answer first, that several rivers are now navigated at rates which there seems no hopes of the railways now contending with. And secondly, that from my experience, I have no doubt that they can be improved. It is impossible to enter into the detail of this here; and I must beg to refer those who are willing to look into it, to my published papers, where the point is pretty fully discussed. I may also mention, that one experiment has been made in the Jumna, where, by closing the irrigating canals, and thereby turning an additional half-million of cubic yards per hour into that river, the depth of water in it was increased 14 inches; so that, supposing the depth before to be at the fords $2\frac{1}{2}$ feet, this increased it to nearly $3\frac{3}{4}$ feet—a depth which is sufficient for large river steamers. Now the cost of storing water to supply that quantity per hour for so many days can easily be calculated from the data we have in India. This is one way of improving rivers. A good deal may also be done by operating upon their beds, as is now regularly done every year in the Ganges. I have stated in my paper that the government of Madras were now at work in the Godavery, improving its bed for navigation. Sir Frederick also doubted whether large steamers could ever be run on the rivers or canals of India. He was not aware that at this moment large boats, of 400 tons burden, are towed on the Ganges. The large steamers on the Hudson, with a speed of twenty miles an hour, only draw $4\frac{1}{2}$ feet of water, while the depth of the Ganges canal is 10 feet at its head.

I must also advert here to one or two other points. One is the state of the case in respect to the defence of India. This in no respect differs from the commercial view of the question. It is as much for the advantage of the movement of troops that they should be enabled to go 1,000 miles at 10 miles an hour, rather than 100 or 20 at 30, and the remainder by daily marches of ten miles, as it is that goods should be moved cheaply over a long distance, rather than quickly and dearly for short ones. The defence of India will be much better secured by 20,000 or 50,000 miles of communication, with a speed of 10 miles an hour, than by 4,000 or 5,000 at a speed of 30.

Again, it is supposed that irrigation must wait for communication, whereas irrigation stands on its own legs. Whether produce is confined within the limits of a country, a village, or a single field, it should equally be raised by means of irrigation, because it can be raised cheaper than without. A man should, of course, irrigate his garden if he finds that one man can with water do the work of two without, though he never sells a cabbage.

After settling the fundamental principles of this great question of public works for India, such as whether very speedy transit over a few lines, or very cheap transit with a moderate speed over a great extent of line, is most required in the present state of the country; whether we should throw away our immense natural advantages because England, for want of them, has had no alternative but to spend such enormous sums; what I wish to see is the formation of a Board at each Presidency, carefully selected, consisting only of three or four members (because action is the main thing required), one of them an engineer, one from the Civil Service, and one or two non-professional men, all men of talent and judgment, and young enough to be in full possession of their energies, with nothing whatever to do besides the business of thepublic works. To dream of such a vast work being sufficiently investigated by men who have twenty other things to attend to, like the Councils, is palpably absurd. The Governor in Council must of course decide all questions, but they ought to have a body of men to digest the questions, who have made themselves well acquainted with the whole subject, and are capable of forming a sound opinion on such matters. The Council at Madras once rejected a lock, because they objected that it would detain the boats till high-water, and when opened, would let the water out of the canal, not knowing that *the object of a lock was to let the boats pass and retain the water;* and this is a good specimen of the consequence of leaving matters in the hands of those who are necessarily without any materials in their own minds for forming a judgment on them.

When such a Board is formed, then they may proceed to take a comprehensive view of the whole Presidency, and with maps and models before them, showing the heights of all the populous parts of the country, with statements of produce, prices, &c., and other materials, there will be rational grounds for expecting that they will be able to sketch a complete system of public works really suited to the country, bringing within its influence every district, and taking advantage of all natural facilities. A rough estimate of the total cost may then be made, and those works selected to commence upon which will give the greatest relief to the country with the least expenditure of time and money. It is surprising to see, when a matter is thus taken up deliberately and systematically, how much may be effected at a small cost. We have abundant proof from actual results already obtained from public works in India, that the forty millions proposed to be expended in such a comparatively insignificant work as 4,000 miles of railway, which people hope may return 5 or 10 per cent. to the shareholders, and which may return a total profit to the community of 10 or 20 per cent., that this forty millions, if expended upon the most remunerative works, would have yielded a total profit of from 100 to 200 per cent. On making such an investigation, it would soon be discovered that there were natural openings where small sums would produce proportionately vast effects, such as the improvement of the Godavery, which promises for the cost of ten or twenty miles of railway, to relieve 10 millions of people from an enormous loss. If only 100,000 tons a year were carried by it, the direct saving on 500 miles would be half a million a year, besides other benefits which cannot be estimated, from the passenger traffic, &c. So in Rajahmundry, £250,000 has been spent on the public works there, and before they are finished the district is selling £150,000 worth of produce a year beyond what it used to do, besides the increase of exports by land.

If such a systematic proceeding had been adopted it would have been, as it were, impossible that a project for carrying the produce of Berar over the Ghauts to Bombay, by a railway to cost millions, could ever have been entered upon, when there was a river both navigable and improvable at a small cost, flowing from the district to a safe port in the opposite direction.

I cannot but think that all unbiassed persons will agree that common sense requires that some such systematic mode of proceeding as I have now ventured to suggest should have been adopted.

If there were nothing else in the case, to see the English capitalists wasting their money upon such works, when there is an unbounded field for the employment of capital in such a way as would yield at least four or five times as much interest, is grievous enough. Even in England the railways have, upon the whole, failed as a speculation, wealthy as the country is. How obvious it is that in India a million spent upon 500 miles of inferior communication would pay better than the same sum spent upon 100 miles of high-speed railway. But not only have the authorities neglected to ask the question, Will this mode of proceeding produce the greatest proportional relief to the country? but even the shareholders have not asked so obvious a question, in respect of their own interest, as, Will this mode of spending money

on public works in India return us a greater interest for our money than any other?

I feel assured that this subject cannot be much longer kept out of sight, and that the opportunity which the Society of Arts have so kindly afforded me of bringing forward my views on it, will help greatly to hasten a full investigation of it, which is all that is required to burst the bubbles with which we have hitherto been amused on the great question of Indian improvement.

But the most important point I have to notice is the following. In my paper, I said that public works lie at the foundation of the improvement of the people, *not only material but moral.* The mail which has since arrived, brings us the intelligence that "24 villages in one of the *Talooks* (tracts containing perhaps 100 villages) of the Godavery delta proposed to the revenue officer, Mr. Taylor, to defray the cost of maintaining schools *by a fixed annual addition to the Government land tax*, which should form a permanent allowance, and be applied to educational purposes." The Government have approved of this, and added a sum for inspecting-masters, &c. Part of the remarks of the editor of the *Madras Athenæum* on this is as follows:—"In Rajahmundry, irrigation works have for some time fertilised the land, nourished the people, and increased the resources of the country. That district may, therefore, be taken as a favourable result of the British rule, as applied to the soil of the country, and of the effect ordinary comfort produces on the minds of the people. What do we find? That the people actually propose to tax themselves to obtain a superior education for their children." This is what Mr. Taylor says:—"The most thriving communities will naturally be the most forward in the march of improvement, and as might be expected, *the ryots of those villages which have abundantly benefitted by the irrigation works are the first to come forward to beg permission to contribute towards the expense of their children's education.* The spread of sound vernacular instruction throughout the villages may eventually be not the least among the indirect effects of the works of irrigation."

As proofs of the agreement with my views respecting the Godavery, I quote two extracts from the two leading journals of Calcutta and Madras. The *Friend of India* says, that the opening of the Godavery by clearing the obstructions to its navigation is the province of Government, and suggests that funds be at once placed at the disposal of the Madras Government for the rapid prosecution of the necessary operations. And the *Athenæum* says,—"Our object has been to dissuade the Government from locking up money in the railway scheme, principally, seeing as we did, that the advantages of the Godavery project were such as could not be overlooked, and that the river must ultimately beat the rail, we were desirous that money which might ultimately be usefully employed in opening up other portions of the Indian empire should not be laid out on a line whose object could be far better answered at a far less cost."

These extracts show that the papers that have been published on this subject in India have pretty well satisfied the heads of the fourth estate there that the project is not quite the contemptible thing that Mr. Ayrton endeavoured to represent it.

I remain, yours faithfully,

A. COTTON.

## To Correspondents.

In addition to several articles noticed last week as being in type, and still omitted from want of space, the following have been received:—Mr. David Mushet, "On Mr. Sanderson on the Manufacture of Steel:" Mr. Samuel Sidney, "On 'Prices;'" Hon. R. Temple, "The Resources of British Honduras."

## MEETINGS FOR THE ENSUING WEEK.

MON. Geographical, 1 p.m. Annual Meeting.
Actuaries, 7
Architects, 8.
TUES. Royal Inst. 3. Dr. Tyndall, "On Voltaic Electricity."
Civil Engineers, 9. President's Annual Conversazione.
WED. Royal Inst., 3. Dr. Du Bois Reymond, "On Electro-Physiology."
Society of Arts, 8. Messrs. Mather and Platt, "On Earth-Boring Machinery."
Geological, 8. 1. Mr. P. W. Greves, "Notice of the occurrence of a bore at Port Lloyd, Bonin Islands." 2. Mr. D. Sandison, "Notice of the occurrence of an Earthquake at Broussa, on April 11th, 1855." 3. Mr. K. Godwin-Austen, "On the Extension of the Coal Measures beneath the South-eastern parts of England."
THURS. Royal Inst. 3. Mr. G. Scharf, jun., "On Christian Art."
FRI. Botanical, 8.
Royal Inst., 8½. Dr. Tyndall, "On the Currents of the Leyden Battery."
SAT. Asiatic, 2.
Royal Inst., 3. Dr. Du Bois Reymond, "On Electro-Physiology."
Royal Botanic, 3¾.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

Par. No.

*Delivered on 17th May*, 1855.

68. Finance Accounts—Classes 1—7.
171. Election Auditors, &c., and Election Expenses—Returns.
217. Exchequer—Account.
126. Bill—Hardware, &c., Manufactures.

*Delivered on 18th May*, 1855.

195. Railway (Balaklava to Sebastopol)—Copies of Correspondence.
231. Metropolis Main Sewers—Return.
158. Education (Minutes of Privy Council in Chronological Order, &c.)—Return.
212. Stores for the East—Return.
76. Bills—Court of Session (Scotland).
122. Bills—Bills of Exchange and Promissory Notes (as amended by the Select Committee).
124. Bills—Coal Mines Inspection.
127. Bills—Mortmain.
Australian Colonies (Alterations in the Constitutions)—Further Papers.

## PATENT LAW AMENDMENT ACT, 1852.

### APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, May 18th*, 1855.]

*Dated 23rd April*, 1855.

902. H. Balan, Paris—Transporting passengers and goods.
904. J. Wright, 12, Sussex-terrace, Islington, and E. Brimble, 32, Cheapside—Stays or corsets.
906. A. Jenkin, Zell-on-the-Moselle—Furnaces for the reduction and calcination of lead and copper ores.
908. W. Gossage, Widnes—Soap.

*Dated 30th April*, 1855.

964. R. Burns, Liverpool—Propelling vessels.
966. J. Walworth and D. Taylor, Manchester—Stand pipe for hydrants.
968. A. Buchanan and J. Barclay, Catrine, N.B.—Finishing textile fabrics.
970. P. Dépierre, Paris—Dyeing. (A communication.)

*Dated 1st May*, 1855.

971. T. Torbitt, Belfast—Treatment and preparation of potato.
972. T. Hunt, Crewe—Permanent way.
973. W. Eassie, Gloucester—Stopping railway trains.
975. W. Hartley, Bury—Safety valves.
976. J. E. Boyd, Lewisham—Ship's course indicator.
977. G. Fisher, Cardiff—Railway buffer.
978. L. W. Wright, Birmingham—Locks.
979. W. and J. Banks and H. Hampson, Bolton-le-Moors—Bleaching yarns.
980. R. Adcock, Wolverhampton—Purifying alcoholic liquids. (A communication.)
981. W. Hemsley, Melbourne, near Derby—Cutting warp fabrics.

*Dated 2nd May*, 1855.

983. T. Lambert, Harrington-square—Pianofortes.
984. F. W. Harrold, Birmingham—Frames of slates. (A communication.)
985. S. W. Campain, Deeping Fens—Filling sacks.
986. H. Lee, jun., Lambeth, and J. Gilbert, Hackney-road—Mixing concrete.
987. T. R. Bridson, Bolton-le-Moors—Finishing textile fabrics.
988. M. A. C. Mellier, Paris—Paper.

*Dated 3rd May*, 1855.

989. W. Basford, Penclawdd, Glamorganshire—Purifying coal gas, and obtaining useful residuum.
990. J. Burgess, jun., Birmingham—Comb.
991. W. Rowett, Liverpool—Fitting, handing, and reefing vessels' sails.
992. J. Platt, Oldham, and J. Taylor, Hollinwood, near Oldham—Looms.

*Dated 4th May*, 1855.

993. T. Horton, Birmingham—Charcoal and pyroligneous acid.
994. F. Fletcher, Birmingham—Water closets.
995. W. H. Marks, London—Signalling approach of vessels at sea.
996. R. Thiers, Lyons—Stretchers of umbrellas and parasols.
998. J. Lecassagne and R. Thiers, Lyons—Electrometric regulator.
999. J. Hamilton, jun., Liverpool—Iron girders.
1000. D. Dalton, Chester—Smelting furnaces.
1001. J. Trotman, 42, Cornhill—Screw propellers.

*Dated 5th May*, 1855.

1002. R. Midgley and G. Collier, Halifax—Preparing yarn.
1004. A. Brandon, Paris—Heating and warming apparatus.
1006. M. Butcher and T. H. Newey, Birmingham—Forge hammers.
1008. H. G. A. Pecoul, Paris—Generating power in steam engines.

*Dated 7th May*, 1855.

1010. J. Pearson, Totterdown, near Bristol—Fastening tyres on wheels.
1012. D. Foxwell, Manchester—Wire cards.
1014. E. Tyzack, Sheffield—Scythes.
1016. J. Hands, Epsom—Furnaces.
1018. J. H. Johnson, 47, Lincoln's-inn-fields—Paper and cardboard. (A communication.)
1020. J. H. Johnson, 47, Lincoln's-inn-fields—Prevention of smoke. (A communication.)
1022. J. Lewis, Holborn—Soap.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1061. N. Brough, Birmingham—Slide buckles.—11th May, 1855.
1066. D. Caddick, Ebbw-Vale Iron Works, Monmouth—Puddling furnaces.—11th May, 1855.
1067. A. Warner, 11, New Broad-street—Combining sheets of copper or its alloys with lead, tin, zinc, nickel, gold, silver, platinum, or alloys containing these metals, or some of them, with or without the addition of copper, antimony, bismuth, arsenic, manganese, or mercury.—12th May, 1855.
1068. A. Guild, Manchester—Process of bowking.—12th May, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed May 18th*, 1855.

2451. Henry Diaper, Saint Michael's-terrace, Pimlico—The application of a new material to the manufacture of paper.
2453. Pierre Alexandre Dulaurens and Marie Anatole Laubry, Paris—Improvements in glove fixings or fastenings.
2461. Edmund Hunt, Glasgow—Improvements in screw propellers, and in ships or vessels.
2463. Jean Baptiste Bagary, Paris—Improvements in sawing apparatus.
2473. Charles Crickmay, Lozells, Handsworth—Improvements in single and repeating or revolving fire-arms, and in the mode of attaching bayonets to breech-loading fire-arms.
2491. Richard Roberts, Manchester—Improvements in machinery for preparing cotton and other fibres to be spun.
2503. Thomas Restell, Strand—Improvements in umbrellas, parasols, and cases or covers, and walking sticks.
2505. Alfred Vincent Newton, 66, Chancery-lane—Improvements in steam-boiler and other furnaces.
2508. Thomas Knight and Stephen Knight, Southwark—Improvements in apparatus for heating water for baths and other purposes.
2519. John Mason and Leonard Kaberry, Rochdale—Improvements in machinery or apparatus for preparing, spinning, and doubling cotton and other fibrous materials.
2530. Thomas Restell, Strand—Improvements in guns.
2537. Longin Gantert, 38, Glasfort-street, Glasgow—Improvements in machinery or apparatus for dyeing and bleaching of yarns or threads.
2546. Robert Shaw, Portlaw, Waterford—Improvements in looms for weaving.
2551. James Porritt, Stubbin Vale Mill, near Ramsbottom—Improvements in carding machines.
2555. Cromwell Fleetwood Varley, 1, Charles-street, Somers-town—Improvements in producing and applying dynamic electricity.
2585. John Thom, Birkacre, near Chorley—Improvements in apparatus for singeing or firing cotton and other fabrics.
2604. William Grindley Craig, Gorton, Lancaster—Improvements in railway axle boxes and spring fittings.
2605. Isaac Dodds, Sheffield—Improvements in machinery or apparatus for working the slide or steam valves of steam engines.
2643. Luke Turner, Leicester—Improvement in weaving elastic fabrics.
2665. Thomas Hart, 255, George-street, Glasgow—Improvements in Jacquard apparatus for weaving.
2668. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the extracting tannic acid from leather, and in preparing the leather for the manufacture of glue. (A communication.)
2701. Louis Joseph Frederic Margueritte, Paris—Improvements in the manufacture of caustic and carbonated potash and soda.
2742. Gerd Jacob Bensen, 7, Christian-street, St. George's in the East—Improvement in refining sugar.
85. Christopher Turner, Burnley—Improvements in power looms for weaving.
101. John Greenwood, Irwell Springs, near Bacup—Improvements in sizeing, stiffening, and finishing textile fabrics or materials.
213. Auguste Leopold Lenoir, Paris—Improvements in breech-loading fire-arms.
369. Charles Roper Mead, Langdale-road, Peckham—Improved construction of gas regulator.
393. Robert Mc Connell, Glasgow—Improvements in finishing or dressing textile fabrics.
431. Captain Alexander Theophilus Blakely, R.A., Little Ryder-street, St. James's—Improvements in ordnance.
529. James Bullough, Accrington—Improvements in looms and apparatus for weaving.
591. William Hill, Birmingham—Improvements in metallic pens and penholders, and in ornamenting metallic pens and penholders.
639. John Scott Russell, Millwall—Improvements in ship building.

*Sealed May 22nd*, 1855.

2464. Richard Terrett, Hercules Buildings, Lambeth—An improved machine or apparatus for cleaning knives.
2472. Edmund Eaborn, Matthew Robinson, and John Kendrick, Birmingham—Certain apparatuses or contrivances for holding hats in churches, chapels, and other public assemblies.
2476. Stephen Shaw, Plaistow—Improved mode of marking metal plates for rivetting or bolting, and the application of a new material as a template for receiving such marks.
2483. Riley Cunliffe, Accrington—Improvements in machinery or apparatus for making or manufacturing bricks and tiles or other similar articles.
2484. Robert Willan and Daniel Mills, Blackburn—Improvements in looms.
2492. Thomas Greenshields, George-street, Derby—Improvements in treating cotton waste that has been used by railway companies, and preparing it to be used again.
2506. Charles Peterson, Low Cliff, Chale, Isle of Wight—The application of a new vegetable substance to the manufacture of textile fabrics and pulp for paper, cardboard, papier mache, and similar purposes.
2509. John Abraham, Standfield, Great Crosby, near Liverpool—Improvements applicable to draining.
2556. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the arrangement of electric telegraphs (A communication.)
2576. Samuel Heseltine, Harwich—Improvements in the construction of cannon shot and shell.
2593. Edward Maniere, Bedford-row—Improvements in lamps.—(A communication.)
2615. Joseph Mayer, Dale Hall Pottery, Longport, and John David Kind, Birmingham—Improvements in door knobs or handles made of china, earthenware, glass, or other vitreous or semi-vitreous substance, and in attaching the said knobs or handles to their spindles.
2642. Arthur Lyon, Windmill-street, Finsbury—Improvements in machines for reducing or mincing meat and other solid edible substances.
2649. John Sykes, Huddersfield—Improvements in piecing machines, a part of which improvements is applicable to other similar purposes.
2655. Robert Lucas Chance, Birmingham—Improvement in the manufacture of glass.
35. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in machinery or apparatus for effecting agricultural operations, parts of the said improvements being applicable for the obtainment of motive power for general purposes.
327. Richard Shirley Harris, Leicester—Improvements in the manufacture of looped fabrics.
448. Henry Penney, York place, Baker-street—Improved mode of treating vulcanised or cured india-rubber.
617. Alexander Robert Terry, 1, Adelphi-terrace—Improvements in apparatus for copying letters and other documents.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3718 | May 21. | Smoke Preventor | Rev. James Burrow | Ashford Parsonage, near Bakewell |
| 3719 | ,, | Improved Semicircular-end Black or Sharp Key for Pianofortes | George Wilkins | Guildford, Surrey. |
| 3720 | ,, | Water-closet Basin and Trap | Henry Doulton and Co. | Lambeth. |
| 3721 | ,, | Brace Ends | William Graham | 8, Noble-street, Cheapside. |

Journal of the Society of Arts.

FRIDAY, JUNE 1, 1855.

## TRADE MUSEUM.

A few gentlemen interested in the application of Science to Arts and Manufactures, intend meeting at the Society's house on Tuesday evening next, the 5th of June, at eight o'clock, to examine the Trade Museum, recently formed under the joint authority of Her Majesty's Commissioners for the Exhibition of 1851 and the Society of Arts, when members of the Society are invited to attend.

## FOURTH ANNUAL CONFERENCE AND 101st ANNIVERSARY DINNER.

The Council beg to announce that the Fourth Annual Conference of the Representatives of the Institutions in Union, will be held on Monday, the 2nd of July, at 11 a.m. precisely. Also that the One Hundred and First Anniversary Dinner will take place on Tuesday, the 3rd of July.

Further particulars will be published next week.

## TWENTY-FOURTH ORDINARY MEETING.

Wednesday, May 30, 1855.

The Twenty-fourth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 30th inst., the Rev. Dr. Booth, F.R.S., Member of Council, in the chair.

The following Candidates were balloted for and duly elected :—

| | |
|---|---|
| Crosbie, Arthur | Isaac, John Raphael |
| Hardwicke, Earl of | Kennedy, Colonel John Pitt |

The following Institution has been taken into Union since the last announcement :—

395. Bolton, Church Educational Institution.

Previous to the reading of the paper, the Secretary called attention to a specimen of Holmes' Patent Tyre. This tyre has a narrow rib of iron upon the centre of a flat bar, by which the friction on the ground is said to be reduced, whilst it is more durable and lighter, and has all the advantages of a wide tyre upon soft ground.

The paper read was

### ON EARTH-BORING MACHINERY.

By Colin Mather.

The object of the present paper is to describe the various modes of boring artesian wells, or, in other words, of earth-boring, which has become a matter of considerable importance in relation to several objects of public utility and of private enterprise.

When the country was thinly inhabited, the water supplied by surface springs and rivers was found sufficient for the ordinary wants of human life; but when population increased, and the land came more into cultivation, the supply decreased as the demand increased, and it was found necessary to obtain additional supplies of water by digging artificial wells. In course of time, as manufacturing processes were developed, and large cities grew up, other resources had to be created. Among various plans which might be mentioned, the formation of artesian wells has been resorted to in modern times, and with considerable success.

In the sinking of wells, and especially wells of this description, improvements in the art of boring become peculiarly interesting and valuable.

Among the various systems and applications which have been adopted, one well-known method of boring is to attach the chisel to a series of rods, which are suspended from the end of a spring pole. The workmen, taking their stand at the end of the pole, give the vibratory motion, which raises the rods after a stroke has been given, whilst others turn the bar, causing the chisel to strike upon a fresh place, and so gradually to penetrate the earth. When the debris has accumulated so as to obstruct the progress of the chisel, the rods are withdrawn by means of a windlass, each one being unscrewed as it is wound up; when the last rod is raised, the chisel is detached, and the shell for collecting the debris is substituted; this is then lowered by means of the windlass, one rod after another being screwed on till the shell has reached the bottom.

The shell is a tubular instrument, of sheet iron, usually from three to four feet long, something less in diameter than the size of the hole, with a clack at the bottom. This is plunged into the *debris*, and what HAPPENS to get into the shell and above the clack is then brought to the surface, assuming the clack to close as it is designed to do, by winding and unscrewing as before.

Another method of boring is to give the impulsive motion by means of a windlass, which has a rope coiled a few times round the barrel; one end of the rope is attached to the boring rod, and the other is held by the workman, who draws the rope tight. The windlass being then slightly turned, the friction upon the barrel being sufficient to enable the workman to hold the rope, the rods are raised a sufficient height to give the required stroke. The workman then slacks the rope suddenly, when the coils become loose, and the rods descend with a force equal to the motion derived from their own weight and the distance through which they have to fall. This method is generally resorted to when the weight of the rods is so great as to overcome the elasticity of a spring-pole.

A third method is that described by Mr. Vignoles, in a paper read at a meeting of the British Association, and which appeared in the *Mining Journal* of September 26th, 1846.

Mr. Vignoles says :—"The apparatus is composed of a hollow boring rod, formed of wrought-iron tubes screwed end to end; the lower end of the hollow rod is armed with a perforating tool, suited to the character of the strata which have to be encountered. The diameter of the tool is larger than the diameter of the tubular rod, in order to form around it an annular space through which the water and the excavated material may rise up. The upper end of the hollow rod is connected with a force-pump by jointed and flexible tubes, which will follow the descending movement of the boring tube for an extent of some yards. This boring tube may be either worked by a rotary movement with a turning handle, or by percussion with a jumper. The frame and tackle for lifting, lowering, and sustaining the boring tube, offer nothing particular. When the boring tube is to be worked, the pump must be first put in motion. Through the interior of the tube a column of water is sent down to the bottom of the bore-hole—which water, rising in the annular space be-

ween the exterior of the hollow boring-rod and the sides of the bore-hole, creates an ascending current which carries up the triturated soil; the boring tube is then worked like an ordinary boring-rod; and as the material is acted upon by the tool at the lower end, it is immediately carried up to the top of the bore-hole by the ascending current of water. It is a consequence of this operation, that the cuttings being constantly carried up by the water, there is no longer any occasion to draw up the boring tube to clear them away—making a very great saving of time. Another important and certainly no less advantage, is, that the boring tools never get clogged by the soil; they work constantly, (without meeting obstructions) through the strata to be penetrated, thus getting rid at once of nine-tenths of the difficulties of boring."

The writer of this paper admits that the wonderful results of this machine, contemplated in the report from which the above extract is taken, caused him at that time to pause in proceeding further with his experiments on earth-boring. After patiently waiting from September, 1846, till May, 1848, without hearing of the method of boring thus favourably described being carried into execution, he wrote the following letter to the editor of the *Mining Journal* :—

"Sir,—I should be extremely obliged if you, or any of your correspondents, would inform me what progress Fauvelle's new system of boring has made in this country. I have been anxiously looking and waiting for some marvellous result ever since your number of the 26th September, 1846. It was also stated in your journal of the 5th December, 1846, that the Pennant Lead and Copper Mining Company had made arrangements to test its capabilities.

"If you could return answers to the following questions it would be deemed a favour by many of your readers and correspondents:—Whether, in the first place, the trial alluded to ever took place, and, if so, what has been the result? Or, if it is still going on, what are the expectations it holds out? And, lastly, the address of the parties who have it in hand.

"Manchester, May 11th."

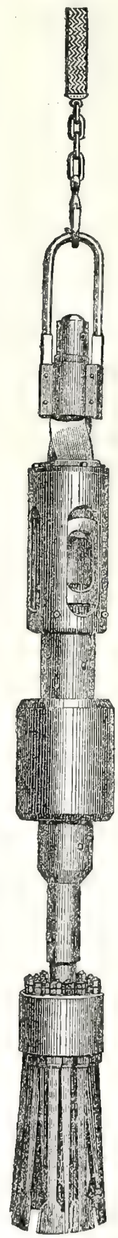
As no answer appeared it was taken for granted that the whole description corresponded with a statement in the same report, "That the weight of a hollow rod, three inches in diameter, and the iron a quarter of an inch thick, would be *less* than that of a solid rod of an inch diameter."

At the present time a well is being bored at Highgate by MM. Degousée, probably the most experienced and extensive borers known. Great praise is due to them for the liberal way in which they publish their proceedings and explain their apparatus. Their method differs but little in principle from that generally used in this country, except in the employment of steam power for raising and lowering the rods, and for giving the percussive motion to the cutters, and, further, in the great variety and superior make of their implements. Perhaps the greatest novelty of their system is that, instead of the spring pole or the windlass, they use a lever, the motion being applied to one end of the lever, and the rods attached to the other. A counterbalance is attached at the motion end of the lever, partly to counterpoise the great weight of the rods.

A great deal has been said about the Chinese method of boring with a rope, but sufficient details have never reached this country to enable that method to be carried into practice here.

Having thus briefly described the methods of boring now in general use, it is next proposed to explain the new and improved plan just being brought into operation.

The construction of the boring head and shell pump, and the mode of acquiring the percussive motion, constitute the chief novelties of the system and machine. The couple-cylinder engine, with the reversing or link motion, is used for winding and lowering apparatus, but an ordinary winding engine, similar to those used in collieries, may be applied.



BORING HEAD.

SHELL PUMP.

The boring head consists of a wrought-iron bar, about eight feet long, on the lower part of which is fitted a block of cast iron, in which the chisels or cutters are firmly secured. Above the chisels an iron casting is fixed to the bar, by which the boring-head is kept steady and perpendicular in the hole. A mechanical arrangement is provided, by which the boring-head is compelled to move round a part of a revolution at each stroke. The loop or link by which the boring apparatus is attached to the rope is secured to a loose casting on the wrought-iron bar, with liberty to move up and down about six nches. A part of this casting is of square section, but wisted

about one-fourth of the circumference. This twisted part moves through a socket of corresponding form on the upper part of a box, in which is placed a series of ratchets and catches, by which the rotary motion is produced. Two objects are here accomplished—one the rotary motion given to the boring-head, the other a facility for the rope to descend after the boring-head has struck, and so prevent any slack taking place, which would cause the rope to dangle against the side of the hole, and become seriously injured by chafing.

The shell-pump is a cylinder of cast-iron, to the top of which is attached a wrought-iron guide. The cylinder is fitted with a bucket similar to that of a common lifting pump, with an India-rubber valve. At the bottom of the cylinder is a clack, which also acts on the same principle as that in a common lifting-pump, but it is slightly modified to suit the particular purpose to which it is here applied. The bottom clack is not fastened to the cylinder, but works in a frame attached to a rod which passes through the bucket, and through a wrought-iron guide at the top of the cylinder, and is kept in its place by a cotter, which passes through a proper slot at the top of the rod. The pump-rod, or that by which the bucket is worked, is made of a forked form, for the twofold purpose of allowing the rod to which the bottom clack is attached to pass through the bucket, and also to serve as the link or loop by which the whole is suspended.

The wrought-iron guide is secured to the top of the cylinder, and prevents the bucket from being drawn out when the whole is so suspended. The bottom clack also is so arranged that it is at liberty to rise about six inches from its seating, so as to allow large fragments of rock, or other material, to have free access to the interior of the cylinder when a partial vacuum is formed there by the up-stroke of the pump.

The percussive motion is produced by means of a steam cylinder, which is fitted with a piston of 15 inches diameter, having a rod of cast-iron 7 inches square branching off to a fork in which is a pulley of about three feet in diameter, of sufficient breadth for the rope to pass over, and with flanges to keep it in its place. As the boring-head and piston will both fall by their own weight when the steam is shut off, and the exhaust-valve opened, the steam is admitted only at the bottom of the cylinder; the exhaust-port is a few inches higher than the steam-port, so that there is always an elastic cushion of steam of that thickness for the piston to fall upon.

The valves are opened and shut by a self-acting motion derived from the action of the piston itself, and as it is of course necessary that motion should be given to it before such a result can ensue, a small jet of steam is allowed to be constantly blowing into the bottom of the cylinder; this causes the piston to move slowly at first, so as to take up the rope, and allow it to receive the weight of the boring rod by degrees, and without a jerk. An arm which is attached to the piston-rod then comes in contact with a cam, which opens the steam-valve, and the piston moves quickly to the top of the stroke. Another cam, worked by the same arm, then shuts off the steam, and the exhaust-valve is opened by a corresponding arrangement on the other side of the piston rod. By moving the cams the length of the stroke can be varied at the will of the operator, according to the material to be bored through. The fall of the boring-head and piston can also be regulated by a weighted valve on the exhaust-pipe, so as to descend slowly or quickly, as may be required.

The general arrangement of the new machine may be described as follows:—

The winding drum is 10 feet in diameter, and is capable of holding 3000 feet of rope, 4½ inches broad and half an inch thick; from the drum the rope passes under a guide pulley, through a clam and over the pulley which is supported on the fork end of the piston rod, and so to the end which receives the boring head, which being hooked on and lowered to the bottom, the rope is gripped by the clam. A small jet of steam is then turned on, causing the piston to rise slowly until the arm moves the cam, and gives the full charge of steam; an accelerated motion is then given to the piston, raising the boring head the required height, when the steam is shut off, and the exhaust opened in the way described, thus effecting one stroke of the boring head as regulated by a back pressure valve in the exhaust pipe. The exhaust port is six inches from the bottom of the cylinder; when the piston descends to this point it rests on a cushion of steam, which prevents any concussion. To increase the lift of the boring head or compensate for the elasticity of the rope, which is found to be one inch in one hundred feet, it is simply necessary to raise the cams on the cam shaft whilst the percussive motion is in operation. The clam which grips the rope is fixed to a slide and screw, by which means the rope can be given out as required. When this operation is completed, and the strata cut up by a succession of strokes thus effected, the steam is shut off from the percussive cylinder, the rope unclamped, the winding engine put in motion, and the boring head brought up and slung from an overhead suspension bar by a hook fitted with a roller to traverse the bar. The shell-pump is then lowered, the *debris* pumped into it, by lowering and raising the bucket about three times, which the reversing motion of the winding engine readily admits of; it is then brought to the surface and emptied by the following very simple arrangement. At a point in the suspension bar a hook is fixed perpendicularly over a small table in the waste tank, which table is raised and lowered by a screw. The pump being suspended from the hook hangs directly over the table, which is then raised by the screw till it receives the weight of the pump. A cotter, which keeps the clack in its place, is then knocked out, and the table screwed down. The bottom clack and the frame descending with it, the contents of the pump are washed out by the rush of water contained in the pump cylinder. The table is again raised by the screw, and the clack resumes its proper position; the cotter is then driven into the slot, and the pump is again ready to be lowered into the hole as before. It is generally necessary for the pump to descend three times in order to remove all the debris broken up by the boring head at one operation.

The following facts obtained from the use of the machine in boring in the new red sand stone at Manchester, will shew its actual performance, and enable us to compare it with the other systems mentioned in this paper. The boring head is lowered at the rate of 500 feet a minute; the percussive motion is performed at the rate of 24 blows a minute, and being continued for ten minutes, the cutters in that time penetrate from 5 to 6 inches; it is then wound up at 300 feet a minute. The shell pump is then lowered at the rate of 500 feet a minute, the pumping continued for one minute and a half, and being charged, the pump is wound up at 300 feet a minute. It is then emptied and the operation repeated, which can be accomplished three times in 10 minutes, at a depth of 200 feet. The whole of one operation, resulting in the deepening of the hole 5 to 6 inches, and cleansing it of debris ready for the cutters or boring head being again introduced, is seen to occupy an interval of 20 minutes only. The value of these facts will be best shown by comparing them with the results by the old method.

At Highgate the boring has occupied two years in attaining a depth of 680 feet from the bottom of a well 500 feet deep from the surface. Their progress at present is at the rate of 6 inches per week, working night and day. At Warwick, 13 months were occupied in boring 400 feet through red marl. At Saltaire, two years in going 80 yards.

One well-known defect of the old method of boring consists in the "buckling" and dangling of the rods, which has the effect of enlarging the hole in some instances to a diameter of four feet where soft strata intervene. This arises from the buckling and dangling of the rods causing them to strike against the sides of the hole, and

breaking off portions of earth which fall to the bottom. thus considerably increasing the quantity of debris to be brought up by the shell, and occupying an immense time in getting out the debris which has merely fallen from the side, without increasing the depth of the hole. This is a serious defect where geological purposes are to be served by the boring, because the earth from the side falling to the bottom of the hole mixes with that which is cut up by the chisel, and thus prevents an accurate knowledge being obtained of the strata which the boring has penetrated. It must be remarked also that the defect of buckling is to crystallise the iron, deteriorating its quality, and thereby causing those frequent breakages which retard progress, and add so materially to the expense of this system of boring. The process of crystallisation being beyond the observation of the workmen, the result is scarcely if ever known till the breaking of the rods reveals it. To remedy this difficulty, and obviate the effects of buckling, it has been found necessary to put down iron tubes into the bore-hole. As the first length of these tubes can scarcely be got to a depth of more than 200 feet, on account of the great external friction, it is necessary, when the tube has to be carried to a further depth, to put down a second and a third length of tube, and as each length must come to the surface, the diameter of the bore-hole is very materially diminished. It will easily be seen that when the bore-hole is required to be of considerable depth, this diminution of its diameter will at length so contract the hole as to render the supply of water comparatively limited, and in fact to threaten the design with actual failure after a vast outlay has been incurred. These inconveniences, so serious in character, are all obviated by the new method of boring. No rods are used, and as the rope which is substituted for them seldom comes in contact with the sides of the hole so as to disturb the strata tubing will rarely be required. Indeed, it will only be necessary when the particular strata through which the hole passes happens to be very fluid, and even then it will not always be wanted. The great power of pumping and the facility of winding possessed by this new machine would enable it to exhaust any ordinary quicksand which might find its way into the hole. The pumping process could be carried on at a depth of 500 feet at the rate of a cart-load per hour. It is possible with the improved machine to cleanse the hole so effectually that not a loose particle remains at the bottom. This will at once be seen from the fact that the pump has sufficient power to draw in masses of rock or other substances of from three to four pounds weight. This circumstance renders the machine particularly useful in geological researches, inasmuch as the lowest strata are brought up in a state of the greatest possible compactness and purity, notwithstanding any admixture of earth from the sides, or of that which the shell has been unable to bring up in the previous operation.

Some of the more important public uses to which the new machine can be applied may now be briefly enumerated.

Sanitary questions deservedly occupy at the present time a large share of public attention. Water, as is well known, is the chief agent in sanitary reform. It is necessary for flushing sewers, for supplying baths and wash-houses, as well as for meeting the domestic wants of all classes of the community. The importance of cleanliness cannot be over-rated, as a means of promoting the general health, and it imposes the necessity for a much more copious supply of pure water than is as yet enjoyed in most towns. Many small towns which are so situated that they cannot command a supply of water from natural sources, are prevented from obtaining it by boring, on account of the great expense, and still more the vexatious uncertainty of the process. The corporation of Manchester have expended upwards of a million sterling in supplying that city and its neighbourhood with water, and they sell it to the corporation of Salford at the rate of threepence per thousand gallons. It is confidently believed that by the new method of boring an abundant supply of water could be procured on the spot at half that price. Thus, in a sanitary point of view, the new machine is of the utmost value since it enables us to procure a much greater supply of water in far less time, and from depths which were all but inaccessible on the old method of boring. For example, the work at Highgate, which has occupied two years, could have been done in thirty-three days. That at Warwick, which has occupied thirteen months, could have been done in twenty days. That at Saltaire, to supply the workpeople with drinking water, which has occupied two years, could have been done in twenty-nine days.

It must be borne in mind that water is seldom sought by the tedious and expensive process of boring till it is urgently wanted. The old method, therefore, not only occasions a vastly increased outlay, but also involves an amount of privation which in many cases is a matter of serious importance.

In conclusion, another important use may be noticed to which this invention may be applied, namely, the ventilation of mines, with a view of preventing the dreadful explosions which are unhappily too frequent. These explosions most frequently arise from the ignition of the gases or foul air accumulated in the galleries, or old workings, and in large cavities which have been partitioned off. The remedy in these cases would be to bore down from the surface and perforate these parts of the mine at different places, so as to admit a current of fresh air into the parts where the foul air had accumulated. On the old method of boring this object is impracticable, since, in addition to the expense, the diameter of the hole within reach of the old system is quite insufficient for the purposes required. The improved plan now proposed is not only (as has been shown) much more economical, but it is capable of boring holes of ample dimensions to be adapted as air shafts in the way proposed. A diameter of three feet has been suggested above, but the largest practicable limit is much beyond this. Instead of partitioning off the winding shaft, and connecting it below with a complicated system of passages for return currents, it would be found in practice much more useful to bore several holes, of a moderate diameter, at the end of the workings. On this plan the air would have only half the distance to travel, and the ascending shaft would not require to be kept at nearly so high a temperature, or, if kept at the same temperature, the ventilation of the mine would become so much the more effective and complete.

It is hoped that the facts contained in this paper will sufficiently prove the vast superiority of the new method of boring herein described, and the great advantage which will accrue to the community from its general adoption. Relying upon these facts it is presumed by the inventor that the improvements he has introduced will constitute a new era in the art of earth boring, and in the various important objects to which it is and may be applied.

The following certificates have been kindly given confirming the statements above made respecting the actual performance of the machine :—

[COPY.]

"Town Hall, Salford, Borough Treasurer's Office,
March 22nd, 1855.

"*To Messrs. Mather and Platt, Engineers, Salford Iron Works.*

"GENTLEMEN,—I have pleasure in certifying to the amount of cutting done by your admirable and highly-ingenious earth-boring machine, during my visit at your establishment this day.

"The bore-hole was 15 inches diameter, and 205 feet 3 inches deep when the machine was set to work; the operations of lowering, working, and raising the boring head, and of lowering, working, and raising the pump, and the broken rock, occupied nineteen and a half minutes.

The depth of the hole was again measured, and found to be 205 feet 10 inches; shewing that the machine had cut the red rock, and brought to the surface, *seven inches* in depth.

"The machine appears to me to be exceedingly well-adapted for the performance of the work it has been constructed to perform, and being worked by a steam-engine, requires the attention of only two persons.

"The work performed in my presence is equal to 21½ inches per hour, or about 18 vertical feet per day of ten hours.

"The following is the actual time occupied in each movement of the machine:—

| | | |
|---|---|---|
| Lowering boring-head | 1½ | minutes |
| Boring | 10 | ,, |
| Drawing up boring-head | 1½ | ,, |
| Lowering pump 1st time | 1½ | ,, |
| Drawing up pump and broken rock | 1 | ,, |
| Lowering pump 2nd time | 1 | ,, |
| Drawing up pump 2nd time | 1 | ,, |
| Lowering pump 3rd time | 1 | ,, |
| Drawing up pump 3rd time | 1 | ,, |
| Total time | 19½ | minutes. |

"Vertical depth bored through red rock in well 15 inches diameter, *seven inches*; being at the rate of 21½ inches per hour, or about six vertical yards per day of ten hours.

"E. R. LANGWORTHY,
"Alderman and Justice of the Peace."

"I was present during the above-mentioned operations, and took the time of working Messrs. Mather and Platt's extraordinary machine, which is correctly stated above.

"DAVID CHADWICK,
"Treasurer of the Borough of Salford."

## DISCUSSION.

Mr. HERBERT MACKWORTH, M. Inst. C.E., Government Inspector of Mines, said, every one must feel indebted to the gentleman who had illustrated the paper which had just been read by the elaborate diagrams and the beautiful working-model before them, but for himself he felt thankful to any one in this country who would devote himself to the improvement of boring, an art of the highest importance to our mineral resources, but which, unfortunately, for many years had been left to continental engineers to improve and extensively apply. Ryan, at the close of the last century, took out a patent for improvements in boring and a mode of extracting large lumps of rock as specimens, and he was followed by Goode, in 1823. On the Continent, the names of d'Oeynhausen, Degousée, and Kind (the so-called Napoleon of borers), had become famous from the great practical success which had attended their improvements; whilst in England we had been satisfied to go down 300 yards, at enormous cost and with great uncertainty. Kind had executed borings 764 yards deep at Mondorf, 566 and 626 yards deep at Brunswick, and 742 yards at Minden. These borings were for salt brine. He was lately executing one at Homburg, which had attained a depth of about 600 yards, to obtain water sufficiently hot for warm baths. The Parisians regretted that their well of Grenelle, 600 yards deep, made by Mulot, was not a few 100 yards deeper, so as to obtain water for warm baths without the necessity of re-heating it. The Chinese system had been the foundation of so many trials in boring, that it was worth mentioning that Imbert related that boring was executed there for obtaining carburetted hydrogen gas, to a depth of 600 yards, by a heavy chisel suspended to a rope. This system was applied some years ago at Chatham; it had been much improved on the Continent by Jobard, Selligue, and Sello, the latter of whom applied it to drawing off fire-damp from certain portions of coal mines, as recommended by the author of the paper. It would rarely be found beneficial in coal mines, from the small area of the shaft, the influx of water into the mine, and other objections. Mr. Mather's method contained improvements on the Chinese system, but exhibited some of those first and rather crude steps which had been previously tried before success was obtained. The Société Freminville employed apparatus of a very ingenious kind, and, to obviate the great objection to the Chinese system, the crookedness of the hole, tubed the interior so as to serve as a guide for the tool itself. No system had ever shown such wonderful results in one or two instances under very favourable circumstances as Fauvelle's. M. Arago related, that in July 1846, at Perpignan, 186 yards in depth were bored in 23 days, or 140 hours, being more than double the very favourable statement of the performance of Mr. Mather's machine. That this system had not come into general use, was owing to several important defects, which it was unnecessary to go into now. He gave it as an example that the merits of improvements in boring must not be tested by what they would do in flat beds of new red sandstone, or Halifax flags, such as we saw on the table, and for half an hour at a time, but by actual proof, in deep, hard, and highly-inclined strata. Although the present system had been started at least as far back as 1848, it did not appear to have attained a greater depth than 80 yards, and only to have been tried for a few feet in stone of the same consistence as London pavement flags, in which its performance was unrecorded. As a practical man, he did not like to take the statements of actual performance which had been made to us, but which were no doubt quite correct, as a proof that this method had been perfectly successful. There was no art in the whole range of engineering which required greater practice, skill, and care, than that of boring. Neither the boring head nor the shell pump, however well they might answer for soft rocks, seemed calculated for hard and highly-inclined beds. He should like to hear of some actual comparison under the same conditions between this pump and the ordinary shell, for it did not seem probable at first sight that a more rapid current of water could be obtained through the bottom valve by a suction-pump than by allowing the shell and heavy rods attached to fall downwards in the water. It was very important to have all tools used at the depth of several hundred yards as simple in construction as possible. A great difficulty found in these rope borings occurred when the boring tool broke and jammed, as then rods would probably have to be put down to extract the tool, if the hole was not altogether abandoned. The chief difficulty consisted, however, in boring the holes so true and straight that tubes could be put down to secure the soft strata when necessary, a difficulty which the boring-head exhibited was hardly calculated to overcome. It might be desirable, for the purpose of calling the attention of persons interested in borings, to those improvements which had had the test of long practice, to mention that the great steps which had been made were due mainly to the introduction, by Mr. Kind, of the free-falling tool, the substitution of wooden rods for iron, and a means of cutting out cores in the holes as specimens. The free-falling plan left about sixty feet of the rods attached to the chisel to fall with it. As the upper part of the rods acted only to suspend the tool and raise it, they did not fall with their weight upon it to jam against the sides of the bore-hole, which was the main cause of the delays and accidents in ordinary boring. By introducing light wooden rods, and the free-fall system, when the Mondorf boring was half-executed, the lower half of the hole was bored in less than half the time and cost of the upper half. Some of the borings which he had seen in operation were proceeding at the rate of from eleven to fifteen yards per week. The diameter of the hole was 1 foot, the weight of the tool 10 cwt., the number of strokes from 8 to 25 per minute, and the fall varied from 1 to 3 feet. By means of a crown borer and a cylinder with teeth inside, cores 8 inches in diameter, and from 1 to 3 feet long, were brought up and laid on the surface of the

ground in the same relative position which they occupied underground, so that the amount and direction of the dip of the strata could be ascertained, as well as the commercial value of the mineral gone through. The following table contained some interesting particulars of borings which had been executed:—

ABSTRACT OF REGISTERS OF BORINGS ON KIND'S SYSTEM.

| Localities. | Diameter of Bore. | Depth in Yards. | Time in days of 12 hours. | Cost of labour and material per yard. | Cost of the Boring. | Nature of the Rocks. | Observations. |
|---|---|---|---|---|---|---|---|
| | Inches | | | £ s. d. | £ s. | | |
| At Montmorot Jura, No. 1 | 12 | 164 | 84 | 0 19 8 | 160 10 | Shifting sand and gravel, 33 yds., lias marls, 43 yds., gypsums, 66 yds., saliferous, 22 yards. | |
| Do. No. 2 | do. | 185 | 112 | 1 2 0 | 203 12 | Do. | |
| Do. No. 3 | do. | 309 | in progress. | | | | Without cost of installation, and carriage of tools, &c. |
| At Stiring Moselle, No. 1 | do. | 327 | 354 | 0 19 1 | 311 11 | N. red sandstone, 88 yds., carbfs. grits, and shales 131 yds., coal measures, 108 yards. | |
| Do. No. 2 | do. | 355 | 422 | 1 0 11 | 372 5 | Do. | Employing a small engine and attendant. |
| Do. No. 3 | do. | 295 | 330 | 0 19 8 | 289 11 | Do. | |
| Do. No. 4 | ft. in. 4 0½ | 120 | 216 | 1 4 4 | 146 0 | Do. | |
| At Guines Pas de Calais | 12 In. | 263 | 86 | 1 1 9 | 285 17 | White Chalk, 100 yds., hard grey chalk, 163 yards. | |
| At Vizernes Do Boring 764 yards | 12 In. deep. | 159 | 37 | 1 0 7 | 164 0 | | Without cost of installation but including tubing. |
| At Mondorff, Grand Duchy of Luxembourg by old system | 10 In. | 371 | 37mon | 5 1 0 | 1873 0 | Chalk, 46 yards, white grit, 14 yards, keuper, chalk, and gypsum, 86 yds. | |
| At Mondorff, Grand Duchy of Luxembourg by new system | 10 In. | 393 | 14mon | 2 2 0 | 829 0 | Gypsum, 35 yards, red marls 87 yards. quartz grit and red sandstone 292 yds. | |

One shaft, which he saw at Forbach, had been bored of a diameter of fourteen feet, to a depth of 100 yards, in nine months, by means of chisels fixed on iron arms, and worked in a simple manner by a 12-horse engine. He was happy to admit that Mr. Mather's machine, though not altogether new, exhibited great ingenuity; it offered many suggestions, but he had failed as yet to show that it was capable of boring to 1000 yards, or one quarter of that depth. Fauvelle's system gave, as he had shown in one instance, a much higher result, but failed in some others. Practical men, especially in a matter of boring, required the test of practice, and the question of cost had not been touched upon at all. Improvements in rope boring had always offered a very tempting field, from the facility with which the tool was raised up and down; and, in the hands of gentlemen of so much energy and enterprise, there was great hope that the difficulties hitherto attending it might be overcome. The criticisms he had ventured to make were in no unfriendly spirit, but with the view of awakening inquiry, and to promote the discovery of those vast resources of coal which there was no doubt lay for hundreds of miles in extent along the edges of existing coal-fields, but were covered up with the new red sandstone. By knowing what had been done on the Continent, we knew what we had to do to excel— a success he trusted there would be no delay in attempting, and he should be very glad to see the inventor of this system fill up this vacant niche in English mining engineering.

Mr. Fraser would not attempt to follow Mr. Mackworth through his excellent *resumé* of the improvements in earth-boring, but having given particular attention to the plan before the meeting he would refer to what he considered its distinctive features. He had lately deepened a well by boring in the chalk 125 feet; the original depth was about 400 feet. The plan adopted was the old system of jointed rods with a chisel at the end; after the rods had been worked for a considerable time, the rods were disconnected and the shell screwed on in the place of the chisel to remove the debris; the chalk through which the tool passed was completely pulverised, and the result of a day's work was often very dispiriting; the smallest of the specimens shown by Mr. Mather were larger than any he had seen brought up by the old shell; their circular boring head had dislodged the pieces of red sandstone and limestone now exhibited, and the facility with which the tool could be raised or lowered 400 or 500 feet per minute, for the purpose of repairs, was one of the great improvements. He thought that sufficient attention had not been drawn to the shell pump, which they used after the boring-head had done its work. It could be lowered to the bottom of a boring equal in depth to the celebrated well at Grenelle, and discharge its contents on the surface in less time than the speaker had occupied, bringing up pieces of iron and broken parts of the boring tool, through the partial vacuum formed by this ingenious pump. He thought that it would be unnecessary to go to the Continent in future for an engineer to sink a well similar to the one in progress at Highgate, and that Mr. Mather was deserving of their thanks for a paper which was worthy of place amongst the important papers which had been read to the Society during the session.

Mr. Homersham, C.E., had had some experience in boring, especially in chalk, though not to the very great depths mentioned by Mr. Mackworth. He had bored to depths of from 400 to 500 feet, and looking to the best systems of boring that had been in use in this country, and looking to the machine before them, he considered that a great improvement would be effected by means of it. He thought the shell-pump, as there applied, to bring up the *debris* from the bottom of the bore, would be the means of fetching up the broken rock much quicker and with greater certainty than was done by the use of the common shell and miser. He, therefore, was not surprised to see the large piece of iron that had been brought up by the shell pump from the bottom of a deep hole, and which was exhibited upon the table. In fact, the deeper the boring was, the more effectual would be the action of the shell pump, owing to the great power of a high column of water rushing into the vacuum created by the action of the piston. The apparatus being entirely worked by steam instead of by manual labour, he considered a great improvement upon the old system of earth-boring, and he felt that they were under great obligations to Mr. Mather for having so ably brought the subject before them.

Mr. Mackworth would be glad to hear from the inventor whether he could give any idea of the comparative working of the ordinary shell and the pump used by him; whether they had been tested under similar circumstances?

Mr. Mather said, with reference to the power of the pump in comparison with the ordinary shell, the great difficulty with the latter had been to remove the loose gravel from the bottom of the boring, as the shell could not get hold of it; but send down this pump, and every particle of gravel or sand was taken into it by the absorbent power possessed by the pump, by which means the bore-hole was kept perfectly clear at the bottom. This could not be the case with the old shell, which, under any circumstances, would leave a portion of *debris* in the hole. Specimens of broken cutters, and a ball of iron weighing three to four pounds, were here produced, which had been brought up by the shell-pump from a depth of nearly 200 feet with the greatest facility. Mr. Mather entered into an explanation of the grapnell by means of which the boring-head, weighing 17 cwt., could be at once taken out of the bore in case of its becoming detached by any accident, and stated that in the only case in which this event had occurred the boring-head was so recovered, with the loss of a few minutes only in time. With reference to the hardness of the strata which had been bored by this machine he thought the specimens on the table afforded a sufficient test of the capabilities of the machine.

Mr. Hensman remarked, that the objection to this instrument taken by Mr. Mackworth had been with regard to its use where the strata existed at considerable inclination. He (Mr. Hensman) thought that by increasing the length of the boring head, there could be no difficulty in sending it through strata of considerable inclination. As regarded the valve at the bottom of the pump, he thought an improvement might be made upon that which the inventor had employed. He would ask what was the greatest length of boring head they had used.

Mr. Mather replied about 8 feet.

Mr. David Chadwick (of Salford) said, having had an opportunity of seeing the machine at work, he should be wanting in his duty if he did not bear his humble testimony to its great efficiency. He had witnessed its operation, when the work performed was equal to 21 inches per hour, or 6 vertical yards in 10 working hours. As an earth-boring machine, he considered the invention one of very great importance, and as every town was now being supplied with water from artificial sources, such an instrument was of great value. He thought this machine had been unnecessarily depreciated by comparison with the Chinese system of boring with a rope, of which he had heard, but it had never occurred to him that the inventor was indebted to that method for the improvements he had effected. The machine might be compared to a combination of Nasmyth's steam-hammer with the boring tool, and was as perfectly under the controul of the operator as the machinery of a steam-boat upon a river; besides which, the operation was most rapid, with an absence of all complication. In the Philosophical Transactions of the Royal Society would be found a most amusing and interesting account of the boring of the artesian well at Holland House, where great difficulty was experienced. It would seem, from the observations of Mr. Mackworth, that they were chiefly indebted to foreigners for all that was great and good in earth-boring, but there was something to congratulate themselves upon—that this was the invention of an Englishman, although he was not there to say that it was not susceptible of improvement, to which no doubt the inventor himself was alive. Mr. Mackworth had objected that boring through red sand-stone was not a sufficient test of the capabilities of the machine to penetrate hard strata, but it was to be recollected that this was, comparatively speaking, a new invention, and he believed he witnessed the boring of the first hole by it. At the same time, Mr. Mather himself was no novice in the practice of boring, and therefore, if objection were made to the machine, it could not be upon the score of inexperience in such operations, and that would not prevent any improvement being pointed out. He would only further remark that he believed the machine had been at work in Yorkshire upon a material that would sufficiently test its capability for perforating hard substances, and had been found to work most satisfactorily. Beautiful as was the model before them, they could form no idea of the practicability of the invention, without seeing the machine at work. He had himself the highest opinion of its efficacy as an earth-boring instrument, and he considered it a decided improvement upon existing methods.

Professor Tennant inquired what thickness of the harder stone exhibited upon the table, had been gone through in the boring on which the machine was now occupied.

Mr. Mather replied about six yards.

Professor Tennant thought that was a very good test, as it was a far harder material than any of the specimens of red sandstone on the table. He had only just come from an inspection at the Geological Society, of specimens of the silicious pebbles from the boring at the Highgate-road well, which were harder than any of the strata before him, and when a boring machine had to contend with that it was very formidable. He had learned that day, that they had got to a depth of 1200 feet with that boring, and that during the last 12 days it had gone on very rapidly, the depth having been increased from 1166 feet, to 1200 feet.

Mr. Carter, of Halifax, said, with regard to the silicious pebbles, the professor would find that the flint formations in the chalk, though probably of equal hardness, did not present nearly as much difficulty of perforation in ordinary cases as the stratum of which the piece on the table was a specimen.

Professor Tennant—This is a limestone.

Mr. Carter replied, that the stratum, though containing lime, could scarcely be called limestone; the labour of perforating it, however, presented a work of great difficulty, owing to the thickness and the compactness of the material; but although the progress through it was slow, it was equally certain and sure. With reference to the boring head, he would remark that to adapt it to hard material of this nature, the cutters had been reduced to half the length of those in the implement exhibited on the table. By this means the required stiffness had been obtained. He remarked that the machine had only been experimentally tested in the new red sandstone until it had been very recently applied under his direction in the neighbourhood of Halifax, to the far more variable and difficult stratification of the coal measures and underlying rocks of the millstone grit formation. It was only a few days since the hard and compact rock had been penetrated, and they found that a little more time was necessary for the perfecting of the instrument to adapt it to all the different kinds of strata which might have to be perforated. With reference to the pump-shell, he was satisfied that as they obtained by its action an almost complete vacuum, specimens like those on the table would be brought up with perfect facility, whilst the improvements in the implements might remove all difficulty in the perforation even of material as hard as that exhibited on the table.

At the request of Mr. Wilson, Mr. Mather explained the action of the steam-engine in lifting the boring-head.

The Chairman then conveyed the thanks of the meeting to Mr. Mather for his very interesting paper.

The Secretary announced that on the evening of Tuesday next, there would be a meeting at the Society's house in reference to the Trade Museum, which members were invited to attend. Also that there would be no Ordinary Meeting on the evening of Wednesday next, the 6th of June, as on that day the private view of the Chalon Exhibition would take place.

## THE PAST AND PRESENT POSITION OF LIFE-BOATS.*

By Andrew Henderson, M.S.A., & Assoc. Inst. C.E.

The term "Life-boat" was, properly speaking, first applied to a boat invented by a Mr. Henry Greathead, of South Shields, for the purpose of preserving the lives of shipwrecked persons. The following circumstances gave rise to this invention.—

In September, 1789, the ship *Adventure* was stranded on the Herd sand, on the south side of Tynemouth harbour, amidst tremendous breakers—the crew dropping from the rigging, one by one, in the presence of thousands of spectators, not one of whom could be prevailed on by any reward to venture out to their assistance.

On this occasion a committee of gentlemen of South Shields offered premiums for plans of a boat which would best resist the dangers of the sea, particularly of broken water. The preference was given to Mr. Greathead's design. Being the first boat built for this special purpose, a description of her will be interesting, especially as we possess a model, presented to the Society of Arts by its inventor upwards of fifty years ago. It will be seen that this was a broad shallow boat, with rising floor, curved keel, and very great shear of gunwale, with three sliding keels, the sides and inside of bottom being lined with near 7 cwt. of cork. After many years of trial, Mr. Greathead petitioned the House of Commons; a Committee of the House took evidence, and awarded him £1200. Beyond this, he received from Lloyd's 100 guineas; from the Corporation of the Trinity House 100 guineas, and from our Society of Arts a gold medallion and 50 guineas. Such was the reception Mr. Greathead deservedly met with from scientific and other societies of his day for this first step towards the construction of a truly useful life-boat, which, if not perfect, was at least well adapted to the north-east coast of England.

It may be observed that this type of the English life-boat, being broad and flat-bottomed, with bilge-keels, was enabled to cross the bars of rivers, or to land on a beach in little water, and like the Musulu boats on the Coromandel coast, was without ballast, extra buoyancy, or means of freeing itself from water. Both boats steer with an oar, and are entirely dependent on the skilful management of an experienced crew on the coast or harbour where they may be stationed. The sliding keel is of much use in deep water, or when the boat is under sail, and being easily removed, it forms no impediment in launching or communicating from the shore to a stranded ship, as a shore life-boat.

The first effort to provide means of communication with the shore from the wrecked vessel herself, or a "ship's life-boat" appears to have been made, in 1828, by the late George Palmer, Esq., of Nasing-park, formerly a commander in the E.I.C. merchant service, and lately M.P. for Essex, and deputy-chairman of the National Institution for the Preservation of Life from Shipwreck. Through this Institution, in 1828, Mr. Palmer circulated a sketch and specification of his boat and fittings, the extra buoyancy consisting of air-cases and casks in the wings, bow, and stern, under the thwarts. She was built as a whaleboat, sharp at both ends, so as to pull against a head sea, with few hands, to draw little water, and to be light in weight. After undergoing practical trial in 1828, the model was adopted by the Shipwreck Institution, and from that period to 1854 twenty-nine life-boats on this plan have been placed on the coast, many have been carried by Indiamen and other ships, and some established by the French Government.

The great shipping ports of the Tyne on the east coast and the Mersey on the west, having most requirement for the services of life-boats, possess the most efficient establishments, maintained at Shields, Sunderland, and other ports by local committees, while the Liverpool Dock Trustees have life-boats on six stations at the entrance of the Mersey and Dee.

Those on the east coast are of the form of Greathead's life-boat, modified by the introduction of buoyancy under a platform, or water-tight deck, with tubes passing through to allow the boat to free herself of water if shipped in a sea way—some having the addition of water ballast under the platform. The Liverpool life-boats on Costain's model are a modification of Mr. Palmer's form and fittings, but are of greater breadth and rise of floor, the extra buoyancy consisting of air-casks under the thwarts. They have, however, neither iron nor water ballast, relieving tubes, valves, nor self-righting power. But during the last fourteen years' service they have assisted 312 ships and saved 1261 lives without upsetting. They are fitted with sails, are generally towed out by steamers, and are maintained with experienced crews, at a cost of £2,000 a year.

In 1849, the Tyne life-boat, manned by 24 pilots, went out to aid the *Betsey*, on the Herd sand; when alongside a heavy knot of sea recoiling from the bow of the vessel caught the bow of the boat and turned her up on end, throwing the crew and water ballast into the stern sheets; she turned completely end over end, and went on shore bottom up, when 20 out of 24 of the crew were drowned under the boat. This occurred to a large improved boat, 33 feet by 11, very broad and shallow, with round floor and great sheer of gunwhale, a water-tight platform or deck one-third the depth above the bottom, covering an air case of 22 cubic feet, with a water ballast tank, open at top or centre, containing 30 feet, air casks fore and aft under thwarts, delivering tubes through deck, and bottom fitted with valves.

This sad accident was partly attributable to the movement of water on the platform and in the ballast tank. The form and fittings of this boat are given because this lamentable loss of life, with other shipwrecks, induced his Grace the Duke of Northumberland to offer the sum of 100 guineas for the best model of a life-boat, to be sent to the Surveyors' Department of the Admiralty by the 1st of February 1851. The chief objections to the present life-boats were then stated to be, 1st. That they do not right themselves after being upset. 2nd. That they are too heavy to be readily launched. 3rd. That they do not clear themselves of water fast enough. 4th. That they are very expensive.

Captain Washington, R.N., (the present hydrographer,) and a committee of naval officers and surveyors, were appointed to examine the models and award the prize. The result was, that 280 models and plans were sent for consideration, many of which were exhibited at the Great Exhibition. In June 1851 the Committee made their report, agreeing on fifteen points which they considered the essential qualities of a life-boat, with numbers in the order of their precedence making 100. The numbers adjudged to 37 boats varied from 60 to 84. The prize was awarded for the latter number to Mr. Beeching, of Great Yarmouth, his being considered to be the best model of a life-boat.

This report, accompanied by plans, drawings, and detailed descriptions, was prepared at the expense of the Duke of Northumberland, and 1,300 copies were gratuitously distributed by his Grace, affording much useful information, most difficult of attainment, not only with regard to our own coasts, but to the maritime nations of Europe and America. His Grace at the same time expressed his intention of placing the best life-boats that could be built on all the exposed points of the coast of Northumberland.

A catalogue of the models and plans gives the length, breadth, depth, weight, and cost of all. Thirty are described in detail, with observations, and there are published plans and sections of the internal construction and disposition of buoyancy of thirteen life-boats, commencing

* This paper was to have been read at the meeting of the Society on the 18th of April, but the time at the disposal of the meeting did not admit of this being done.—Sec.

with Mr. Beeching's prize model, which is stated to be ballasted with two tons of water and with a half-ton iron keel. By means of raised air cases at the extremities it was said she would right herself. Remarks were also made on her great weight and deep keel, and that through the large area of tubes, with the crew on board, the water would be above the decks.

There are plans of Teesdale's and Farrow's boats, on the principle of water-ballast under a platform, and of Hinks, Plenty, and others, having the space below the platform filled with cork. Also plans of boats by George Palmer, Esq., Costain, of Liverpool, White, of Cowes, and others used on our coast, having their buoyancy in air cases, casks, or compartments at the side and bilge of the boat.

The report states, that the different boats are delineated, to enable a boat-builder to make choice of one adapted to his coast; and that Mr. Peake had prepared a drawing, showing a plan and section of a thirty-feet boat, in which, profiting by experience in the examination of the models, all the best qualities of a life-boat are said to be combined.

The Committee state the conclusions they have come to as to form, dimensions, material, and internal fittings, adding that the breadth should never be less than one-fourth the length, and the depth one-third the breadth, the weight one and a quarter cwt. for each foot of length: a fair rule. Extra buoyancy, or that required beyond the materials used in the construction of the boat, is described as the characteristic feature of a life-boat requiring great consideration. The report concludes with the life-boat regulations of the Royal National Institution for the Protection of Life from Shipwreck, of which his grace the Duke of Northumberland had become president, and the naval officers who awarded the prize became members of the committee of management.

With this report was published a "Wreck Chart," on which were marked the life-boat stations and wrecks at the principal ports of England, Scotland, and Ireland in 1850, with a statement that there had been 681 vessels wrecked on the three coasts, causing the loss of 784 lives, while there were only 96 life-boats on the whole of the coasts of the United Kingdom, half of which were unserviceable, thus showing the urgent necessity for extending an improved means of preventing shipwreck and loss of life by the increased establishment of more efficient life-boats. These objects were promoted through this, the Society of Arts, in March, 1852, by the diffusion of valuable information, contained in the admirable paper on the "Progress of Naval Architecture," and on "Life-Boats," by Captain Washington, R.N., (14th lecture on the Results of the Great Exhibition,) in which he passes in review the principal established life-boats and models, and offers opinions as to their essential qualities, and suggests the means of diminishing the frequency of shipwreck and thus preserving life when exposed to it, concluding with the opinion that past experience declares the means are within our reach, the question only needing to be grappled with in earnest to overcome all difficulties.

Concurring in these views, I have for many years taken deep interest in the management of the "Shipwrecked Fishermens' and Mariners' Society," especially since its incorporation, in 1850, with the establishment of a department to provide life-boats on the coast, and exhibit an improved construction of fishermen's boats.

With this object, as a member of the Life-boat Committee of that Society, I concurred in the purchase for £50 of Francis's corrugated-iron life-boat, stated to weigh half a ton, and to be adopted by the government on the coast of America. She was brought to this country by the frigate that brought their produce to the Great Exhibition in 1851, where her model might be compared with the prize model and many of the 280 competitors; but, unlike the prize model, her trials were made on a full-sized boat at Woolwich, where she was found to weigh 19 cwt., was deficient in stability and buoyancy, and was reported to be unsuitable as a life-boat by the Northumberland Committee.

The Northumberland report and prize-boat, the Great Exhibition, and the publication by this Society, had created much interest and competition in the construction of an efficient life-boat, together with some dissatisfaction that the prize had been awarded without any practical trial of a full-sized boat, and a feeling existed that too much importance had been attached to the property of righting herself when upset.

The very great diversity in the form, fittings, and material of the 280 models proposed, renders it most difficult to ascertain their relative merits. A boat admirably adapted to one locality and service, may not be found efficient in others; and again, an experienced and skilful crew can work a boat with safety and efficiency, which, in the hands of strangers, would be comparatively dangerous.

To facilitate comparison, since the publication of the Northumberland report, I adopted their tabular form, containing the particulars and dimensions of the principal life-boats competing for the prize, and I have added further particulars in twenty columns, to afford a closer analysis of their relative proportions, resistance, form, bulk, displacement, and buoyancy, and the form is illustrated by diagrams of their midship sections, and the angle of light and load water lines, with a short account of the properties and service of each.

This table* comprises the Musulu boat, so much used on the high surf on the Madras coast without life-boat fittings. There are five of the type of Greathead's boat, the Tyne and Shields boat, elaborately fitted with cork, air-cases under deck, delivery tubes, and water ballast, including Beeching's prize model.

Lines 8 and 9 exhibit the Percy life-boat, built at Woolwich Dockyard, for the Duke of Northumberland, on the plan recommended by the Committee as a guide, in which all the best qualities of a life-boat should be combined. She was completed November, 1851, and when tried was found to possess very great stability and buoyancy; but when turned keel upwards, she could not be righted by the crew, till lifted over by the crane. It was evident at the trial that she had too much stability to be sea-kind, and would be uneasy and slow in a seaway.

The dimensions of this boat will be found in the 8th line, the proportions of length being 3·41 times the breadth, and a depth of 0·51, or half the breadth; the external bulk being 519 cubic feet to the height of gunwale amidships, with a displacement loaded to two-thirds the height of gunwale of 9 tons 5 cwt., and at light line 3 tons 18 cwt., on a draft of water of 14 inches, thus exhibiting a very great capacity for weight or burthen.

As to form, a reference to diagrams will show this boat to have a very flat floor of only two degrees rise, with straight sides, the angles of the light water lines from the midline being 22 degrees, and of the load lines 34 degrees.

Line 9 exhibits the same boat altered by Mr. James Peake, reducing the breadth 9 inches; thus increasing the proportion of length to 3.71 breadths; decreasing the angle of water line to 12 and 16 degrees light lines, and 22 and 25 degrees load line; and also increasing the rise of floor. Two other boats, of 21 and 27 feet, built on this model at Blackwall, had three feet added to their bows, to bring them to the same proportions.

The internal fittings of these boats underwent repeated alterations, resulting in the removal of three-fourths of the cork under the platform, and the substitution of air compartments formed between water-tight bulk-heads across the boat. The wing or bilge space for one-third the length was fitted with boxes containing from three to four cwt. of cork as buoyancy and ballast, the latter increased by a cast-iron false keel of from five to seven cwt.

* This table may be obtained by application to the author.

A platform, or water-tight deck, a little above the line of flotation (except a space amidships occupied by a well for anchor and cable) has four delivering tubes on each side through the bottom, fitted with self-acting valves, that relieve the boat of water to the line of flotation, and prevent its admission from without.

The alterations in the form and fittings of these boats occupied many months. The boat built at Woolwich at the expense of the Admiralty was tried at Brighton. It was found to right herself, and was eventually established at Cullercoats. Six boats, on the modified plan, were placed by the Shipwreck Institution at the ports mentioned in lines 11, 12, and 13, and have been tried on their several stations. There is no information published as to the detail of their alterations, trials, and fitting, but judging from the boats now in course of construction, the experience gained by these costly experiments and alterations have led to great improvement in the form, workmanship, and disposition of buoyancy and ballast upon the boat originally designed. They are different from the prize model of Mr. Beeching, both in principle and detail. Such boats are well adapted for the Coast Guard, and all stations where there are experienced crews, but they require great care, are not adapted to other purposes than life-boat service, and are more costly and heavy than was expected.

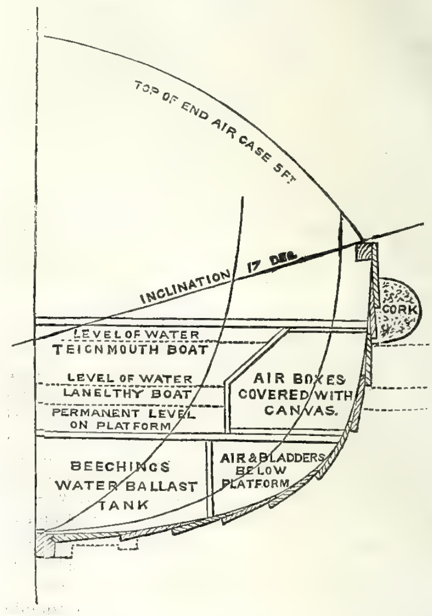
The "Shipwrecked Fishermen's and Mariners' Society" being the other only public body that has undertaken the provision of life-boats, it may be necessary to state, that it was instituted in 1839, by gentlemen connected with the mercantile marine, to provide for all sea-faring people shipwrecked on our coasts, and to assist fishermen, seamen, or their widows and families, on a subscription of 2s. 6d. per annum. The number of subscribers exceeds 36,000, many of whom contribute 3d. per annum towards the life-boat fund, which, together with a grant, donation, and subscriptions, exceeded £2000 in 1852.

The society was incorporated in 1850, and is under the patronage of influential noblemen, and the management of a large Committee, principally of naval officers, the subscriptions from fishermen and seamen exceeding £6000 a year, with donations to the amount of £1000, which enabled them, in 1853, to relieve 5,474 shipwrecked persons, mariners, and widows. These funds are admirably distributed through the instrumentality of 500 honorary agents in different parts of the country, and the systematic arrangements of the central office in London are well carried out by the secretary and travelling secretary.

The Life-boat Committee of the society commenced operations by the purchase of Francis's corrugated iron life-boat. When there was much difference of opinion as to the claims of Mr. Beeching to the prize, and when the best life-boat was still an open question, the Life-Boat Committee of the Shipwrecked Fishermen's Society, or a limited number of them, including the paid secretary, Mr. T. Lean, Purser, R.N., adopted the prize model for the Society's boats, ordering three from Mr. Beeching, on his own plan and terms, viz., £4 9s. per foot.

The peculiarities of Mr. Beeching's model and patent mode of fitting life-boats will be seen by reference to the annexed diagram of the midship section, from a drawing and specification of a 28-feet boat, which was tried at Woolwich dock-yard in November 1851, in the presence of the committee who awarded the prize. This boat, estimated at 22 cwt., weighed 29½ cwt., and with oars, sails, and crew, 50 cwt. She had 19 cwt. of water ballast, and when upset under a crane righted herself readily. With crew on board, she drew 20 to 21 inches of water, the tubes admitting water 4 or 5 inches on top of platform. (See diagram.) This boat was sent to Teignmouth and tried 15th January, 1852, and when turned over under the crane lay bottom up three or four minutes, and with a crew of twelve men the water rose to within two inches of the thwarts. In December 1851, the Lytham boat, of the same dimensions, was tried at Liverpool by myself, and the secretary Mr Lean, and when upset under the crane she righted herself; but on the suggestion of Mr. Beeching, some 14 or 16 men getting on one side, she upset, and remained bottom up three or four minutes, till assisted by the Liverpool life-boat men, most of whom expressed their opinion that she would prove dangerous.

BEECHING'S PRIZE LIFE-BOAT.




In 1852, the society sent the prize-model boats to Tenby, Llanelly, Port Madoc, and Newhaven. The annexed midship section of one of these boats shows their form and fittings; the results of their trial being most important, I will here give a description of one of them. The platform, or air-tight deck, is one-third of the depth above the bottom. The principal feature is the water-ballast tank, extending over three-sevenths of the length and three-fifths of the breadth amidships. A 28-feet boat will contain upwards of a ton of water. The air space at the side and end is filled with bladders. Eight four-inch tubes pass through the ballast-tank and bottom, relieving the boat of water to the level of flotation. Practically, all Beeching's boats retain the water at a permanent level of four or five inches above the platform for three-fifths of the breadth, as shown on the diagram, and thus, when under sail, or laid over by a sea, this water, shifting to leeward, acts as a counter ballast; and as seen in diagram, the Teignmouth boat, with an inclination of 17°, would have her lee gunwale immersed, and of some three tons of water above the platform four-fifths would be on the lee side, and should the compartments under the platform not be perfectly tight, the water ballast would also shift to the lee side, leaving air or vacuum on the weather side; the alternate pressure of which and the water on platform, actually draws the oakum from the seams.

The *self-righting* power of Beeching's boats was obtained in the prize model by very large air-compartments in the bow and stern, occupying two-fifths of the length and as high as the stem above the gunwales, as shown in the midship section; these compartments contained 30 to 60 feet of air or buoyancy, and forced the boat to right herself, when turned under a crane, or upset; but experience proves that when often repeated, or in a sea way, its efficiency was neutralised by leakage, the increased weight of the boats rendered assistance necessary to right them. This is illustrated by the diagram, where the curved line shows the position of the end air-cases from

stern to gunwale, which when the boat is turned over would be immersed to the level of the thwarts.

Francis's iron life-boat, before mentioned, was tried on the east coast by the secretary, and sent to Rhyl in 1851. On the first attempt to assist a vessel in distress through a cross sea, the water inside the boat remaining above the thwarts, she became water-logged, and was obliged to return. The local committee, requiring a more efficient boat, I proposed to substitute, for her air-compartments under the thwarts, a modification of the internal fittings of Beeching's boat, placing instead of tubes through the boat self-acting relieving valves, at the line of flotation, with pumps for discharging the water below it. These, with an altered disposition of her buoyancy and ballast, were proposed to remedy the want of stability and readiness to become water-logged, so far at least as her peculiar form and materials would allow.

The Society's prize boats having similar difficulties, after several experimental trials the internal fittings of Francis's boat were altered. The amount of water-ballast was reduced, and placed in two separate tanks, fore and aft, one-fourth the breadth amidships, with three wells. The bilge was filled with fishermen's cork, covered with bottom boards rising at the sides. The self-righting power was obtained from air-compartments in bow and stern, of much less capacity than in Beeching's boats. The additional cork and materials increased the weight of the boat to 30 cwt., so that on trial, when upset under the crane, she remained keel up, like the Tynemouth and Lytham boats, till assisted by the crew, and as was the case with the Percy life boat on the first trial at Woolwich. This was mainly attributable to the air-cases under the thwarts and in the bow and stern admitting large quantities of water, it being found impossible to make them tight, though of a very costly construction of gutta percha and planking.

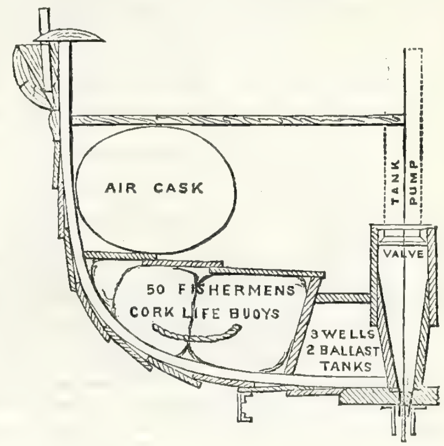
The result of these costly trials and experimental alterations confirmed my opinion of the total inefficiency of Beeching's prize model and water-ballast tank; and although the form and material of Francis's iron boat were unsuited to such fittings, I urged that if air-casks were substituted for the air-boxes and air-compartments in bow and stern, she would be a more safe and serviceable boat than the prize model. Notwithstanding this, the iron boat was abandoned, and another of Mr. Beeching's boats ordered by the Shipwrecked Fishermen's Life Boat Committee for the Rhyl station.

In order to carry out one of the objects of the society, "to exhibit an improved construction of fishermen's boat," and practically to test the usefulness of the principles and alterations I advocated, I designed a boat in which the properties of a life-boat could be applied to the fishing boats in use on our coast, without impairing their utility for the purposes of each locality, or much increasing their cost. In March, 1852, the boat was building at Liverpool, and I took for her type the life-boats of that port, the fishing boats of the Shetlands, and the north country cobble, so as to obtain a light draught of water and facilities in landing on a beach.

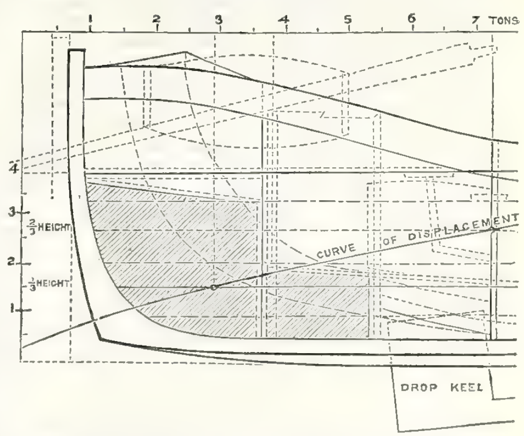
Her dimensions are—length, 28 feet; breadth, 7 feet; depth, 3 feet 6 inches; shear of gunwale, 26 inches; external bulk to gunwale, 568 cubic feet; displacement when loaded to two-thirds of her depth, $7\frac{1}{4}$ tons. Clinch built of larch planks, on eight-angle-iron frames, having bulk-heads athwart the boat to one-third of the depth. The annexed diagrams show this, and also exhibits the form and outside planking, angle-iron bilge, and false keel with iron drop or sliding keel, and also the internal fittings of platform over bulk-head, wells, and tanks, the latter one-third the breadth and one-fourth the depth amidships. The diagrams also show the disposition of extra buoyancy of fishermen's cork life-buoys in bilge, and the position of the air-casks under the thwarts with self-acting valves to relieve the water to the level of flotation, and pumps to discharge the water below.

The peculiarities of construction are the substitution for numerous small timbers of seven or more angle-iron frames, with bulk-heads one-third the depth, which gives strength, and divides the length into water-tight compartments admitting fore and aft partitions. These divide the breadth of the boat into side-bilge, and bottom compartments, the latter only being water-tight, with two water ballast tanks of 29 cubic feet amidships, one-third the breadth at bottom, and one-fourth at top, as shown in diagram. When empty, they would have an extra buoyancy of 16 cwt. While full it would act as water-ballast, or be used as a fish-well by fishing boats. Three smaller open wells collect the water, the centre one containing two relieving valves and two pumps, that clear both boat and ballast-tanks of water.

EXPERIMENTAL FISHERMAN'S LIFE-BOAT, BUILT AT LIVERPOOL.—MIDSHIP SECTION, SCALE $\frac{1}{2}$-INCH TO A FOOT.




SHEAR PLAN OF STERN OF FISHERMAN'S LIFE-BOAT.—SCALE $\frac{1}{4}$-INCH TO A FOOT.




*Self-righting power* may be attained by four air-casks secured above the thwarts in bow and stern, weighing 50lbs. each, and displacing 30 cubic feet or 17 cwt. of water, when the boat is turned over by the sea. The annexed sheer plan of stern of boat exhibits the disposition of air-casks and iron false keel above and below the water-line, which, when the boat is bottom up, displaces half the weight of the boat before the gunwale is immersed, and, counterbalanced by the ballast, causes the boat to right herself.

The boat was launched in October, 1850, and weighed 27½ cwt. Light draught of water 8½ inches, and with 33 men on board, 15¼ inches, and these standing all on one side brought her gunwale down. As a *life-boat*, the extra buoyancy of the hull is half a ton, the air compartments and wells 61 cubic feet, movable buoyancy 24 pair of fishermen's cork buoys in bilge, and 10 air-casks at sides or under thwarts, 38 cubic feet, weighing 4½ cwt., giving an effective buoyancy of 3½ tons, when filled by the sea up to thwarts, sufficient to carry 40 men and to right herself. This was proved by repeated trials at Liverpool and Birkenhead, either with or without water-ballast.

By the self-acting valves, the boat relieved herself of water to the level of flotation in 1½ minutes without water-ballast, drawing 16 inches, and with water-ballast freed herself in one minute drawing 18 inches.

The pumps in pump well, and buckets in bow and stern well, clear the water below, thus attaining the two principal requirements for the prize offered by the Duke of Northumberland, viz, self-righting power and freeing herself of water.

As to the other two points, that the present boats "are too heavy" and "are very expensive." The weight of hull, 27½ cwt., before mentioned, was increased by the movable buoyancy of cork in bilge, air casks and stores, with the addition of 3 cwt. to the angle iron false keel and sliding keel, bringing the total weight of the boat to 36 cwt., or about 1·28 cwt. per foot in length.

The best criterion of relative efficiency, weight, and cost of life-boats obtainable, is a comparison with the result of the costly alterations made in the Percy life-boat at Woolwich in 1852, and in the life-boats since built by the National Life-Boat Institution on the design and under the superintendance of Mr. James Peake, the naval architect of Woolwich Dock-yard. The efficiency of these boats having been tested at several stations by Commander Ward, R.N., the inspector of life boats to the National Institution, we may feel assured that all that could be effected by science in design and seamanship in practical trial, will have been obtained in the last of the seventeen boats built during the last three years.

The recent annual report of the National Institution, published in their Life Boat Journal of May, 1855, contains a statement of the 50 life-boats now maintained by them on our coasts, giving the dimensions, weight, cost, builder, and number of lives saved by each boat.

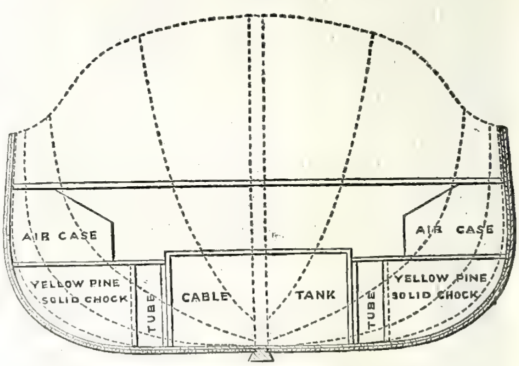
Taking the Cullercoats boat first built at Woolwich, and altered during 1852, and the eight boats of the latest construction, the average dimensions of the nine are: length 28⅓rd feet, breadth 7½ feet, ratio of length to breadth 3·75, weighing 40¾ cwt., or an average of 1·43 cwt. per foot in length. My "Fisherman's Life Boat" is 28 feet long, ratio of length to breadth 4·00, thus closely approximating to the average of the nine, whilst the weight is only 36 cwt. It may be here stated that repeated trials by Mr. Peake and myself rendered it necessary in each case to make a gradual increase in the weight of the iron keel—the latest boats by Mr. Peake having one of cast iron of 9 cwt., while in the Fisherman's Life Boat, by the use of angle-iron false keel, the object is attained at half the weight, by the position of the iron drop-keel, as shown in diagram 3, besides its advantage under sail and safely in a heavy sea or beaching, to which I shall more especially allude subsequently.

The average cost of the last eight boats built on Mr. Peake's design, by Forrest, of Limehouse, is £149 each, or five guineas per foot in length. The cost of the Cullercoats boat, built at Woolwich, is not mentioned, but must have been very considerable, seeing that she was altered both in proportion, form, and fittings, several times, sent to the coast by Her Majesty's steamers, and tried by the coast guard officers before being sent to her station, by which time her cost must have been increased three or four fold. With my "Fisherman's Life Boat," the cost of the first boat has likewise greatly exceeded what they may be ultimately constructed for, which I estimate at £100, or between £3 and £4 per foot, fitted for fishing. The alterations in the "Fisherman's Life Boat" were confined to the internal fittings, and like the Woolwich boat, arose out of the difficulty of keeping the air compartments under the platform water-tight, and from the cork placed under it becoming soaked with wet and losing its buoyancy, and thus preventing the boat retaining her efficiency.

Whatever the extra expense may have been to the Government, the Institution, the Shipwrecked Fisherman's Society, or myself, it will have been a judicious outlay, if the practical experience obtained results in an improved construction of the life-boats stationed on our coasts, or making the existing fisherman's boats to have the properties of a life-boat.

The result of Mr. Peake's experiments is shown by his last boat being four times as long as she is broad, with a flat floor and straight sides, but fine lines in bow and stern, with a considerable sheer of gunwale. The planking is of diagonal pine, and there is a water-tight platform or deck, one-third the depth, resting on four stout pine bulkheads athwart the boat, secured to bottom to form air-tight compartments in bow and stern, the bilge spaces being filled with blocks of light pine, instead of cork or boxes, as heretofore. In the midship part of the platform is a covered well, containing anchor, cable, and stores, with air boxes at the sides under the thwarts, and air compartments in bow and stern up to height of gunwale. These assist in giving the power of "self-righting," and are aided by a thick cast iron false keel, bolted to keel bottom and keelson, and weighing about 1 cwt. to every 3 feet of length. The boat frees itself of water by six tubes through the bottom fitted with self-acting relieving valves at the height of the platform. She is fitted to steer with oars, and to pull 8 to 12 oars double banked, to carry a small lug sail, and is provided with improved life belts, waterproof coats and boots, and everything requisite for the special service of a life-boat at most of the stations on our coasts.

MR. JAMES PEATE'S LIFE-BOAT.




Thus it will be seen that the repeated experiments of Mr Peake and myself have led to the adoption by both of a model very similar in its details, the only difference being, that whereas Mr. Peake's is intended for a coast life-boat only, useful for no other purposes, mine is for giving to a fisherman's boat the properties of a life-boat when requisite.

With this view, the "Fisherman's Life Boat" is fully rigged with a lug foresail and mizen, similar to the numerous fishing boats on the coast of Cornwall and many of the Scotch and Shetland boats, the masts being stepped in three moveable trunks, as used by Chinese fishing boats, so as to alter the rake to suit the action of the sails when going free or on a wind, these being used as a standing lug in tacking, the sails having battens similar to the Chinese sails, to keep them to their masts and facilitate reefing. Like the east-coast luggers, they are intended to carry a mainsail in fair weather, the trunk being fitted with

a winch to work the gear, trawl, or lines; there are also two wells for live fish of 30 cubic feet below the water-line amidships, with openings through the keel, as shewn on section. The cork used for nets may be stowed in the bilge under the platform as buoyancy or ballast.

To test this rig and fittings, the boat was placed at the disposal of four fishermen experienced in the estuary off the Mersey and the Dee, and employed in trawling off Hoylake, in company with numerous fishing boats, which were made shorter and of greater breadth, drawing two to three feet more water, having three to five tons of stone ballast. On trial, the "Life Boat" held good way with the fishing boats while dragging the trawl, but when beating to windward, the deep-keel fishing boats were more weatherly, and the fishermen stated that the life-boat was too buoyant or floaty, and that there was difficulty in keeping the fish wells water tight.

To obviate these objections, the bulk heads and partitions of wells were secured to bottom, the angle iron false keel and drop keel being substituted for the flat false keel, increasing the weight 3 cwt. These have been found to answer the purpose intended, the boat retaining her self-righting power, while at the same time the sliding keel makes her more weatherly and stiff when down, and admits of the boat being sailed into shoal water. She was allowed to take the ground on a rocky bottom without injury in a close reef breeze.

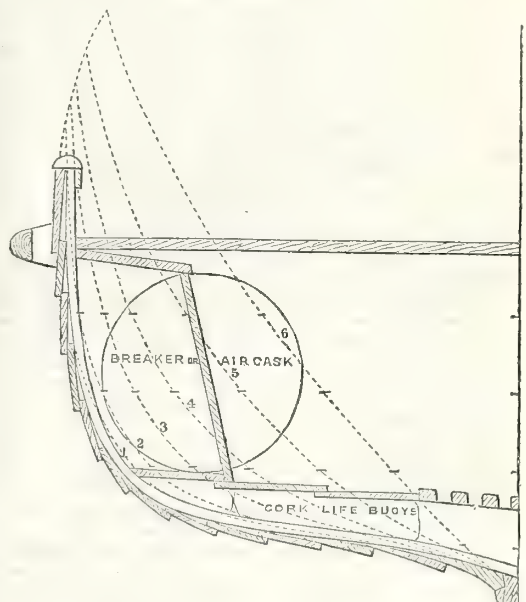
The advantages of this, both to fishing and life-boats, was exemplified last year by the unfortunate loss of one of the crew of the Liverpool life-boat, near Formby, who had gone out fishing in one of these small over-ballasted boats with his son, and was obliged to attempt to land on a sandbank, the boat drawing so much water when she took the ground, that the sea turned her over and drowned the crew. *With the sliding keel up*, the "Fisherman's Life-Boat" would have taken the ground in about two feet of water, where the sea would hardly have depth to turn the boat over or prevent the crew landing. *With the sliding keel down*, the "Fisherman's Life-Boat" would have crossed Rhyl bar, under sail, without upsetting, as Beeching's Prize Life-Boat did, on the 22nd of January, 1853, by rolling over to windward and remaining bottom up till six of the crew were drowned.

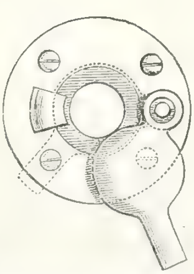
From investigation on the spot, and from the survivors, the upsetting is clearly traceable to the weight of water above the platform, and water ballast below moving to windward with the roll. This destroyed the stability and overcame the buoyancy, as it had before done in so many trials of Beeching's boats. The principle of this latter is now condemned by the alteration of nearly all the boats he has built for the Duke of Northumberland, Ramsgate, and the "Shipwrecked Fishermen's Mariner's Society," who ordered this boat for the Rhyl station in preference to accepting my offer to place at their disposal my Fisherman's Life-Boat.

The magnitude of our mercantile marine, the great increase in the size of our ships, the number of steamers, and our numerous seagoing population, make the exhibition of an improved construction of "ship's life-boat" a great desideratum. Following in the steps of my respected friend, the late George Palmer, Esq., I have designed a plan and specification of a ship's life-boat, with a view to apply the properties of a life-boat to the ship's boats in ordinary use at sea. Bearing in mind the necessity of their being light and strong, and the fittings such as can be easily repaired or removed without increasing the cost of the usual boats, I have designed her to be built of light pine, clench built, on eight angle iron frames, rivetted to an angle-iron keel on stem and stern plate, also to an angle-iron stringer under the thwarts, and an angle-iron gunwale piece. Bulkheads of pine are rivetted athwart the frames, one-fourth the depth from keel and one-eighth the breadth under the thwarts. The disposition of planking and internal fittings are shewn in the annexed diagram of the main breadth section of a medium-sized boat, 28 feet long, 7 feet broad, and 3 feet 6 inches deep, having 10° rise of floor, with the bilge a little hollow near the keel; the sheer of gunwale half an inch to a foot; the water lines hollow forward and straight aft; eight thwarts, 3 feet 6 inches apart.

The buoyancy is comprised in side compartments, between a rising plank fore and aft under the thwarts (between the bulkheads, 1-8th of the breadth broad) and a fore and aft platform over the bulkhead at the bilge; the bow and stern partitions to be made up by a side plank, as shown on the section, between midship thwarts to be filled by 6 air casks or water-breakers; the bilge below the platform to be filled with cork, the boat to be hung to the davits by threefold iron blocks, hooked to a shackle in the stem and stern, as shown in sheer plan, where will be shown the position of the air compartments in bow and stern. The weight of this boat is calculated at one ton, and it will displace about five tons, and when filled to the level of thwarts with water will have buoyancy sufficient to carry thirty men.

SHIP'S LIFE-BOAT.



The small diagram shows a zinc plug, of simple construction, intended to be screwed to the bottom plank, where the usual cork or wooden plug is placed; but as the former gets lost, and the latter often splits the plank, the zinc plug closes by turning a flat ridge over the faced collar or hole, secured in its place by screw and nut.

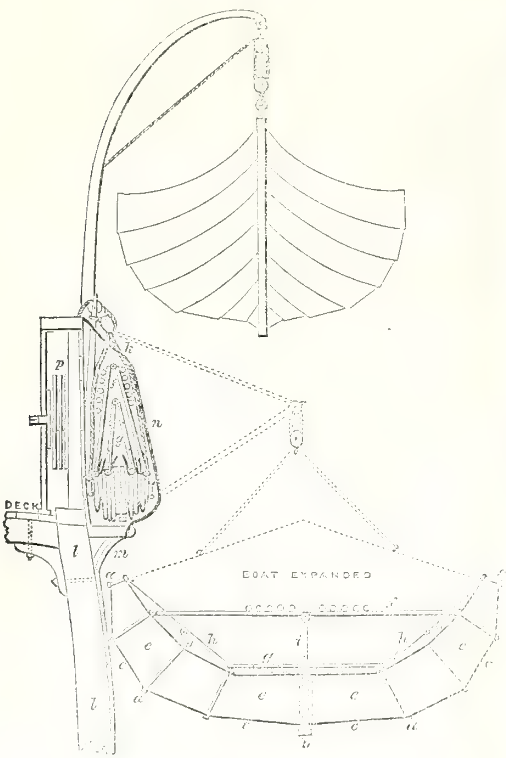
The cost of this plug is 1s. 6d., and I am assured the boats can be built for 18s. to 24s. a foot, by the boat builders usually employed in building ships' boats on a plan and specification which have been lithographed and distributed, in the hope of inducing shipowners to make trial

of such a combination of wood and iron as will give the greatest strength with the least weight.

Lowering Ship's Boat.—With respect to this very important question, after much experience I am convinced that the mode adopted by whalers is the simplest and best. That mode consists in strong davits, a good purchase of two large threefold blocks, with swivel hooks, into a shackle at the top of the stem and stern post. The boat to hang, as will be seen in the annexed diagram of a ship's side, with the usual iron davits and quarter-boats.

Our large steamers, transports, and emigrant ships, might carry a sufficient number of these boats at davits, with the addition of a collapsing life-boat stowed outside the bulwark, with separate davits, as shown in the diagram annexed, as would enable them to be provided with the means of saving all on board in case of wreck or fire, and of disembarking all the troops she could carry.

CONVEYING LIFE-BOATS AT DAVITS.




BERTHON'S COLLAPSING BOAT.

The Rev. J. S. Berthon, of Fareham, having for years devoted much time, labour, and money in the perfection of his invention, the following brief description is offered in explanation of the diagram of his collapsing life-boat, for providing abundant boat accommodation to all sea-going ships:—

The frame work, which is made of wood, with bands and fastenings of metal, is composed of longitudinal timbers running the whole length, and hinged at their ends to each other, and to the top of the stern and stern-post. They are broad and deep, and extend two skins of a very strong flexible waterproof material, the outer skin being firmly attached to their outer edges, and the inner one to their inner edges. The whole body of the boat is thus divided into as many water-tight longitudinal compartment as there are spaces (usually eight) between the timbers. These air-cells fill themselves with air in the act of expansion. Her mode of hanging is shown in the annexed diagram.

The extension of this boat, which is instantaneous, when its weight is allowed to fall upon certain slings or spans attached to its gunwales, requires no exertion of manual strength, and it is kept permanently open by the thwarts, bottom boards, and certain gunwale stanchions.

The space required to stow these boats (viz., outside the ship's bulwarks with strong strappings) is about one-sixth of their width when open, so that numerous boats can thus be carried out board in constant readiness, and when in action they are inferior to none in buoyancy, safety, general efficiency as life-boats, and speed under sail or oars. The cost is about the same as that of the best ship's life-boats.

These boats have been most favourably reported on by the officers of H. M. dockyard at Portsmouth, by order of the Admiralty, and some large pinnaces on this principle now built for the Government will be shortly under trial in the Royal Navy.

Richardson's Patent Tubular Life Boat.—In reference to this boat, I think I cannot do greater justice to the public than by quoting from the remarks upon it by General Chesney, and read by him before the British Association at Hull, in 1853. The general states of the tubular as follows:—" The boat is formed of two tubes of tinned iron, forty feet in length by two and a half in diameter, tapering at either end and meeting each other, thus giving the appearance of sheer. An iron framework, securely rivetted, unites the whole into one mass, the tubes having longitudinal bars of iron and hoops within, and iron keels running from end to end; they are divided into water-tight compartments, occupied by air-proof bags; a cork fender surrounding the whole fabric. The rowers and passengers are placed on a platform above the framework, which is surrounded by a light gunwale the height of the rowlocks. A rope passes along under the kelson, for the purpose of towing. Sliding keels are added, to render her more weatherly. She carries two lug-sails, top-sails, and jib, steers, rows, and sails well. She was launched January, 1852."

The claims of the tubular life-boat do not by any means rest upon speculation or opinion, however sound, for those who are disposed to examine this interesting question at more length will find ample proofs of her capabilities in rowing, sailing, and steering, &c., as detailed in " The Cruise of the Challenger Life Boat from Liverpool to London," published by Pickering.

The gallant author of this communication has always taken a deep interest in life-boats, and has individually been the means of saving life on several occasions; once on the coast of Ireland he swam of to a wreck with a line carried between his teeth, and succeeded in establishing communication with the shore, thus saving the lives of *thirty persons*, at a time when a storm was raging. According to an arrangement made at Hull, a further paper on " Life Boats" was read by General Chesney, at Liverpool, at the last meeting of the British Association, and it was in consequence of that paper and another on a sister subject by myself, that the general committee recommended " that General Chesney and Mr. Henderson be a committee for the purpose of collecting the statistics of the design, arrangement, and dimensions of life-boats." I therefore take this opportunity to beg the transmission of any facts on this subject, either as respects the efficiency or management of life-boats to General Chesney or myself.

Finding no encouragement in this country, the " Challenger" was sold in October last to the Humane Society at Oporto. A tubular boat has since been ordered by the National Life Boat Institution for Rhyl, on the application of the local committee there, and many others are applied for.

Parratt's Tubular Life Raft.—This raft is shortly reported on by the assistant to the Surveyor of the Navy, Blue Book, No. 332, 1854, as simple in its construction

and possessing great buoyancy, and suitable for emigrant and troop ships.

The last journal of the "National Life-Boat Institution" contains the annual report of the Committee, and notices several important matters affecting the general position of life-boats and their management. Among these are—1st. The recommendation by the Committee that in future the Institution should be denominated the "Royal National Life-Boat Institution." 2nd. The transfer made to the Institution of nine life-boats, eight boat houses, and five life-boat carriages, from the Shipwrecked Fishermen's and Mariners' Royal Benevolent Society, and the relinquishment by that Society altogether of its life-boat establishment. In connection with this, the Committee notice that "a large outlay will be required to make alterations and improvements in some of the boats which the Committee consider advisable." 3rd. The Committee allude to the pecuniary aid which will in future be afforded to the Institution by the Board of Trade. The *manner* in which this aid will be afforded will be by repayments to the Institution, to a limited amount, of—

1st. Award to the crews of its life-boats, or others, for saving or endeavouring to save life.

2nd. Payments to its life-boat crews, for a quarterly exercise and trial of their boats.

3rd. The salaries of the coxswains of its life-boats.

4th. The hire of horses, steam tugs, or other means (when necessary) for transporting life-boats to the localities of wrecks.

5th. The payment of persons for assisting to launch and haul up life-boats.

On these conditions the Institution undertakes, from its own resources, supplied by voluntary contributions, to provide and maintain at each of its stations a life-boat of the best description, and amply furnished with everything necessary to make it efficient. To carry out these benevolent designs the amount of income for the past year was, from donations and dividends, £1,744 19s. 4d., whilst the expenditure being £3,672 15s. 4d., the difference could only be provided for by a sale of stock to the amount of £1,927 16s.

Now there are on the coast of England about 100 life-boat stations, 50 of which are at present under the above Institution, and of the remainder the most efficient are at Liverpool, Shields, and other large shipping ports, whilst the rest are various in their efficiency and management—some being in places where it is difficult to obtain efficient crews to man them, whilst some of them have boats which the local fishermen will not use. Of the 50 under the Institution there are only 17 of the improved model, 9 of Palmer's, 14 of the old models, 7 of Beeching's, and 4 of Costain's, White's, and Clarkson's.

These facts, in connection with the very great expenditure of the institution, the aid offered by the Board of Trade from the mercantile marine funds, and the necessity of being guided by local circumstances, have led me to the conclusion that, to provide efficiently and nationally for the preservation of life from shipwreck, there should be attached to each coast-guard station a life-boat of Mr. Peake's design, provided and paid for by the Admiralty, and kept under the management of the coast guard officers, or of the recently-embodied sea fencibles, so that both may be exercised in this as well as their other duties.

This would not in any way interfere with my proposals to place, wherever local circumstances and the development of fisheries permitted it, an improved construction of fisherman's boat, and the application to some of the properties of a life-boat, in the manner described in the "Fisherman's Life-boat." The expenses attending this should most properly be borne by the Board of Trade, the payments being made either to the "Royal National Life-boat Institution," as proposed, or to the "Shipwrecked Fisherman's and Mariner's Royal Benevolent Society," one of the purposes for which it was incorporated being "to exhibit an improved construction of fisherman's boats."

I may here mention that one of the first objects of this Society was, as its name imports, to assist fishermen on the coast, and a majority of the original subscribers were fishermen, who received assistance to replace nets and boats lost, as well as to relieve the widows and children of those who might lose their lives in their calling. The life-boat department of the Society, now handed over to the "Royal National Life-Boat Institution," originated in the melancholy loss of several Shetland fishing-boats, in 1848, when, the crews perishing, many widows and children were left to be provided for at great expense by the Society. This induced the feeling that, as prevention is better than cure, the former could be best attained by improving fishermen's boats.

This object has been gradually lost sight of, many of these subscribers now being seamen and marines of the Royal Navy, and the management being exclusively in the hands of naval officers. After the Society was incorporated, besides the regular subscription of 2s. 6d. per annum, many gave a further sum of 3d. to the life-boat fund, the capital of which was nearly all expended in 1854 on the nine boats lately handed over to the National Life-Boat Institution. This had become necessary from the untoward circumstance of the adoption of Beeching's prize model by the Life-boat Committee of the Society; and, as a necessary consequence, costly alterations were required, and from want of confidence, very little good has been done by organising crews, which should have been one of the most important duties of the Society.

As the National Life-boat Institution and Board of Trade are now providing crews for coast-boats, the Shipwrecked Fishermen and Mariners' Society should devote its funds to the improved construction of fishermen's boats as well as to the efficiency of ships' life-boats and the means of lowering them. They would then, by the former, carry one object of their incorporation as to their fishermen subscribers, and, by the latter, would also be doing their duty to their numerous seamen subscribers, for the loss of any of whom, it must be borne in mind, that the Society have to pay from £3 to £5 to their widows and children.

With the fearful loss of life, both of fishermen and from merchantmen, a great duty devolves both on the Government and also on any society connected with the subject. One thing necessary is, that further information should be diffused, by drawings and specifications of tried boats, so that any party wishing to build may be able to choose the boat which, from his own observation, he may know to have acted efficiently, and I have placed for this purpose in the hands of the secretary full drawings and specifications of a fisherman's life-boat and ship's life-boat, for the use of any who may require them.

As has been suggested by Lord Hardwicke, it would be a most desirable thing were a committee of this and other scientific societies formed, for the purpose of investigating the merits of these as well as other designs, the practical experiment of which might very well be carried out by a committee of the British Association, at the meeting in Glasgow, in August. As a step towards these experimental trials, it may be stated that General Chesney and myself have been appointed by the general committee of that body to report on the statistics of life-boats generally, and there would be no difficulty in making the necessary arrangements for trial in the Clyde, should this proposition be met in the spirit with which it is made.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

Par. No.

*Delivered on 19th and 21st of May*, 1855.

207. Savings Banks—Accounts.

236. Cambridge University—Copies of Communications.

237. Bills of Exchange Bill, &c.—Report from Committee.
238. Freight Money (Greenwich Hospital)—Return.
241. West India Islands Relief—Statement.
242. East India (Sattarah)—Return.
252. Victoria-street Sewer—Return.
222. Merchant Seamen's Fund—Account (a corrected Copy).
128. Bills—Bills of Lading.
130. Bills—Absconding Debtors (Ireland).
131. Bills—Fisheries (British Islands and France).
132. Bills—Personal Estates of Intestates (amended).
134. Bills—New South Wales Government.
135. Bills—Waste Lands (Australia) Acts Repeal.
136. Bills—Railways (Ireland).
138. Bills—Militia (No. 2) (amended),
140. Bills—Brighton Incorporation.
129. Bills—Bankruptcy (Ireland).
Criminal Offenders (Ireland)—Tables.
Public Works (Ireland)—Tables.
Agricultural Statistics (England)—Report of Poor Law Commissioners.

*Delivered on 22nd May*, 1855.

228. Loan Societies—Abstract of Accounts.
254. Assessments (Metropolis)—Return.
246. Foreign Sugar—Account.
249. County Treasurers (Ireland)—Account.
250. Constabulary (Ireland)—Copy of Instructions.
137. Bill—Grand Juries.

*Delivered on 23rd and 24th of May*, 1855.

239. Burial Grounds (Metropolis)—Return.
247. Army before Sebastopol—4th Report from the Committee.
96. Bills—Grants of Land.
123. Bills—Formation, &c., of Parishes.
133. Bills—Grand Jury Assessments (Ireland).
139. Bills—Places of Religious Worship Registration (amended).
141. Bills—Edinburgh Lands (as amended by the Select Committee).
143. Bills—Personal Estates of Intestates (as amended in Committee, and on consideration of Bill, as amended).
144. Bills—Militia (No. 2,) as amended in Committee, and on consideration of Bill, as amended).
146. Bills—Bills of Lading (No. 2).

*Delivered on 25th of May*, 1855.

145. Bill—Truck Act Amendment.

## MEETINGS FOR THE ENSUING WEEK.

MON. Royal Inst., 2. General Monthly Meeting.
Architects, 8. Rev. J. L. Petit, "A few Remarks on Italian Architecture.
Entomological, 8.
Chemical, 8.
TUES. Horticultural, 3.
Royal Inst. 3. Dr. Tyndall, "On Voltaic Electricity."
Linnæan, 8.
WED. Ethnological, 8½.
Pharmaceutical, 8.
THURS. Royal Inst. 3. Mr. G. Scharf, jun., "On Christian Art."
Antiquaries, 8.
Photographical, 8.
FRI. Astronomical, 8.
Philological, 8.
Royal Inst., 8½. Prof. Faraday, "On Richenkorff's Indication Apparatus."
SAT. Royal Botanic, 3¾.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, May 25th*, 1855.]

*Dated 19th January*, 1855.

148. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury —Electro motive power. (A communication.)

*Dated 18th April*, 1855.

860. H. Harvey, 73, Denbigh-street, Pimlico—Application of cork for beds, mattrasses, &c.

*Dated 25th April*, 1855.

919. H. Cockcroft, Haslingden—Self-registering letter box.

*Dated 2nd May*, 1855.

982. Sir J. S. Lillie, 4, South-street, Finsbury—Tents.

*Dated 5th May*, 1855.

1003. J. Beaumont, Elland—Treating wheat meal.
1005. J. H. Dickson, Rotherhithe—Scutching and heckling machinery.
1007. S. Roberts, Hull—Steam engines.

*Dated 7th May*, 1855.

1009. R. Broadbent, Stalybridge, and S. Farron and B. Grundy, Ashton—Steam engines.
1011. Marquis de Balestrino, Genoa—Motive power by explosive gases. (A communication.)
1013. E. Price, Cardiff—Daylight reflectors.
1015. R. Clark, Glasgow—Elastic finish to piece goods.
1017. T. Bazley, Manchester—Creels.
1019. J. H. Johnson, 47, Lincoln's-inn-fields—Hair pins. (A communication.)
1021. J. H. Johnson, 47, Lincoln's-inn-fields—Cocks and valves. (A communication.)

*Dated 8th May*, 1855.

1023. W. B. Wilton, Lowestoft—Steam-engine furnaces.
1024. C. C. E. Minié, Paris—Muskets.
1025. J. Hughes, Chapel-en-le-Frith—Paper.
1026. D. Foxwell, Manchester—Sewing machines.
1027. T. T. Lingard, Manchester—Presses.
1028. R. Needham, Hollinwood—Steam boilers.
1029. J. H. Johnson, 47, Lincoln's-inn-fields—Paper tubes. (A communication.)
1030. J. A. Williams, Baydon—Machinery for driving ploughs, &c.
1031. J. Bowron, South Shields—Glass tiles.
1032. B. Hallewell, Leeds—Drying grain.
1033. H. V. Newton, 66, Chancery-lane—Air engine. (A communication.)
1034. J. J. Imbs, Brumath, France—Cartridges. (A communication.)
1035. T. Williams, 14, Red Lion-street, Clerkenwell, and J. H. Fuller, New Brentford—Wrenches, pliers, and spanners.

*Dated 9th May*, 1855.

1036. R. K. Bowley, Charing-cross—Boots and shoes.
1037. J. Gedge, 4, Wellington-street South—Cleansing rooms. (A communication.)
1038. J. Gedge, 4, Wellington-street South—Woven fabrics. (A communication.)
1039. J. Gedge, 4, Wellington-street South—Spectacle cases. (A communication.)
1040. E., H., and F. C. Cockey, Frome—Clod crushers.
1041. J. M. Worrall, Salford—Cutting piled goods.
1042. J. M. Worrall, Salford—Cutting piled goods.
1043. R. S. Markindale, Salford—Removing wool from sheepskins.
1044. D. Morrison, Birmingham—Metallic bedsteads, sofas, &c.
1045. G. Taylor, Liverpool—Steam-engine governors. (A communication.)
1047. C. Whipple, United States—Preparing and combing wool.
1048. S. Grainicher, Zofingen—Pumps. (A communication.)

*Dated 10th May*, 1855.

1049. C. Mertens, Gheel, Belgium—Breaking and scutching machinery.
1050. J. W. Lewis, Manchester—Lightning conductors.
1051. E. A. Forbush, Ashland, U.S.—Sewing machine.
1052. W. Scott and A. Powell, Birmingham—Rifling and draw-boring gun barrels and ordnance.
1053. A. V. Newton, 66, Chancery-lane—Preparing colours for printing fabrics. (A communication.)
1054. M. Allen, Worship-street—Valve.
1055. E. Eastwood, Long Eaton—Railway carriages.
1056. F. W. Norton, Edinburgh—Figured pile fabrics.
1057. J. Harris, Darlington, and T. Summerson, West Auckland—Iron railway wheels.
1058. C. J. Hunt, Mitcham—Tug and other hooks.

*Dated 11th May*, 1855.

1059. J. Hallam, Sheffield, and J. Elee, Manchester—Rowels or toothed cylinders for self-acting temples.
1060. E. and T. Humphries, Pershore—Riddles for separating straw from grain.
1062. J. H. Johnson, 47, Lincoln's-inn-fields—Sulphuric acid. (A communication.)
1063. C. Henderson, Tufnell park—Locks.
1064. J. Pascall, Chislehurst, and G. Fry, Lee—Blanching, forcing, and propagating garden pots.
1065. J. Steele, Greenock—Drainage of moulded sugar.

*Dated 12th May*, 1855.

1069. F. G. Sanders, Poole—Brick, pipe, and tile machines.
1070. G. Robinson, Manchester—Invalid's bed.
1071. J. Herdman, Belfast—Wrought-iron plates for shipbuilding, &c
1072. W. B. Adams, 1, Adam-street, Adelphi—Propulsion of vessels.
1074. G. Whyatt, Openshaw—Cutting piled goods.
1075. J. H. Linsey, Coleman-street—Account books.
1076. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury —Stone-boring machinery. (A communication.)
1077. F. J. Pieton, Wignehies, France—Knitting machinery.
1078. W. Dray, Swan-lane—Frames for structures.
1079. F. A. Theroulde, Paris—Preserving animal substances. (A communication.)
1080. T. Rickett, Stony Stratford—Pressure gauges.
1081. J. Dupre, Plymouth—Ovens. (A communication.)

*Dated 14th May*, 1855.

1082. J. Higgins, Oldham—Steam boilers.
1083. W. Robertson, Edinburgh—Treatment of fuel.
1084. J. Pettigrue, Drumcree—Propelling vessels.
1085. R. Mc Connell, Glasgow—Girders.
1086. R. Morrison, Newcastle-on Tyne—Steam engines.
1087. J. Buchanan, Glasgow—Healds for weaving. (Partly a communication.)
1088. T. C. Eastwood and T. Whitley, Bradford—Preparing and combing wool.
1089. J. Mason, S. Thornton, and L. Kaberry, Rochdale—Spinning machinery.
1090. A. Robertson, Sheffield—Fire-grates.
1091. R. S. Newall, Gateshead—Laying down submarine electric telegraph wires.
1092. H. C. Garrett, Massachusetts—Lubricating axles.
1093. L. L. Hill, Westhill, New York—Silvering glass.
1094. J. Lackmann, Hamburgh—Sheet iron. (A communication.)
1095. G. T. Bousfield, 8, Sussex-place, Loughborough-road—Burning hydro-carbons in lamps. (A communication.)

*Dated 15th May*, 1855.

1096. P. Christie, Greenock—Tent.
1098. W., and F. B. Fawcett, and J. Lamb, Kidderminster—Carpets.

Journal of the Society of Arts.

*FRIDAY, JUNE* 8, 1855.

## FOURTH ANNUAL CONFERENCE.

The Council beg to announce that the Fourth Annual Conference of the Representatives of the Institutions in Union, will be held on Monday, the 2nd of July, at 11 a.m. precisely. Viscount Ebrington, M.P., Chairman of Council, will preside. The Council would be glad to receive suggestions as to the subjects to be discussed on that occasion. Institutions would oblige the Secretary by forwarding copies of their last reports, or any other information that may bear on their progress or present position.

## 101st ANNIVERSARY DINNER.

The One Hundred and First Anniversary Dinner will be held at the Crystal Palace, Sydenham, on Tuesday, the 3rd of July, at 4½ for 5 o'clock p.m. precisely. The dinner tickets, to include dessert, but not wine, will be 8s. 6d. each. The tickets will be ready for delivery on and after Monday next.

The Council trust that the members of the Society and their friends will use every exertion to make this dinner as great a success as was that of last year.

## INSTITUTE BOOK ORDERS.

The first arrangements made by the Society for the purchase of books and periodicals by the Institutions in Union at reduced rates, after having been in operation 19 months, have been somewhat modified, and it is hoped improved. The experience gained during that period shows that the delays necessarily involved in the execution of the orders at one particular period only in each month have been a source of inconvenience to the Institutions, and have been said, in some instances, to more than counterbalance the benefits derivable from the reductions. It has been found, too, that when the Agent's commission of 5 per cent. on the reduced rates came to be added to the account, the average rate of discount did not exceed 25 per cent., notwithstanding the much higher rates allowed by some publishers.

The Council, being desirous of improving on these arrangements, and if possible of obtaining greater facilities for the Institutions, caused inquiries to be made in the trade, and they have now the satisfaction of stating that a responsible firm are prepared to undertake the whole affair on the following terms:—To supply the orders sent through the Society of Arts from day to day, at a discount of 27½ per cent. off *books*, and 25 per cent. off *periodicals*, except where such periodicals are irregular in price, such as the Quarterlies, in which case they will charge the *trade price*,—that is, the Institutions will receive the full benefit allowed to the trade.

In future one copy of an order only will be required. This must be sent to the Secretary to the Society, as heretofore, by whom it will be countersigned, and be at once passed on to the agents, with whom the remainder of the transaction will rest. It will then be invoiced, and the Institution will be informed by the Agents of the amount to be remitted. On this being received by them, the order will be immediately executed, the invoice being returned to the Institution receipted.

May Account.

| | Full Price. £ | s. | d. | Red. Price. £ | s. | d. |
|---|---|---|---|---|---|---|
| Bury St. Edmunds, Athenæum | 38 | 12 | 6 | 28 | 6 | 0 |
| Derby, Working Men's Institute | 3 | 15 | 0 | 2 | 19 | 8 |
| Dudley, Mechanics' Institution | 16 | 12 | 0 | 13 | 12 | 4 |
| Durham, Mechanics' Institute | 3 | 11 | 6 | 2 | 12 | 5 |
| East Retford, Literary and Scientific Institution ........... | 1 | 0 | 2 | 0 | 16 | 7 |
| Hyde, Mechanics' Institute ...... | 6 | 1 | 6 | 4 | 15 | 4 |
| Leicester, Mechanics' Institution | 5 | 15 | 6 | 4 | 8 | 9 |
| Melbourne, Mechanics' Institution | 13 | 14 | 1 | 10 | 6 | 8 |
| Royston, Mechanics' Institution | 6 | 13 | 6 | 5 | 2 | 7 |
| Sevenoaks, Literary and Scientific Institution...................... ... | 1 | 12 | 7 | 1 | 3 | 11 |
| Stamford, Institution............... | 0 | 15 | 9 | 0 | 13 | 0 |
| Wolverhampton, Athenæum...... | 12 | 6 | 10 | 9 | 11 | 1 |
| | £110 | 10 | 11 | £84 | 8 | 4 |

Being a saving of £26 2s. 7d., or nearly 24 per cent.

## CHALON EXHIBITION.

This collection of the works of the late John James Chalon, Esq., R.A., with a selection of those from Alfred Edward Chalon, Esq., R.A., was opened to the public yesterday. The private view took place on the day previous, when there was a very full attendance of the members and their friends.

## TRADE MUSEUM.

A meeting of gentlemen interested in the application of Science to Arts and Manufactures took place at the Society's House on Tuesday evening, the 5th inst., for the purpose of examining the Animal Department of the Trade Museum, recently formed under the joint authority of her Majesty's Commissioners for the Exhibition of 1851, and the Society of Arts.

Amongst the company were Messrs. B. C. Brodie, F.R.S.; J. P. Bull; C. Enderby, F.R.S.; R. T. Fauntleroy; Sir John Forbes, M.D., F.R.S.; F. Fuller; J. P. Gassiot, F.R.S.; J. Glaisher, F.R.S.; G. Godwin, F.R.S.; N. Gould; P. Graham; Prof. Grant, F.R.S.; J.

Sparkes Hall; G. N. Hooper; S. M. Hubert; Capt. Ibbetson, F.R.S.; Sir Robert Kane, F.R.S.; A. Lapworth; J. R. Lavanchy; Matthew Marshall; J. J. Mechi; Prof. W. H. Miller, F.R.S.; Prof. Partridge, F.R.S.; Col. Portlock, R.E., F.R.S.; C. A. Preller; G. Rennie, F.R.S.; W. W. Saunders, F.R.S.; P. L. Simmonds; A. Smee, F.R.S.; Col. Sykes, F.R.S.; C. R. Weld; J. O. Westwood; J. Whatman, M.P.; Prof. Wheatstone, F.R.S.; Alderman R. Wilson (Bramley); T. Winkworth; J. Yates, F.R.S., &c., &c.

## ON THE COMMERCIAL PRODUCTS OF THE ANIMAL KINGDOM.

By P. L. Simmonds.

The admirable collection of animal products which has just been opened for the inspection of the members under the auspices of the Society, is eminently suggestive, and calculated to be of great service to the interests of Commerce and to the progress and improvement of Manufactures generally. Forming the nucleus of what must eventually of necessity expand into a vast and highly important Trade Museum, it shows how easily instruction and information may be conveyed to the mind in a popular form through the eye, by a gradual progression from the rough raw material up to the finished product, illustrated in its different stages by the various tools, appliances, and general results of skill, industry, and experience.

Although Professor Solly has displayed great taste and judgment in his artistic arrangement of the various cases, so as to form a general grouping of a most attractive character, pleasing and interesting even to the most uninformed and ordinary examiner, the collection is obviously intended for much higher purposes.

Its sources of instruction—its commercial statistics and general comparative details have yet to be developed and elaborated, subject by subject, and class by class, in a well arranged catalogue and by popular descriptions, for I fear Professor Solly assumes too readily that in this scientific and educational age all have made themselves acquainted with the nature of the substances collected, and the ordinary processes to which they are subjected in various stages of manufacture. Even among those closely identified with these subjects, I think it will be found that a large number scarcely come up to this standard, and some are lamentably ignorant, not only of the sources of supply of the very articles they deal in and work up, but of many other points most essential to be known. Many will also plead that they are too onerously and actively engaged in the actual business relations of their trade and manufacture to search out and investigate for themselves new products, new improvements, new tests for the detection of adulteration, &c., but are delighted to have these familiarly brought home to them by the scientific enquirer.

Hitherto we have had no collective series of *animal products* open for inspection, although the field of inquiry is a wide and important one. Vegetable products and mineral substances have on many occasions been made the topic of investigation, and there are several good collections extant, but the animal kingdom has been comparatively neglected, and the only opportunities afforded for acquiring information have been by zoological collections of living species, museums of stuffed animals, or periodical cattle shows. As to the varied commercial products furnished by animals, the information even at the present day is of the most meagre description, and yet there is not a family or a class of animals which does not supply numerous important and very valuable products for the use and benefit of mankind, more especially as regards food. The tenants of the sea, the land, and the air, are all, more or less, useful to man, and there is much yet to be learnt respecting them, by comparison, investigation, and inquiry. Every day, indeed, adds to our stock of knowledge in this wide field, and proves that there is not an animal substance which may not be turned to some profitable account. The mere question of food is a most interesting study, and one on which there is much to learn, even from savage tribes. We find that they live and thrive upon the most repulsive and unpromising species of animal food, and that they also make use of many substances for useful purposes which have been long overlooked and neglected by us. The food delicacies of various nations derived from the animal kingdom would of itself form a curious study, and one from which we might derive some useful hints. We may be disposed to smile at rats and dogs, and horseflesh; at seals and sharks' fins and sea slugs, at snakes and lizards, snails and frogs, and locusts, as common articles of diet, but these serve to show the ready adaptation of the frame of man to seemingly loathsome food, and what habit can do to form the taste.

The investigations of science and the applications of mechanical skill are, it is true, furnishing us from time to time with various excellent substitutes for animal substances. Thus, the strong horsehair-like fibre of the kittool and of the ejoo palms, and galvanised wire, are substituted for bristles in brushmaking. Gutta percha hose and fire buckets take the place of leather. Caoutchouc is now moulded into admirable combs, less liable to fracture than those of bone and tortoiseshell. Vegetable ivory, from certain palms of South America, comes into use for small turnery wares, for which the tusks of the elephant and the teeth of the seahorse were formerly used. Even human teeth, largely in demand by dentists, are now artificially manufactured on an extensive scale by the Americans from ground quartz, pressed into moulds, coloured, and burnt to harden them. One firm in New York (the *Journal of Commerce* informs us) employs 30 men in this business, and turns out 3,000 teeth per day. Porcelain buttons are replacing to some extent pearl and bone buttons. The extensive use of gas for illuminating purposes and the large supply of numberless vegetable oils and fats for the manufacture of candles and soap, has caused less attention to be paid to the whale fisheries. Split canes take the place of whalebone for the ribs of umbrellas. Artificial leather and vegetable substances for stuffing couches, beds, and chairs, are other instances.

For the purposes of food, however, man, from his omniverous character, must always be largely dependant upon the animal tribes, more especially in the temperate climes and colder regions. Fish, flesh, and fowl, will ever, therefore, be in increasing request as population multiplies, and animals, wild or domesticated, will as a necessary consequence, continue to be snared, bred, and slaughtered.

In the recent instance of the allied troops in the Crimea, where large masses of men were pent up in a small space, dependant entirely for sustenance on extraneous supplies, in the case of a failure (owing to stress of weather) to obtain cattle for slaughter, how vitally important it would have been to have had on hand a stock of dried or cured animal food, of a varied nature, and if possible in a concentrated and portable form. The best modes of preserving food, of curing meats, of salting and drying fish, of cooking these in the most palatable form, and with the least possible waste,—all these are very important elements of knowledge in certain situations.

Again, as respects warm clothing, a large supply of sheepskins, buffalo robes, seal skins, camel's-hair rugs, boots and shoes, &c., were required at short notice, and the Government were ill-informed of the probable supply and ordinary prices of many of these articles, or where they were to be obtained best.

Surely such points as these, where the comfort—nay, the very existence—of thousands of men were at stake, to

say nothing of the importance also of supplies of the raw material to our manufacturers, bespeak the necessity of accumulating all kinds of information that can be obtained relative to every product calculated to benefit Commerce and the Arts.

The information furnished to the members of the Society up to the present time on animal products, has been for the most part of a very general character, with some few exceptions, such as the learned and valuable lecture by Professor Owen, on the Raw Materials of the Animal Kingdom, that of Mr. Forbes, on the Woollen Manufactures; and of Mr. Dickins, on the Silk-worm and its Products. Incidental mention is indeed made of some of them in the lectures of Dr. Royle, on the Arts and Manufactures of India, Dr. Lindley on Substances used as Food, in my own paper, on Undeveloped and Unappreciated Raw Products, (page 39 of this volume), and in the Reports of the Juries of the Exhibition of 1851. But what is much wanted, is special descriptive accounts and recent details relating to particular animal products from particular countries—as respects their extent of supply, commercial value and application to the arts and manufactures—considered specially in a utilitarian point of view, by comparison with the practice and results of other countries. Historical essays, tracing down the processes of manufacture—the origin of inventions, the rise and progress of particular trades, and the legislative enactments affecting them, are curious and interesting for reference and indicative of much literary research on the part of those who undertake them. But these will scarcely bear the test of that *cui bono* inquiry which is now applied to everything by men of business and manufacturers. There is ample scope for the supply of much valuable and desirable information, which might be elicited by the Society of Arts on a variety of subjects connected with the animal kingdom. For instance, a good treatise on the commercial products of the hog is a desideratum, in order to stimulate our colonists in different quarters to enter more largely upon this profitable branch of rural economy. Why is this domestic animal so little appreciated in the British possessions, when the hog trade of the United States is something enormous. The mere list of its products is an extensive one, and all are of a profitable character—so that not a particle goes to waste. In the United States, the hogs of commerce (that is exclusive of those killed for home consumption) number upwards of three millions. The products consist of hams, and shoulders, and sides, forming pork and bacon to the extent of about 110lbs., each pig being computed to average 200lbs., although some have been fattened up to 1200 lbs.; fine leaf lard, in the proportion of upwards of one-eighth of the weight, is obtained, and occcasionally a quantity of lard oil is also made; the head and feet weigh about the same proportion as the fat or lard; hog skins and bristles, and the cleaned entrails for sausage and polony cases; prussiate of potash from the blood and bones—and the refuse as manure, make up the list of valuable products of this one domestic animal, raised and fattened at a very small expense on maize.

The improvement of the breed and management of sheep in our colonies is another subject requiring attention. More care in the preparation and packing of the fleece is necessary, and inquiry should be set on foot in order to ascertain how it happens that the relative weight of wool abroad falls so far short of that obtained at home. A good report on the commercial products of many wild animals that can be obtained in large quantities in various districts, is also very desirable. Even in respect to the insect tribe and sea fowls we have much to learn, particularly on the lac insect: varieties of wax, the culture and preparation of cochineal; the products to be obtained from the different sea fowl; the numberless dainties of foreign birds which could be brought home at considerable profit, prepared in various ways—in some quarters frozen in ice, as is the practice in the north of Europe; in others salted and smoked, after the fashion of the wild pigeons thus cured by the North American Indians; or boiled in their own fat, like the mutton bird of the New Zealanders. Our gourmands would duly appreciate the excellent flavour of the tender flesh of the clucking hen of Jamaica, the best wild fowl of the country, which partakes of the mingled properties of a compound of ham, partridge, and pigeon, if they could but have it brought to their tables. The young mangrove hen, a species of rail indigenous to the same island, I have found to combine the peculiarity of flavour of the snipe and the sanderling with the fleshiness of the quail.

The importance of feathers for the purposes of dress and ornament is alluded to in an article on Plumagery, by Dr. Macgowan, republished in the Society's Journal, page 93 of the present volume, where modes of weaving feathers and interweaving them with silk are described. The Chinese and Aztecs appear to have made elegant and costly garments of feathers. The gorgeous feather robe of the Sandwich Island monarch, made from the feathers of the rare bird (*Melithreptes pacifica*), which has been added to and improved in its fabrication through eight successive monarchs' reigns, is valued at a million of dollars! Flowers, and tippets, and muffs, and other articles of ladies' attire, are still made of the choicest feathers.

The fisheries of the various seas, rivers, and coasts is a sadly neglected subject. We have indeed scarcely any correct lists of the fishes frequenting peculiar localities, their commercial value, the modes of capture and curing them. Hooks, lines, nets, bait; habits of the fish, whether migratory or local, whether used for food or manure, or only taken for their oil—all these are points to which inquiry might be profitably directed. The various Chambers of Commerce, the harbour-masters, and agents for Lloyd's could be specially addressed on these subjects, and would certainly facilitate such inquiries. The scientific culture of fish is now occupying a considerable share of attention in this country and on the continent, and the desirability of introducing the spawn of salmon and other fish into our colonial rivers in Australia, Van Diemen's Land, and elsewhere is of importance.

In view of the great value of leeches in the Materia Medica, some enterprising Frenchmen have recently been leasing marshes in Ireland, and sowing them broad-cast with leeches, in the hope of deriving large profits therefrom, that is, if the artificial or mechanical leech does not supersede the natural blood-sucker. Seven or eight million leeches are imported annually by three or four firms in London, and the value of those used in France is estimated at £200,000 to £300,000. The trade in no article, however small or trivial, should be lightly estimated, when we consider what fortunes have been made by enterprising men out of the most unpromising and seemingly unimportant articles. The human hair harvest of France—the flowing locks parted with reluctantly by females—amounts to 100 tons a year, of which we import about 50 tons for the use of our hair-workers for artificial tresses, braids, and wigs.

There are many substances of the animal kingdom used in pharmacy of considerable importance; and others possessed of valuable curative properties, are from time to time being discovered. Those who are in the habit of consulting the pages of the *Pharmaceutical Journal* will find that products of animals enter largely into the Pharmacopœia.

Dr. T. Thompson has pointed out the medicinal value of various animal oils besides cod-liver oil, such as sperm and seal oil, and the result was a conviction that fish oils generally resembled one another in their remedial properties, although differing in their aptitude for digestive assimilation in the human stomach. He tried neats-foot oil, an animal oil obtained from a soft solid fat found between the parchment and the leather skin of animals, also an oil obtained from a species of fish abounding on the Malabar coast; and these trials were frequently attended with encouraging results.

The practice of daily inunction is common in many warm countries, and serves to soften the skin, and keep the body in health. In some regions vegetable oils are chiefly used; cocoa-nut and castor oil by the negroes in the West Indies, the East Indians, and the natives of the Pacific Islands; palm oil, nut oil, and ghee, or fluid butter, by the African races; olive oil on the shores of the Mediterranean, &c. The New Zealanders and some others use shark oil; the Esquimaux and Greenlanders imbibe large quantities of train, seal, and various fish oils, whilst the natives about the large rivers and coasts of Brazil use turtle oil and fat obtained from the alligator and crocodile.

Those who are employed in the woollen trade, soap and candle and other factories, where oils and fats are largely used, enjoy a comparative immunity from scrofula and phthisis. Sailors believe a whaling voyage to be a cure for consumption, and probably the quantity of oil drank and taken into the skin may have its beneficial effect upon the system.

In the paper which I read before the Society in November last, I made mention of the commercial products of the dugong (*Halicore indicus*), an animal which although occupying a wide range in the Indian Ocean and eastern seas from Ceylon to Port Phillip, has hitherto been comparatively unappreciated. The oil obtained from the blubber has, however, very recently been brought into notice by medical men in Australia, as a new therapeutic agent, possessing all the advantages of cod liver oil, without its nauseous taste and smell. It has also been successfully used in diseases of the ear, and is further represented to be a good depilatory. The smooth blackish blue skin, which is about three-fourths of an inch thick, has not (that I am aware of) been yet applied to any useful purpose.

The fat of the emu will, if properly boiled down, produce about two gallons of oil, and this oil is also stated to be a very successful restorative in cases of rheumatism.

In the foregoing discursive remarks, my object has chiefly been to stimulate inquiry, by calling attention to the comparatively unexplored field of the animal kingdom, especially as regards its commercial products. Even in the interests of zoology much remains yet to be done, and the hints and suggestions of Professor Owen, in the Admiralty "Manual for Scientific Inquiry," may be studied with advantage by very many who have opportunities for collecting specimens abroad and furnishing information. The valuable and extensive researches of Mr. C. Darwin, in his "Voyage of a Naturalist," prove how much may be done by any one individual enthusiastically devoted to scientific pursuits, and losing no opportunity of throwing light on unknown or doubtful topics.

A careful study of the various series of products and manufactures as arranged in the Trade Museum by Professor Solly will, I am sure, convince many how scanty and superficial has been until now their general knowledge of the different subjects illustrated, and, I trust, induce them to aid in the good work of supporting such an establishment by stimulating contributions from friends at home and abroad.

## SCHOOLMASTERS' ASSOCIATION.—ELEMENTARY SCIENCE IN SCHOOLS.

A large meeting of schoolmasters and schoolmistresses took place at the Sanctuary, on Saturday morning, to hear an address from Mr. J. C. Buckmaster, "On the Importance of Elementary Science as a branch of National education. He commenced his address by showing that the kind of education generally given to the children of the middle and working classes was in no way adapted to the practical requirements of life. In our ordinary schools boys were taught a little arithmetic, a little geography and history, and perhaps a little grammar. In what were called the better class of schools, boys were kept thumbing Latin and Greek grammars, to the exclusion of almost every other kind of knowledge; at the age of 14 or 15 they went into the world without a particle of useful available information. What was the result? Disappointment and discontent; labour was tedious and irksome, because they were unable to interpret its laws, Strikes, lock-outs, combinations, intemperance, and idleness, were the natural consequences of this ignorance. The common phenomena around them was a blank. The book of nature was open, but its pages were without consolation or instruction. After pointing out the advantages of a general acquaintance with science, especially those sciences which bear directly upon industrial pursuits, he sketched out a plan by which he thought regular instruction in science might be given in elementary schools. When persons talked of teaching common things, they often forgot that a considerable acquaintance with science was often very necessary for the successful teaching of common things. A subject which is only imperfectly understood by the master cannot be properly taught; he, therefore, suggested that there should be separate masters to teach science, as it was unreasonable to expect one man to teach everything efficiently, except in very rare cases. He then alluded to the great want of suitable mechanical apparatus and text-books. Every school ought to have good models of machines in common use, not for purposes of decoration and ornament, but for the purposes of instruction. A good working model of a steam-engine, so that it could be attached to other models, such as a common pump, a crane, a system of pulleys, a paddle-wheel, &c., all this might be done with great practical benefit. A boy who could work Proportion might work out many useful problems in mechanical science. Chemistry he regarded as the most important of the sciences, and one which could be easily taught in most schools. Metallurgical operations, the manufacture of gas, dyeing, bleaching, printing, brewing, cooking, the Davy lamp, respiration, and combustion, were all intimately connected with chemical science. The experiments gave the subject additional interest, and fixed the facts permanently in the mind. In a short time the boys obtain a great amount of useful information; their ingenuity will be exercised; they will begin to construct apparatus and perform experiments. I am not speaking, said he, imaginatively, I am telling you what actually takes place at a school at Wandsworth, which has recently been established with great liberality, for the express purpose of teaching the applications of science to the industrial purposes of life. This school has been most successful; it is well attended by the children of artizans and tradesmen. The people appreciate this kind of education because they often feel the want of it themselves. In teaching science the master should strive to teach a little thoroughly, rather than a great deal superficially. He then referred to what he described as the sciences of observation—natural history, botany, and geology. The two last sciences, he thought, might be developed to a very considerable extent, especially in the country. Boys should be encouraged to make collections of the characteristic natural productions of the neighbourhood—a small collection of plants, stones, insects, &c. Prizes should be awarded to the boys who made the best classification. By these means you would be laying the foundation for those habits of thoughtfulness and observation which would be a never-failing source of happiness and delight. To teach a boy that which will be useful to him as a man—to give him that knowledge which will enable him to adapt himself with little inconvenience to the varied circumstances of life—to inculcate habits of self-reliance and self-respect—to provide a support for his weakness and imperfection—to raise and refine his thoughts by the contemplation of nature and the progress of human knowledge, is, in my opinion, the highest and holiest mission in which man can be engaged.

The address occupied upwards of an hour, and was listened to with great attention.

## FLAX AND ITS PRODUCTS IN IRELAND.

Contributed by William Charley, Seymour Hill, Belfast.

### Letter XII.

No raw material or textile manufacture has been improved more gradually than flax and its various products.

It is stated by a learned professor that on the walls of the ancient temples of Egypt, in addition to the records of military glory traced by the cunning hand of the artist, the peaceful ways of agriculture are not forgotten, and drawings of men carrying water to fill wooden vats, supposed to be intended for flax-steeping, are distinctly visible.

Yet in modern times some of our flax reformers propose to do wonders "all at once," and to break through the old fashioned, but not unsuccessful routine, with most sweeping innovations.

A leader among this class of enthusiasts was Mr. Lee, to whom I have already devoted some attention (see letters IV. and V.). He flourished in 1816. Of late years the most distinguished pioneer in this "fast corps" is the Chevalier Claussen. In 1851 his new plan was much talked about, and samples illustrative of his system were exhibited at the Crystal Palace. The Jury (Class XIV.) did not pronounce any opinion on the merits of the proposal, not wishing to crush any new idea that had not been well tested and fairly tried, but the practical men on the jury, I know, held an opinion not favourable to the flax cotton.

It certainly does appear a rather Quixotic undertaking to reduce a fibre, possessing so much value and strength as flax, to the level of the lower priced and less durable cotton. Is it not the aim of most noted Manchester manufacturers to imitate linen, and approach as near as possible to it in the appearance and style of cotton goods? Besides, a pound of dense flaxen fibre would not produce nearly as much yarn or cloth as a pound of the more bulky cotton, and the pound of flax would be worth on an average fully *double* as much money value as the other fibre.

To turn cotton into flax would be *real promotion* to the former; to attempt reducing flax to cotton is not, and cannot be, a step in the right direction.

The Committee of the Royal Flax Society of Ireland have expressed views similar to those held by myself and many others, and have recommended M. Claussen to give up persevering with the valuable flax fibre, and try his hand at the *refuse tow*. This may perhaps be more fortunate, and some improvement may eventually result in this *branch* of preparation; it would certainly be gratifying, should this gentleman after all his exertions attain even partial success in promoting some genuine reformation in any branch of the linen manufacture. To cottonise refuse tow is a plausible speculation, for good cotton is superior to very bad linen.

The celebrated Louis Crommelin alluded to in letters I. and II., writing on the subject of preparing flax without the watering process, A.D., 1705, says, "flax may be prepared without watering, by grassing it until such time as the straw corrupts, yet it is better to water it where it can possibly be done without great inconveniency." To overcome this "inconveniency," many projects have appeared from time to time. In 1775, Lady Moira (an Irish peeress) brought the matter before the Society of Arts, her attention having been directed to the subject by a talented Swede, named Des Charmes.

His idea was to cottonise flax, of course omitting the tedious "retting process," but after due consideration the proposal fell to the ground. It is said Bartholletand Gay Lussac were penetrated with ideas similar to those of Des Charmes, and considered the production of "flax cotton" a feasible undertaking: neither, however, carried out the attractive theory in *stern* and solid *practice*.

This M. Claussen has the merit of attempting to do; his process, so far as I can learn, is 1st, to steep the flax fibre or tow in a weak solution of caustic soda, cold, for 24 hours; 2nd, to boil it in a similar solution for two hours; 3rd, saturation for one hour in a vat containing 5 per cent. of carbonate of soda, followed by immersion in another vat containing water, with about ½ per cent of sulphuric acid added. The sudden chemical action on the fibre in the last steep produces singular results, and gives it a peculiar bright and cottony appearance. It is, however, evident that the "inconveniency," *i.e.*, the watering process, troublesome as it unquestionably is, will extract less of the oily and toughening matters of the fibre, called "nature" by the spinners, than such a series of boiling and chemical operations as I have just described. The spinners are thoroughly practical men, and they all, I believe, still prefer the old watering process to any yet discovered, not from prejudice or partiality, but from the acknowledged superiority of flax prepared in that way, to any other in the *spinning quality* so much esteemed.

Among the most successful of practical improvements in the common retting process, is that introduced and patented by Mr. Shenck. The principle of this plan is simple and easily understood. It consists in substituting for the irregular action of the out-of-door watering pools, the certain and regular effect of water heated to a given temperature under cover, so as to hasten the desired fermentation so necessary to separate the pure fibre from the woody and gummy portions.

The water is heated by steam in the vats containing the flax, and any temperature required can easily be attained; about 80 or 90 degrees Fahrenheit have been found the most suitable, and the entire time occupied does not exceed 60 or 70 hours. For some years this patent system stood high in public favour, and the fibre approached very near in texture that prepared in the old way; latterly it appears to be making no great progress, and I am afraid, from what I hear, that in a financial point of view the plan was not sufficiently remunerative, in fact I do not think "it paid well."

It is, however, generally thought that Shenck's system is a fair and feasible improvement, and it is hoped will yet be more adopted than hitherto, with such qualifications and additions as experience may suggest.

Louis Crommelin quaintly says, "It is impossible to prepare flax without grassing; the effects or influence which the water has on it is only that water rots the straw and makes the flax easily separated from the straw, but does not contribute to the making your flax to separate one thread or fibre thereof from the other, wherein consists the use of grassing your flax, for this it is that makes your flax to be finer or coarser when you come to spin it with respect had to each species or sort of flax." This was written 150 years ago, and yet remains on this day a sound opinion. The want of grassing, or "crofting," as it is sometimes technically called, is a defect in many of Shenck's patent establishments, and I think if this process were made an "addenda" to the fermentation in vats, the result would be more satisfactory to all concerned, and would tend much to improve the spinning quality of the fibre produced.

To carry this out right, the establishment should be in the country, at some distance from any smoky town chimneys; a few nice grass fields should be selected convenient to the rettery, for the purpose of receiving the flax after removal from the vats.

Besides this additional process, I think several economical arrangements might be introduced so as eventually to make the business remunerative and encouraging, two very necessary points in all speculations.

A few patriotic individuals might carry on a new business for a time at a loss to themselves, but unless such institutions are self-supporting, or derive funds from the State, even the most high-minded become wearied, and finally retire.

Dr. Stephenson, of Belfast, stated in a pamphlet published in 1808, that a Mr. O'Reilly had proposed improvements in the old plan of fermenting flax, which were well worth testing, but which the prudent doctor recommends should be tried first on a *smale scale*, and afterwards

increased in proportion to success. One of these new plans was *to boil the stalks in pure water*, or, if wished to ferment more speedily, in a caustic mineral alkaline ley. The other plan proposed was, to suspend the flax in a steam tight chamber with a boiler attached, from which steam was to be introduced, that from a weak caustic ley being thought best for the purpose, though in reality there could be no difference.

It is curious how similar ideas strike intelligent minds when absorbed in the study of a particular subject, and how the germ of many modern improvements can be traced in the writings and recorded sayings of clever men long since passed away.

I feel quite sure that neither Mr. Shenck nor Mr. Watt ever read the pamphlet I have just quoted from, as copies are very rare, and only to be had from a few gentlemen resident about Belfast, yet every one must admit the first plan of O'Reilly plainly shawdows forth a system like Shenck's, while the second seems to point out the new system patented by Watt.

I do not wish to detract in the slightest degree from the credit due to the latter-named gentlemen, who have devoted so much time and attention to the *practical* improvement of the retting process, but I wish to shew that the idea had many years ago occupied the attention of talented men *in Ireland*, and though not carried out *in practice* the principle was announced for the consideration of practical men, and a fair trial suggested and recommended.

Having briefly explained the patent system of Shenck, an outline of Watts's still newer system will be necessary. This differs in some points very materially from Shenck's. Instead of any fermentation, boiling and crushing are substituted, and the unpleasant smell caused by the retting of the flax is thus avoided. It is still a matter not decided whether the flax fibre is or is not in as good condition for spinning and bleaching as under the fermenting process hitherto employed. The advocates of Watts's plan maintain that there is more yield of fibre, and that the quality produced is equal to that of the old process; while, "*au contraire*," the opponents of the system object decidedly to the boiling or steaming, and say, without fermentation the fibre is deficient in spinning and bleaching qualities. I will not venture to pronounce an opinion at present, but knowing that Mr. Watt is a clever man, and is well supported by his friends, the Messrs. Leadbetter, of Belfast, I venture to indulge a hope that he may eventually overcome the difficulties pointed out by those not yet converted to the system, and I am sure all reasonable minds will accord to him their warmest sympathies in any efforts to systematise the old-fashioned and rather uncertain open-air process of retting.

In Watts's rettery the flax is placed in an iron steam-tight chamber, with a cistern on the top to act as a condenser. The steam is introduced at the bottom: it heats and softens the flax, and being condensed to water on contact with the roof of the chamber, falls down again, washing the flax thoroughly on its way. After undergoing this process for from 12 to 18 hours, the flax is removed, and immediately passed through between heavy rollers, by the action of which it is pressed nearly dry, and is so flattened as to lessen the adhesion of the epidermis to the woody and fibrous portions of the plant, and thus makes the cleaning that must follow a more easy operation. From the rollers the flax is transferred to the drying-rooms, of course heated by steam, and after this it is ready for the scutching process.

The arrangements of the rettery I inspected were carried out under Mr. Watts's personal inspection, and were regular and business-like. The flax was received in the straw, and was delivered scutched and ready for sale to the spinners.

There have been many other reforms in the retting process proposed by various individuals at different times, but I do not think any of them of sufficient importance to require special comment.

## Home Correspondence.

### REFORMATORY DISCIPLINE.

SIR,—I have received the following very interesting letter from my friend, Mr. Bengough, who, together with Mr. Barwicke Baker established the Reformatory at Hardwicke. I have obtained his permission to send it you for insertion in the *Journal*.

I wish much that more unity could be achieved. But so long as Mr. Power and his party urge the remission of all punishment for the crime committed, I fear it is hopeless.

It is impossible for us to say that the punishment which society requires in its defence, in order to deter the future commission of crime by others as well as the offender, is a punishment necessarily reformatory to the recipient. It may or it may not be so. Most assuredly it is not asked for as an atonement of the offence; for it is none whatever. Just as little is it *vindictive* in any proper sense of the term. It is inflicted simply because protection to life and property require it, and because all countries and all ages have sanctioned the equity and experienced the necessity of thus deterring crimes. Mr. Power also mistakes the facts when he says that it is cruel to apply this principle to young and little children. They who break the laws, and incur its penalties, are in a very large proportion, older children, who are perfectly conscious of their faults and deserts.

These are the only remarks which Mr. Bengough's able letter leaves me room to make. It is gratifying to me to find my own views so substantially and powerfully corroborated by one who has a practical experience on the subject; and has also thought deeply upon it.

I am, Sir,
Yours truly,
JELINGER SYMONS.

The Vineyard, near Hereford, May 26.

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Exeter, May 11th.

MY DEAR MR. SYMONS,—I have been so much interested in the report of the paper which you read last week before the Society of Arts on the subject of juvenile crime, at which I was unfortunately unable to be present, that I should like to offer you a few remarks upon it. The discussion was, I think, well confined, under the advice of the chairman, to the root question, so to speak, of the whole subject—a child's responsibility, and consequent criminality and liability to punishment. I cannot think of anything more important than a reconciliation, if it be possible, of the conflicting views upon this subject; and one remark which fell from Mr. Power, Recorder of Ipswich, holds out the hope that in the direction to which it points a common ground may at last be obtained. I allude to Mr. Power's reply to Lord Lyttelton's observations, which in the report of the discussion in the Society's Journal stands thus—"I beg to say that I have no objection to any amount of punishment, so long as it is directed to the reformation of the offender. What I oppose is vindictive punishment, which has *not* reference to the reformation of the offender, but merely as some atonement to society, which he has offended." I think Mr. Power himself must admit that the tenor of the objections which he himself raised to that part of your paper which touched the question of punishment appears to go very considerably further than the interpretation which he puts upon them in the words I have just quoted, and it is, therefore, a matter of great importance to have gained a declaration so explicit from one who is sometimes supposed to be the great advocate for not punishing children at all.

In this admission, then, and the distinction between vindictive and reformatory punishment which all will allow to exist, I think will be found the elements of agreement between opinions seemingly so discordant as are those of Mr. Power and others who think with him and

those represented by yourself. Vindictive punishment, by its very nature, can never be of a reformatory kind; but there is a kind of punishment which is inflicted, not with any notion of making the offender *atone to society* for the injuries it has received at his hands, but as an absolutely necessary consequence to *himself* for the fault he has committed, as it is a *sin*. Against such a kind of punishment, to which alone, in strictness, the term ought to be applied, I conceive that, with one proviso, namely, that it should at least not be of a kind to *hinder* if it did not actually promote reformation in the subject of it—the opponents of a *vindictive* punishment could not with any consistency object. I need scarcely remind you how we have inspired authority to state that the infliction of this punishment is the province to which the Divine appointment of rulers has immediately destined them: this carrying out of the inseparable connection between sin and suffering, which it is one of the greatest exercises of faith to receive, and with many one of the greatest difficulties of reason. One great objection is, I know, advanced against our attempting to carry out this punishment now, in the impossibility of estimating the *relative* much more the *absolute* wickedness of any given crime. But granting this impossibility to the full, we should not, in the first place, be deterred by this difficulty from carrying out, as perfectly as we can, what seems to be an absolute duty imposed upon all who have the power; and in the next place, the *severest earthly* punishment which we could inflict would be, absolutely, not excessive for any real sin. To questions of how far the sanction of a human law can make that a sin which is not made so by the Divine law, I do not wish to turn aside. Theft, the main crime we have to deal with in the class of juvenile offenders, is a sin by the law of God. That it is a sin of much greater heinousness in those who know its nature well—who have had the advantage of good education and careful nurture than in those who, perhaps, do *not* know (if there are such,) that it is,—what they understand as it were by nature the force of—wrong I need not formally admit. But is it not to be punished at all in them? What, then, does our blessed Lord mean, when he speaks of "the servant who knew *not* his lord's will," but is *yet* to be "beaten with few stripes because he did it not." The infliction of punishment, indeed, I cannot but consider a paramount duty of those who are entrusted with power; but as I have already intimated, I as firmly believe that, except where such is the direct command of Him from whom all power is derived—all *human* punishment should seek, what all *His* punishments in this life at least, with perhaps some singular exceptions, do seek—the reclaiming the sinner from his sin. Now, say that a poor child just taken from the kennel does not know that he has done wrong in taking that which was not his own, will he not be the more likely to remember in aftertimes the lesson that it *is* wrong, because he receives with it that other lesson—that wrong *deserves*—by a higher law then man's, and by a higher appointment is here to *receive*—pain. Nothing indeed can be more futile—a more entire departure from that great example which all rulers ought to imitate than so to punish, *not* the incorrigible and hardened, for of them we are not speaking, but the weak and ignorant, as that it should leave them only more hardened in their sin. Futile it is because it injures that society which it is their object and duty to protect. But with the fullest admission of the Divine right of real punishment, I easily conceive the existence, which we perceive—of the very strongest objection to those which are at present practised among us, both for their nature and for their manner, partaking as they do much of the vindictive character, in which they are inflicted. I do hope, then, that it is here alone that that apparently great difference of opinion lies between the advocates for, and the opponents of, the punishment of juvenile criminals. I believe that we are all seeking in reality one object. To put an end to the worse than absurdity of treating a little child as the object of *vengeance* for the wrong done to society, which is beyond doubt more sinned against than sinning itself in the neglect which it has suffered the child to grow up in; and we all, I think, see very clearly that imprisonment and our whole penal system, as at present conducted, can leave scarcely any other impression upon the child's mind than that he is so treated—can leave certainly very little of the impression that he must suffer *because he has done wrong*. But beyond that we all are agreed also, I believe, on the necessity of protecting society against at least any further injury on the part of the child, and, therefore, of reforming it before we permit it to have its liberty again. But although the two objects should ever be kept together in view, if what I have already observed with regard to the Divine obligation of punishment is true, the mere restriction of the reformatory process cannot rightly supersede it, as you remarked, or take its place. They are unpleasant, it is true—irksome to a painful degree, especially at first to the untamed spirit who must be subjected to them, but they are not inflicted *as* a punishment, and besides, in most cases, are nearly or quite counterbalanced by the regular comforts which are at the same time enjoyed. If, then, children who have sinned must be punished, (and the punishment, we must remember, inflicted on that ground—its only true one—reacts for the benefit of society as a deterrent of others, for which purpose primarily—as I believe—society would have no right *whatever* to inflict it), if, I say, children must be punished, and feel the punishment to be the necessary meed of their crime, it is, indeed, a most important question—how and where they are to undergo it. As to the place—though I confess at one time I was strongly opposed to the uniting of a penal and reformatory establishment together—the great difficulties which exist in making a child committed to even our best prisons feel the *real* intention of the punishment inflicted upon him there, and the exaggerated attention of which he is necessarily the object tending so strongly to inflate his pride, have considerably modified my opinions; and, on the other hand, I had not to *learn* to believe that if we can make a child understand *why* he has been punished, and why he must be detained after his punishment, our having punished him will no more interfere with that child's confidence, nay, his love of us, and the influence of our exhortations, and of our setting before him the pleasure of a reformed life, than punishment would deprive us, which God forbid, of the love of a child of our own. With regard to details, I would have the place or the appliances of punishment strictly different in outward aspect from the reformatory portion of the establishment, while the latter should present the *greatest* amount of liberty, with the *lowest* of rigidity or severity of discipline which would be compatible with the safe detention and orderly behaviour of the children. I may appeal to my own experience, as well as that of others who have been engaged in the same work, as to the superior reformatory influence which is at work where the fullest scope is given for individual action and the development of individual character. But before proceeding, as I should like to do by-and-bye, to the further consideration of this point, I will see whether it is not possible to reconcile the conflicting opinions as to *what* the punishment is to be. You will understand that I do not think it will be held that it need be *positively* reformatory, so long as it be not the *contrary* in its action. The reformatory process is to succeed it, and may begin when the punishment is at an end. I do not myself see, then, how we can dispense with either of the only two punishments which are possible to us—confinement of various degrees of strictness, and flogging. The latter, however, should only be inflicted in cases where there was any great aggravation of the crime, as in the knowledge of the offender, or the circumstances under which it was committed. But, practically, this consideration must be left to the judge who sentences the culprit. In cases of a first or very slight offence, however, I may suggest that confinement in separation, or even in association, if tole-

rably strict, and with silence enforced, would be sufficient. The terms should never be very long, and I am inclined to think that the extremest cases would be amply met with a flogging, followed by not more than a week of close confinement, and a subsequent longer term in association. To flog a lad and turn him into the streets again, is, I know, worse than useless; but I know also, from what the boys I have had charge of have told me, that the *first* flogging they ever had did produce a very wholesome effect for the time upon their minds, and I cannot but think, indeed I have seen myself that, inflicted solemnly, as a punishment, under the eye at least of the manager of the institution, and with everything to impress it upon the boy's moral feelings, it would have its effect; even where he had been flogged in prison repeatedly without effect, because in a mere formal, and often, I know, in an openly vindictive spirit on the part of those who inflicted the punishment, where a boy had been frequently in prison or troublesome while there. A sentence of, say, one month's imprisonment, then, should imply one week in close confinement, and three weeks in associated confinement, in entire or partial silence, with work and instruction. My own experience has led me to think that too high a value can scarcely be placed upon a short close confinement, unrelieved by occupation of any sort, and only by an occasional visit at the hours of meals. I have inflicted this myself with no injury to the boy's health, and a very great and decided benefit to his character. It was for an outrageous act of dishonesty on two boys at the Hardwicke school; I may therefore state, from my own experience, that to a lad of 13 to 15 it would not be an excessive infliction; a child of 11 or 12, I suppose no judge would think of sentencing to it.

With regard to the association of the boys under punishment, we must remember that after punishment they will be associated with as few restrictions as possible upon their intercourse, and that while under punishment they may if it is thought desirable, be associated in classes, according to the extent of their culpability, as measured by the length of their sentence of punishment.

On the whole, then, I conceive that the necessary punishment of the juvenile offender would be more probably efficiently carried out in an institution where only the boys—of course the same, with certain exceptions, will apply to girls—where only the young are to be dealt with. A person who may have every qualification for the governor of a prison where men are to be dealt with, would be very often little fitted for dealing with boys. The manager of a reformatory institution *must* seek far more than the other *need* do, to win the *affections* and confidence of the children. He should be the first to teach them, as I have said, the reason of the punishment which he is *ordered*, nay, obliged, to inflict upon them. He *should* have the power of pointing them on to the time when they *will* see him in a different light, of encouraging them to learn to look upon him from *the first* as their friend, and anxious to see them put where they may freely do well, first under his own eye, then, when they leave him at last, under only the eye of God. On the manager, be he clergyman or layman, be he called master, or chaplain, or governor, or what not, the whole success indeed of the institution will, under God, depend. It is not the rules—they may hinder or help him—but it is only the man, by his personal action, that can reform. And can the state find such men? Has the experiment been ever fairly made? There are two difficulties in the way of its success; first, that of steering between making the appointment so valuable as to tempt men to undertake it who have no sort of qualification for it, and of making it so little remunerative that many a man who might have the necessary qualifications would be unable or unwilling to enter upon it; secondly, that of allowing the person who is charged with it the very great liberty of action and freedom from interference, without which he could hardly hope for success. The particulars in which this liberty would be most essential, I should consider to be these:—The absolute power of appointing and dismissing every person employed in any capacity about the institution. The authority, within certain broad limits, of punishment, not subject to the questionings of visitors or inspectors, unless the occasions, as entered in a Journal, were so frequent as to justify an inquiry into his general management; thirdly, the assurance that his recommendations for liberty, partial or entire, to any boy, or even for the relaxation of any rule of the institution which he found on trial to work ill, would meet with the consent of those with whom the ultimate authority over the school might lie. I say the "assurance," and I would imply that it should be the province of the inspector to see that no rule was altered without his knowledge, but not to withold his sanction for any alteration, not fundamental, but concerning the details of the system, without positive cause existing externally to his possible private opinion. He should, besides this, have to take care that the money expended was duly accounted for, that nothing was ordered but through him, and he would be then quite a sufficient check upon the manager's necessary freedom. As I have spoken of some rules as fundamental, I am led to enter briefly, as I am desirous to do, a little more into the principles of reformatory treatment. I have already mentioned full liberty for individual action, and the development of individual character, as being almost at the foundation of all which can be truly called by that name. That the boys should have the most complete opportunity to speak and act as their nature prompts them; certain actions and certain subjects of conversation, or forms of speech—such particularly as any reference to the crimes of their previous life, should be decidedly and plainly interdicted, and as decidedly punished when they occurred,—the one just specified most appropriately by sending the offender back again to the punishment of silence in the penal ward. But within these limits, and with due regard to the maintenance of order, for instance, during the meals, and in the dormitory, and not allowing the boys by talking to neglect their work, no restriction should be sought to be imposed on them in this respect. In practice it will not be found that there is very much talking during work, and its permission will be amply repaid by the greater freedom of intercourse which will grow up between the boys and those who superintend their labours. On them a great deal of the success which may be hoped for will depend, which makes it the more important that their appointment and removal should rest entirely with the responsible manager of the institution. Their manner should be firm but kind. They should seek to encourage those who were doing their best, but felt their lack of skill: and for their own sake as well as for the example which they would show the boys, they should be actual workers with them. They must be numerous enough in proportion to the boys, (that there should be no lack of strength in such establishments, has been most forcibly and earnestly urged by Mr. M. D. Hill,) and they will find no difficulty in superintending, at the rate of a moderate number, say from 8 to 10 boys each. Here, again, I may appeal to the experience, first of Redhill, and then of the Hardwicke school, and I venture to assert that the superintendence which the labourers in those places exercise is fully as efficient as, and much more healthy in its influence than, that of the military warder of Parkhurst, against which place, however, I have no wish to make any invidious remark. With the exception of the penal ward, which should bear its character in its very appearance, as little evidence of restraint should certainly exist as could, with safety, be at all dispensed with. For all practical purposes of safe custody, the security of the dormitories would be almost the sole thing needed. The buildings connected with the ordinary requirements of life, *i.e.*, the washing apparatus, &c., might be readily so placed as that no boy could enter them or leave them unobserved, which would preclude the possibility of their making the use of them, at night for instance, to cover an attempt to escape.

Before darkness set in the whole of the boys should be mustered in the school or day room, previous to which time they of course should not have been for any time out of sight, either of the labourers, during their work, or of one of the school teachers during the time allowed for recreation (which would not be long) in a playground, so placed that he might command a view of the only exit from it. I think that such necessary securities against evasion as these might be esteemed fundamental parts of the institution, which an inspector should see rigidly carried out. Such also might be the regulated hours of work, sleep, instruction, and meals, while I can easily conceive that the manager of the institution might reasonably expect his representations of the desirableness of alterations in this respect, as the result of experience, to meet with careful attention. But in his desire to test individual boys, by allowing them much greater liberty than it would be safe to allow to all, it would be essential to give him all but an absolutely unfettered discretion, for with such only could he hope to create or strengthen in the boys' minds the sense of responsibility or the power of self-control. I should claim for him also the absolute judgment as to the fitness of a boy to leave the establishment. He should be able unhesitatingly to promise a boy, with the security of being able to keep his promise, that he should obtain on any given occasion his discharge. It is well known how greatly the success of the system devised by Captain Maconochie was interfered with by his being unable to fulfil the expectations he held out to the prisoners under his charge.

I have, however, by this time extended what I had intended to say to you, in connection with the paper and discussion to which I at first referred, much beyond what I had anticipated when I began. There is much, especially on the principle of reformatory treatment, which I have only imperfectly touched upon, but I think I have addressed myself to the principal points which that paper and discussion brought out, viz., the questions of the right of punishing children at all—of how they ought to be punished—and most important of all, of the possibility of, and the terms necessary to the enlistment of that agency by the State in its behalf, which has so abundantly, and on the whole, so successfully answered the summons of the voluntary labourers in the great public cause, the reformation of juvenile offenders. That the necessarily considerable responsibility which must be placed in the head of a reformatory institution, and the difficulty of securing the first attempt against the chance of being entered upon solely for the emolument connected with it, should render people of very different views adverse to the attempt being made at all, is not a matter of surprise. If it be made, and made wisely, the earnest attention of all who wish well to the cause, and I believe their fervent prayers, will be with an experiment which may be the first partial solution of one of the most difficult of our social problems; and as I believe the attempt will sometime be made, we shall see, I hope, men casting aside their present prepossessions for particular systems, and contributing all the influence that their experience can bring to bear on getting it made with a well-considered and deliberate wisdom.

I remain, dear Mr. Symons,
Yours very truly,
G. H. BENGOUGH.

## Proceedings of Institutions.

Brighton.—The Fourth Annual Report of the Committee of the Mechanics' Institution, states that the number of members is now 392, having remained stationary during the year. The number of volumes in the library is 2,696, showing an increase of 241. The reading room has been much resorted to; a new feature in connection with it, and a remunerative one, has been the quarterly sale of the daily and weekly papers. The lectures have been so badly attended that the Committee has not been encouraged to fill up each course as they could have wished. The musical entertainments, on the other hand, have been very well attended by the members, but the expenses are so great that the Committee do not feel justified in adding to their number. The elocution class is the only one really in existence, notwithstanding that efforts were made sixteen months back with a view to the extension of class instruction, but only 5 names were enrolled for the geography class, 8 for the arithmetic, 5 for the French, and 9 for the Palestine one. A band in connection with the Institution promises to become an honour to it. The exhibition of photographs lent by the Society of Arts was, in a pecuniary point of view, a failure. The receipts during the year amounted to £215 1s. 10½d., the expenditure to £211 13s. 10½d., leaving a balance of £3 8s. in the hands of the treasurer.

Yorkshire Union of Mechanics' Institutes.—The eighteenth anniversary meeting of this Union was held at York, on Wednesday in last week. The proceedings were commenced by the meeting of delegates in the morning, at which 49 Institutions were represented out of the 133 in union. There was a full attendance of members of the Central Committee, as well as many visitors. Mr. S. Wilson having been called to the chair, in the absence of Mr. E. Baines, the president, who was prevented attending owing to indisposition, the secretary then read the committee's report. From this it appeared that during the year Mr. G. S. Phillips, the agent to the Union, had paid altogether 165 visits to the Institutions—having delivered lectures at 94, attended conferences at 56, and public meetings at 38. By means of these visits the Institutions are becoming more educational, the fees in some are being raised, and altogether they are becoming more efficient; and in the Stockton-on-Tees Institute, notwithstanding the fees have been increased, the number of members has increased from 390 to 455, or 65 during the year. After referring to the Literary and Scientific Institutions Act, 17 and 18 Vict., cap. 112, which gives the power of holding property, and of suing and being sued, the report goes on to observe, that "these are great advantages, and that they have accrued is owing to the existence of a Union of Institutes." One of the first instances of the beneficial results of the new law has occurred in the case of the Masham Institute, which has received the donation of a very excellent site from the Master and Fellows of Trinity College, Cambridge. The Wakefield Institute has received a donation of £500 from Mr. Daniel Gaskell, towards purchasing a building. There is another point in which the legal position of Institutes is, in the opinion of the committee of the Union, unsatisfactory, viz., the exemption from local rating, the Act 6 and 7 Vict., cap. 36, being open to interpretations which contravene the original objects for which it was passed. The committee express the hope "that the Society of Arts will vigorously take up this question, and cause to be introduced during the next session of Parliament such amendments in the statute as will faithfully carry out its spirit and intentions." The next topic alluded to is the Itinerating Village Library, which, it is conceived, will become an important department in the future operations of the Union; but the success of the plan depends much more upon the local librarians than upon the Central Committee. The present number of stations is 24; the total number of books is 2,100—divided into 42 sections, of which 17 sections are in hand. A donation of 211 volumes, handsomely and strongly bound, has been received from H.R.H. Prince Albert. If in every village where a library is located a comfortable reading-room were established in connection with it, no small amount of discomfort and positive evil, arising from the overcrowded dwellings of the labouring population, would be prevented. In addition to this there should be persons appointed to read aloud, which, coupled with the stimulus of conversation, would make such a village club a powerful

instrument for individual and social benefit. From returns sent in from some of the Institutes, it appears that 21 have commenced employing paid teachers who did not do so before, and that 24 have extended their class instruction. Only 13, however, have adopted the plan of visiting the pupils in case of absence. The committee are very urgent on the subject of class instruction, and they say that "Neither the library, the newsroom, nor lectures, nor all of them combined, can supply the absence of class instruction, because none of them can so bring the mind into intimate relation with the knowledge to be acquired. In miscellaneous reading and lectures, points of any difficulty are kept out of sight or passed over, but in class instruction they must be mastered, or further progress is impossible." In too many instances, it is observed, the original educational objects of the Institutes are departed from, and amusement takes the place of instruction. Now it is quite possible to unite both departments in one Institute, and those at Huddersfield, and Rotherham, and Masbro', are successful examples of this combination. With regard to a suggestion made by Mr. Harry Chester in a lecture on Mechanics' Institutes, at the Society of Arts Educational Exhibition, that a special committee should be appointed by each Institute, composed partly of its own members, and partly of non-members, to endeavour, first, to raise the average of the school age; and second, to induce the continuance of study after leaving school,—the report remarks that such a committee, "if it combined the managers of day and Sunday schools with the conductors of the Institute, might, by bringing proper influences to act upon youth and their parents, cause the Institute to be regarded as the natural sequence of the school, and materially raise the character and influence of both." On the subject of female education, the report says:—"The reports and facts furnished by the Institutes show that, in two or three instances, increased attention is being paid to Female instruction. For instance, at Rotherham there are fifty females receiving instruction. At Bradford there are the same number. At Stanningley the Female classes succeed. There is, however, we regret to say, no proportionate progress made in Female instruction compared with its real importance. Everyone asserts the necessity of Female education, that it is more important than that of the other sex,—that the education of woman is the education of both man and woman begun in the right place, and other generalities are from time to time uttered on this suggestive topic. But as an admitted principle, demanding practical realisation without any further delay, it seems to meet with far too small recognition. The most noteworthy exception to this remark is in connection with the Leeds Institution, where a Girls' Day School, of very high character, is being established. The course of instruction, besides the ordinary accomplishments of the usual boarding-schools, comprise departments which *all* schools *ought* to embrace, and which will certainly confer upon the pupils advantages of no ordinary value, such as Natural History, Natural Philosophy, Elementary Chemistry, and Physiology." At the Churwell, Headingley, and Northowram Institutes Sewing Classes have been established, one person of superior education being employed to read aloud to the rest while at work.—The report having been adopted, the following resolutions were passed. 1st. "That as a primary principle of the operation which the Union is to produce the greatest amount of good at the least cost, and as the most extensive part of its instrumentality is that connected with the office of the salaried agent and lecturer, it is indispensably necessary that whatever may economise his time and energy, and the outlay (whether borne by the Union or by the individual Institution) incidental to the discharge of his duties should be adopted and carried into practical effect. This meeting, therefore, hereby expresses its deliberate opinion that the irresponsibility of the visits of the agent to meet the particular convenience of Institutions, whereby he is compelled to make repeated journeys to one neighbourhood, entailing unnecessary expense and much waste of time, should be forthwith discontinued, and that the Union committee be requested to arrange a topographical employment of the agent's services, with defined circuits for certain periods, all the institutions having due notice of his visits. That it be understood, however, that this shall not preclude permission to the agent to accede to a special invitation from any Institution having urgent need of his services and being prepared to incur the cost of the visit, but this meeting respectfully urges on the Institutions in the Union the duty of generally supporting the committee in carrying out a topographical arrangement of the agent's visits." 2nd. "That this meeting, while expressing its satisfaction with the exertions of the Society of Arts in obtaining the Act 17 and 18 Vict., c. 112, giving a legal negociation and security for their property, would urge on that Society the consideration of the 6th and 7th Vict., c. 36, with the view of effectually securing its objects and removing the difficulties in its administration." 3rd. "That in the next list of premiums, offered by the Society of Arts, they be requested to offer prizes for class-books to assist, and more especially adapted to, the evening classes of Mechanics' Institutes." Some remarks were then made as to the best methods of increasing the efficiency of the evening classes of Mechanics' Institutes, and of combining reading-rooms with village libraries, after which the usual cash accounts were read, showing a balance due to the treasurer of £75 9s. 5d. The following Institutes were admitted into the union, viz., Crosskill's, Hartlepool Working Men's Institute, West Hartlepool, Wainsgate (Hebden Bridge), Kettlewell, Rufforth (York), Swillington, Shelley, and Tadcaster. The committee and officers for the ensuing year were then appointed, and it was resolved that the meeting next year should be held at Middlesbro'. The following resolution concluded the business of the meeting:—"That this meeting respectfully offers its most grateful thanks to his Royal Highness Prince Albert, for the countenance and assistance he has given to the Yorkshire Union Village Libraries, by presenting to its collection of books 211 volumes, selected by himself."—The delegates and their friends, to the number of 100, afterwards dined together, and in the evening there was a public meeting, which was addressed by Lord Goderich, M.P., Mr. R. M. Milnes, M.P., the Rev. Canon Hey, the Very Rev. the Dean of Ripon, Mr. J. D. Dent, M.P., the Rev. T. Myers, Sir W. M. E. Milner, Bart., M.P., the Rev. J. Kenrich, the Hon. J. C. Dundas, Mr. T. W. Wilson, Mr. Alderman Leeman, and others.

## To Correspondents.

A Belfast Man is informed that provisional protection for six months is obtained on payment of a stamp duty of £5. On further payment of £15, three years' protection is obtained. To keep the patent in force for the whole term of 14 years a fresh payment of £50 at the end of the third year, and £100 at the end of the seventh year, is required. These are payments to Government, and are irrespective of the charges of a patent agent for preparing specifications and other documents, &c., which vary with each case.

*** A letter from Col. Sir Frederick Abbott, C.B., "On Public Works for India," has been received, and is in type.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 26th, 30th, 31st May, 1st, 2nd, and 4th June,* 1855.

Par. No.

257. Poor Law (North Dublin Union)—Minutes of Evidence.
268. Mercantile Marine Fund—Account.
65 (4). Trade and Navigation—Accounts (30th April, 1855).
253. East India—Territorial Accounts.
261. British and Colonial Spirits—Account.
263. Pupil Teachers—Return.

266. Civil Service—Copy of Order in Council.
274. Gibraltar—Copy of Dr. Baly's Report.
276. Canada—Copies of Address, &c.
245. Sugar, &c.—Return.
265. Cambridge University Bill—Copy of Letter.
260. Fire Insurance—Account.
262. Lunatic Asylums (Ireland) (Advances) Bill—Minutes of Evidence.
275. Spirits (Navy)—Contracts.
243. East India Telegraphs—Copies of Reports.
268. Metropolitan Commission of Sewers—Return.
269. Reformatory Schools—Return.
270. Smoke Nuisance Abatement (Metropolis)—Returns.
267. Metropolis Turnpike Roads—29th Report of Commissioners.
277. Artillery Officers (Woolwich)—Correspondence.
72. Bills—Public Health (as Amended by the Select Committee.)
120. Bills—Insolvency and Bankruptcy (Scotland).
142. Bills—Dissenters Marriages (Amended).
148. Bills—Criminal Justice (as Amended by the Select Committee).
150. Bills—Limited Liability.
151. Bills—Partnership Amendment.
149. Bills—Dwellings for Labouring Classes (Ireland).
150. Bills—Limited Liability (a Corrected Copy).
Railways—Reports upon certain Accidents (January and February).
Ordnance Survey—Treasury Minute, &c.
Railways—(Number of Passengers, &c.)—Return.
Public General Acts—Cap. 19, 20, 21, 22, 23, 24, 25, and 26.

*Delivered on 5th June*, 1855.

248. Supreme Court of Calcutta—Returns.
125. Bills—Justices of the Peace Qualification.
147. Bills—Ordnance Board.

*Delivered on 6th June*, 1855.

152. Bill—Episcopal and Capitular Estates (amended).
Turnpike Trusts—Sixth Report by the Secretary of State.

## MEETINGS FOR THE ENSUING WEEK.

MON. Geographical, 8½.
TUES. Syro-Egyptian, 7½. Mr. Abington, "On the Origin of the Cuneiform Character." 2. Dr. Benisch, "A Critical Examination of the original Hebrew Text of the passages referring to the Exodus." 3. Mr. Lascellas Wraxall, "On the Natron Monasteries in Egypt."
Med. and Chirurg., 8½.
Zoological, 9.
WED. Literary Fund, 3.
Royal Soc. Literature, 4½.
Society of Arts, 8. General Meeting to receive the Council's Report and Statement of the Funds of the Society."
Geological, 8. 1. Prof. Owen, "On Remains of Dicynodon from South Africa." 2. Prof. Owen, "On a fossil Sirenoid Mammel from Jamaica." 3. Prof. Beyrick and Mr. Hamilton, "On the Brown Coal Formation of North Germany." 4. Prof. Nicol, "On the Metamorphic and Devonian Rocks of the eastern end of the Grampians." 5. Sir R. Murchison, "On the Fossil and Drift Wood in the Arctic Regions found by Capt. M'Clure and Lieut. Pym." 6. Commander Bedford, "On the raised Beaches of Loch Gilphead." 7. Mr. R. W. Fox, "On Sand-worn Granite." 8. Dr. W. Gilchrist, "On the Red Soil of India." 9. The Reverends Messrs. Hislop and Hunter, "On the Omret and other Coalfields of Central India." 10. Mr. Consul Sandison, "Notes on the Earthquakes at Broussa."
THURS. Antiquaries, 8.
Royal, 8½.
FRI. Royal Inst. 8½. Colonel Rawlinson, "On the Results of the Excavations in Assyria and Babylonia."
SAT. Asiatic 2.
Royal Botanic, 3¾.

## ATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette June 1st*, 1855.]

*Dated 15th May*, 1855.

1097. R. Jobson, Dudley, and J. Jobson, Derby—Moulds for casting metals.
1099. G. T. Bousfield, 8, Sussex-place, Brixton—Wrought nails.

*Dated 16th May*, 1855.

1100. G. Saxon, Openshaw—Safety plugs for boilers and valves.
1102. T. Richardson, Leeds—Dyeing cloth.
1103. A. R. le Mire de Normandy, 67, Judd-street—Oily acids and soap.
1104. E. P. Plenty and W. Pain, Newbury—Ploughs.
1105. C. W. Siemens, John-street, Adelphi—Freezing water, &c.
1107. R. Jamieson, Ashton-under-Lyne—Forging machine.
1108. R. and E. Vezey, Bath—Carriage steps.
1109. J. H. Porter, Birmingham—Coupling blocks for roof trusses.
1111. R. Murdoch, Glasgow—Sowing seeds and depositing manure.
1112. W. Rye, Miles Platting—Railway wheel.

*Dated 17th May*, 1855.

1113. T. Dawson, King's Arms-yard—Cases for pen, ink, and stamps.
1114. A. M. Mennet, Paris—Ornamenting fabrics.
1115. J. G. Butt and J. H. Martin, Paris—Rotary engines.
1116. W. Johnson, 47, Lincoln's-inn-fields—Oily, resinous, and gummy substances and soaps. (A communication.)
1117. F. D. Blyth, Birmingham—Tea trays, picture frames, &c.
1118. J. Rae, Alpha-road, New-cross—Warming railway carriages, &c.

*Dated 18th May*, 1855.

1120. B. T. Warée, Paris—Sharpening pencils.
1122. J. Jeffreys, Kingston—Sun blinds.
1124. J. Cumming, Glasgow—Looms.

*Dated 21st May*, 1855.

1126. R. J. Stainton and E. C. Davey, 14, Holland-street, Blackfriars—Warming stoves.
1128. P. B. Eassie, Gloucester—Elliptograph.
1130. B. Nicholls, East-street, Old Kent-road—Buttons.
1132. S. Stocker, Brighton—Shaping machinery.
1134. T. Piggott, Birmingham—Telescopic gas holders.
1136. W. J. Curtis, Hardinge-street, Islington—Aeronautics.
1138. L. F. J. Ravenstin and C. Chatel, Paris—Blinds, screens, &c.
1140. A. F. Cossus, Cagliari—Treating oils, &c.
1142. J. L. Rey and A. Guibert, Marseilles—Submarine and preserving coating.
1144. A. H. Mentha, Manchester—Wadding.
1146. J. M. Murton, 3, Somers-place West—Sister-hooks and thimbles for ships' and boats' riggings.
1148. J. H. Johnson, 47, Lincoln's-inn-fields—Signals for nautical purposes. (A communication.)
1150. A. V. Newton, 66, Chancery-lane—Watches. (A communication.)

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1106. R. Peters, 89, Union-street, Borough—Steam engines.—16th May, 1855.
1174. S. S. Putnam, Massachusetts—Forging machine.—24th May, 1855.
1175. S. E. Robbins, Vermont, U.S.—Fire-arms. (Partly a communication.)—24th May, 1855.
1177. Baron von Gilgenheinch, Widenau, Silesia—Machine for tilling land.—24th May, 1855.
1214. A. E. L. Bellford, 32, Essex-street, Strand—Ordnance and cartridges. (A communication.)—28th May, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed May 25th*, 1855.

2499. Félix Delacour, Paris—Improvements in fire-screens.
2524. Ellis Rowland and James Rowland, Manchester—Improvements in metallic pistons.
2552. Daniel Collet, Paris—Improvements in transmitting power.
2559. John Warhurst, Hollingworth—Improvements in furnaces or fire-places applicable to apparatus for heating water and generating steam.
2567. Christopher Hodgson and James Whitley Stead, Salford—Improvements in machinery or apparatus for washing or cleansing woven fabrics and clothes, part of which apparatus is also applicable to churning milk and cream.
2653. James Fenton, Low Moor—Improvements in the manufacture of axles, piston rods and shafts, girders, and other like articles.
129. Constant Jouffroy Duméry, Paris—Improvements in smoke-preventing apparatus.
230. George William Henri, Fishergate, York—A new compound or meal mixture for feeding cattle.
581. William Lister, Dunsa Bank, near Richmond, Yorkshire—Improved implement for raising or loosening turnips and other roots in the ground, and cutting off the tails thereof.
582. Henry Bach, Sheffield—Improvements in sash frames.
655. William Brown, Gresham-street—Improved mode of preparing sewing silk for the market.

*Sealed May 29th*, 1855.

2543. Edward Dowling, Little Queen-street—Improvements in weighing machines, and in their application to implements of transport.
2572. Ferdinand Cellier Blumenthal and Maximilian Louis Joseph Chollet, Paris—Preserving meats.
2599. François Jacquot, Bruxelles—Improvements in the lining of hats, helmets, shakos, caps, and similar articles.
2620. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in photography.
2672. Jean Baptiste Falguière, Marseille—Improvements in apparatus and machinery for propelling boats and vessels on water.
2675. Joseph Gorton Briggs, Kingsland—Improvements in the manufacture of fuel.
2677. Joseph Tucker, 7, Guinea-street, Bristol—Improvement in the construction of ships for saving persons in case of shipwreck.
2714. John Francis Porter, Besborough-street—Improvements in the manufacture of bricks and tiles.
2725. James Dundas, Dundas Castle, Linlithgow—Improvements in the manufacture of cannon and ordnance of every description.
2749. Henry Widnell, Lasswade, Midlothian—Improvements in the manufacture of carpets and other textile fabrics.
18. John Henry Johnson, 47, Lincoln's-inn-fields—Improved system or mode of coating iron with copper.
206. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the construction of kites, and in the application thereof to the purposes of carrying lines and of signalling. (A communication.)

215. William Polkinhorn, Gwennap, near Redruth—Improvements in apparatus for cleansing wheat.
222. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in looms for weaving. (A communication.)
302. Frederick Ransome, Ipswich—Improvements in drying articles made of plastic materials.
362. John Robb and Laurence Hill, Greenock—Improvements in the masts and spars of ships and vessels.
430. William Campion, Nottingham—Improvements in knitting machinery.
534. Samuel Cunliffe Lister, Manningham, near Bradford—Improvements in treating and preparing the fibres of flax and hemp, and other fibrous substances for spinning.
538. Samuel Cunliffe Lister, Manningham, near Bradford—Improvements in machinery for combing wool and other fibres.
548. David Hunter Brandon, 11, Beaufort-buildings, Strand—Improvements in machinery or apparatus for cutting fustians and other piled fabrics. (A communication.)
548. Robert More Butt, Fairfield Works, Bow—Improvements in the manufacture of night lights.
616. Richard Edward Hodges, Southampton-row, and Charles Murray, Manor-place, Walworth—Improvements in door springs.
632. John Morrison, Birmingham—Improvements in the manufacture of metallic pens.
638. Charles Carnell, Philadelphia—Improvements in the manufacture of bricks.
640. George Whyatt, Openshaw—Improvements in machinery or apparatus for cutting piled goods or fabrics.
644. Charles Frederick Behn, Commercial Sale Rooms, City—Improvements in machinery for making moulds for casting metal. (A communication.)
662. George Allam Barrett, William Exall, and Charles James Andrewes, Reading—Improvements in portable and fixed combined threshing machines.
668. Francis Crossley, M.P., Halifax—Improvements in the manufacture of mosaic rugs.
680. George Leonard Turney, Wood-street, Cheapside—Improved mode of arranging or packing pins and needles for sale.
690. Thomas M'Low, Middle-row, Holborn—Improvements in screw propellers.
712. Joseph Morgan, Manchester—Improvement in the manufacture of candles in which tallow is used.
714. Edward Vansittart Neale, Russell-place, and Thomas Dawson, King's arm's yard—Improvements in handles and parts of handles for umbrellas, walking sticks, knives, and for other like articles; and for articles of furniture, in stoppers, finger-plates, medallions, jewellery, furniture, and other decorative articles.
724. George Fergusson Wilson, and George Payne, Belmont, Vauxhall—Improvement in treating oils to obtain an elastic product.
734. Richard Peyton, Bordesley Works, Birmingham—Improvements in the manufacture of iron gates and fences.
746. Jacob Maas and James Adams, White Hart-yard, Southwark—Improvements in mills for splitting or grinding beans, peas, corn, and all kinds of grain.
752. Christopher Nickells, Albany-road, Surrey, and James Hobson, Leicester—Improvements in weaving pile fabrics when wires are used.
762. Denny Lane, Sunday's Well, Cork—Improvements in obtaining power by water.
790. Louisa Monzani, St. James's-terrace, Blue Anchor-road—Bermondsey—Improvements in folding stools and folding chairs. (A communication.)

*Sealed June 1st, 1855.*

2579. George Aubury, Queen street, Edgeware-road, and William Richard Bridges, Gravel-lane—A portable apparatus for the manufacture and supply of gas.
2601. Charles Thomas Guthrie, New Bond-street—Improvements in angles, T squares, straight edges, parallel rules, and other similar instruments employed in drawing.
2696. Gustave Irenée Sculfort, Maubeuge—Improvements in manufacturing screw plates.
2697. Jabez Smith, Bedford—Improved buckle or fastening.
99. John Charles Pearce, Bowling Iron Works—Improvements in machinery or apparatus for the manufacture and working of iron and other metals.
145. Samuel Isaacs, 22, Newman-street, Oxford-street—Improvements in the manufacture of artificial coral.
468. John Coney, Newhall-hill, Birmingham—Improved construction of gun lock.
620. Jonathan Musgrave, Bolton-le-Moors—Improvements in steam engines.
722. William Edward Newton, 66, Chancery-lane—Improved mode of constructing centre-bits.

*Sealed June 5th, 1855.*

2588. James Higgins and Thomas Schofield Whitworth, Salford—Improvements in the manufacture of bayonets, and in machinery or apparatus connected therewith.
2597. William Davis, Old Kent-road—Improvements in furnaces.
2608. Francis Puls, Whitechapel-road—Improvements in electro-galvanic apparatus for medical purposes, part of which improvements are also applicable to other electro-galvanic apparatus.
2611. Richard Larkins, 2, St. John's-villas, Highbury—Improvements in the construction of locks and keys.
2616. Charles Frederick Stansbury, Cornhill—A machine for cutting keys.
2629. John Court, jun., Sheerness—Improvements in rockets.
2632. Llewellyn William Evans and James Mc Bryde, Saint Helens—Improvements in the burning of sulphuret ores for making sulphuric acid and for smelting.
2648. Peter Joel Livsey and William Weild, Manchester—Improvements in cartridges and projectiles, and in the construction, mounting, and working of ordnance.
2652. Lieut. Matthew Curling Friend, R.N., 44, Ashburnham-grove, Greenwich, and William Browning, 111, Minories—An apparatus for determining the magnetic aberrations occasioned by local attraction.
2667. James Cunningham, West Arthurlie—Improvements in starching textile fabrics.
2673. John Avery, 32, Essex-street, Strand—Improvements in machinery for cutting metallic bars. (A communication.)
2728. Thomas Boyle, 45, Skinner-street, Snow-hill—Improvements in reflectors for artificial light.
3. Joseph Seguin, Paris—Improvements in obtaining motive power by the expansion of air, steam, and other fluids.
10. Claude Jules Fincken, 36, Rue de l'Echiquier, Paris—Preserving without loss of heat all windows, glass roofs, false roofs, &c., from the effects of condensation and damp, and also from the effects of external smoke, soot, and dust.
51. Edward Hayes, Stony Stratford—Improvements in apparatus for feeding thrashing machines.
114. James Lee Norton, Holland-street, Blackfriars—Improvements in recovering the wool from fabrics composed of wool or wool in connection with cotton or other vegetable substance.
246. Isaac Jecks, Trowse Newton-lodge, near Norwich—A machine for sweeping grass or weeds from lawns or fields and depositing the same into a box or other receptacle.
382. George Heppel, Preston—An improved rotary pump and engine. (A communication.)
396. Walter Neilson, Glasgow—Improvements in locomotive engines.
408. Victor Joseph Lebel, Jean Fourniol, and Jean Baptiste Remyon, Paris—Improvements in typographic presses.
570. William Galloway and John Galloway, Manchester—Improvements in balancing or regulating the pressure on the slide valves of steam engines.
590. Joseph Mitchell, Lansdown-road, Sheffield—Supplying grease, tallow, or oil, either with or without the addition of black lead, to locomotive engines, horizontal and beam engines, marine engines, and Nasmyth's patent steam hammer.
677. Charles Goodyear, 42, Avenue Gabriel, Champs Elysées, Paris—A new method of moulding india rubber and gutta percha.
678. John Getty, Liverpool—Improvement in the construction of steam and other vessels.
696. Marie Jeanne Thérèse Gillot, and Cécile Celestine Beauvais, 30, Upper Charlotte-street, Fitzroy-square—Improvements in purifying grain, vegetable, or botanical matter, and cochineal.
760. Joseph Brazier, Wolverhampton—Improvements in revolving or repeating fire-arms.
802. George Fergusson Wilson, Conrad Abben Hanson, and James John Walli-, Belmont, Vauxhall—Improvements in the manufacture of lamp candles, and in candle lamps for holding the same.
804. George Fergusson Wilson and George Payne, Belmont, Vauxhall—Improvement in ornamenting glass.
822. Thomas Hill, Walsall—Improvements in the manufacture of horse-shoe and other nails.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3722 | May 25. | A Tap Protector | John Wright | Chipping Ongar, Essex. |
| 3723 | May 29. | Heater and part of a Kettle or other Vessel | Smith, Sissons, and Co. | 8, Duke-street, Adelphi, and Eyre-street, Sheffield. |
| 3724 | May 31. | Improved Capstan for turning down Screw Cylinders or Piles | Rowland Brotherhood | Railway Works, Chippenham, Wiltshire. |
| 3725 | June 1. | Parallel Compass | Charles Tilston Bright | Exchange Buildings, Liverpool. |
| 3726 | June 6. | Family Fire Escape | John Cuxon and Charles Frederick Lucas | Shiffnal, Shropshire. 8, Duke-street, St. James's. |

Journal of the Society of Arts.

*FRIDAY, JUNE* 15, 1855.

## GENERAL MEETING.

Wednesday, June 13, 1855.

The General Meeting to receive the Report of the Council relative to the proceedings of the past year, and the Auditors' statement of Accounts, was held on Wednesday, the 13th inst., Viscount Ebrington, M.P., Chairman of Council, in the chair.

The following candidates were balloted for and duly elected ordinary members:—

| | |
|---|---|
| Homersham, John | Mc Kay, Hugh |
| Howes, Frederick William | O'Beirne, James Lyster |
| Leighton, George Cargill | |

## REPORT FROM THE COUNCIL TO THE SOCIETY, ON THE CLOSE OF THE ONE HUNDRED AND FIRST SESSION.

The Council in laying before the members the Annual Report of their proceedings, would first refer to the Educational Exhibition, which, although commenced in the previous year, and due to the labours of the former Council, has actually taken place since the presentation of the last Report. It is unnecessary here to enter into all the details connected with its establishment and its objects; the members are familiar with them, from the chairman's address at the commencement of the Session, and from the reports in the Journal of the lectures and other proceedings connected with it. The Council, however, would be wanting in their duty were they to pass over without observation that remarkable series of lectures which were delivered at St. Martin's Hall in connection with the Exhibition—a series remarkable not only for the number and varied character of the subjects embraced, but also for the attainments of the individuals by whom they were delivered. During the nine weeks that the Exhibition was open, there were no less than sixty-one lectures given. A list of these will be found in the Appendix to this Report

To these gentlemen the thanks of the Society are eminently due. It is to be regretted that no permanent and complete record of these lectures remains, but many were delivered without even written notes. Abstracts of nearly all were, however, published in the Journal; some few were published separately by their authors, and at the request of the Council, the MSS. of others were furnished to Messrs. Routledge, who undertook their publication in a cheap form, and the volume* of the Exhibition Lectures thus published forms an interesting and valuable contribution to our Educational literature.

Reports on the different departments of the Exhibition were intended to have been made, but difficulties of a nature unnecessary here to specify, prevented this portion of the plan being fully carried out, and only two were obtained, viz., one on the Fine Art Department, for which the Society are indebted to Sir C. L. Eastlake, P.R.A., and Mr. F. S. Cary, and the other on the Musical Instrument Department, to the Rev. W. W. Cazalet. These were published in the Journal. In the Journal, too, will be found an original and interesting Paper "On the School System of Norway," contributed by Councillor Nissen; also an account of "The New York Free Academy," furnished by the Board of Education of that City, and Reports on the Exhibition from M. Milne Edwards, specially deputed by the Minister of Instruction in France to visit it, and by Dr. P. A. Siljeström, Commissioner for Sweden. The articles in the Journal, by "A Member," reviewing the books exhibited, must have been read with interest, displaying as they did an intimate and practical acquaintance with the subject. They may be taken as a careful, intelligent, and impartial report on that section of the Exhibition. It was early seen how desirable it was that such a collection should be permanent, and the Council lost no time in communicating with her Majesty's Government, urging the importance of forming a National Collection of this nature, and pointing out the facilities which the present opportunity afforded for commencing the work. The Council are happy to state that the Government has announced its determination to establish such a collection as a National Museum of Education, and the Council are anxiously looking for the accomplishment of this most desirable object. The Council have equal pleasure in announcing, that on the faith of such a Permanent Museum being established, a large number of the contributors to the display in St. Martin's Hall have most liberally responded to the request made by the Council, and have placed their contributions at the disposal of the Society as free gifts for the Permanent Museum. The Exhibition excited considerable interest, not only in this country, but among foreign nations. Very large and valuable contributions were received from abroad, and the Exhibition was visited by Commissioners from several Foreign governments and Educational bodies, specially charged with the duty of reporting upon its contents. Although in a pecuniary point of view the Exhibition did not pay its expenses, having, notwithstanding the liberal subscriptions received, involved the Society in a deficit of nearly £400; yet the Council are satisfied that it has not been held in vain, and that it has exerted a powerful and important influence upon, and given a permanent impulse to, the progress of an improved education.

The Council have great satisfaction in referring

* Lectures, in connection with the Educational Exhibition of the Society of Arts, Manufactures, and Commerce. London: G. Routledge and Co. Price 1s. 6d.

to the succession of valuable and varied papers which have been read and discussed at the evening meetings of the Society during the present Session.

During the present Session there have been 24 ordinary meetings, 1 special meeting, and 2 extraordinary meetings for the purpose of resuming discussions which it was found impossible to terminate on the evenings on which they were commenced.

The first ordinary meeting was devoted to the reception of an Address* from the Chairman of Council, Viscount Ebrington, M.P., on the Opening of the One Hundred and First Session. In this his Lordship gave a review of the past and present position of the Society, and pointed out those matters which the Council proposed should be undertaken during the ensuing session.

This was followed by a paper by Professor Crace Calvert, "On Various Products obtained from Coal (coal-gas excepted)."† After alluding to the formation of coal, and to the actual and theoretical duty obtained by the use of different kinds for raising steam, he proceeded to speak of some improvements in the manufacture of coke. The products which chemists had ascertained to exist in the substances distilled from coal, were divided into three classes—gases, liquids, and solids. Into the first he did not enter. The second contained an aqueous portion and a tarry portion, the former of which was chiefly valuable for its ammonia, and was useful to chemical manufacturers, in dye-works and the like, and to agriculturists; and the latter produced light and heavy oils, which had been applied, amongst other things, for the preservation of wood. A paper of a similar kind was that by Mr. W. Longmaid, "On Peat and other Vegetable Charcoal, and some of its Uses."‡ Attention having been forcibly directed, on many occasions, to the bog lands of the United Kingdom, as offering an inexhaustible supply of organic matter ready to be converted into fuel suited for many manufacturing and domestic purposes, Mr. Longmaid conceived that a simpler and more economical method of converting it into charcoal might be introduced. His process consists in steeping vegetable matter in dilute sulphuric acid, and drying it at a low temperature, whereby he obtains from 40lbs. to 65lbs. of charcoal from every 100lbs. of dry material submitted to the operation.

Mr. P. L. Simmonds, whose intimate acquaintance with our Colonies, and especially with their resources, peculiarly fitted him for the task, gave some very valuable information to merchants and manufacturers in his paper "On Unappreciated and Unused Articles of Raw Produce from different parts of the World."§ A mere enumeration of the various items touched upon by Mr. Simmonds, will serve to show how extensive was the field of research into which he entered, and it is to be hoped that his labours will result in adding to our list of imports many new materials of commerce, and increasing our supplies of old staples. The many important purposes served by vegetable fibre, the comparative, if not the complete dependence of the manufacturers of this country on foreign supplies, and the large sums of money annually expended in obtaining them, have naturally led to the inquiry—more particularly at the present epoch, when our trade with one nation is stopped—whether in our own possessions, there could not be found materials suitable for the preparation of cloth and cordage, and of paper. To this point, then, attention was first called, and it was shown that in the East and West Indies, and in the islands of the Indian Archipelago, plants yielding serviceable fibres were found in abundance, whilst of the available fibres of the vast valley of the Amazon, of the thistles of the Pampas of South America, of the prairie grasses and reeds of North America, and of the indigenous products of Central Africa, we know literally nothing. This shows the desirableness for all travellers being somewhat acquainted with the pressing needs of Commerce. Gums and resins were next treated of, and then the products of the forests of the globe came under review; and the variety of ornamental woods suitable for the manufacture of furniture, and at present almost unused, was shown to be inexhaustible. Fruits and vinous and fermented drinks, medicinal plants, the products of the sea, the tenants of the air, and the insect tribe, were then successively noticed, especial attention being called to the question of the preservation of food, so that its superabundance in parts where population is sparse, might be made to supply the requirements of thickly-peopled countries. A subsidiary paper, "On the Influence of Climate on Production,"* by Mr. A. G. Findlay, suggested one view of the same subject not always kept prominent, viz., that the nature of the raw products is dependent on the physical and climatological conditions of their locality.

Mr. Mechi's "Fourth Paper on British Agriculture,"† raised two very important questions, which have been much debated—the application of steam to cultivation, and the comparative merits of liquid and solid manure. In regard to the first, it seemed to be considered by those who took part in the discussion which followed the reading of the paper—including Colonel Challoner, Mr. J. B. Lawes, Mr. Wren Hoskyns, Mr. J. Caird, Mr. Morton, Mr. Sidney, Mr. Davis, &c.,—that at present the weight and bulk of the engine, appeared to be incompatible with the si-

* *Vide* ante, page 1. † *Vide* ante, page 17. ‡ *Vide* ante, page 151. § *Vide* ante, page 33.

* *Vide* ante, page 42. † *Vide* ante, page 49.

multaneous cultivation and progression over the yielding surface of the field; whilst as to the latter, it was pointed out that though the sewage of towns existed principally in a liquid form, the manure of the farm was mostly solid, and it was thought that there was scarcely sufficient experimental evidence to prove the economy of converting farm yard manure to the liquid form. Two other points were also discussed, the economy of labour, and the profitableness of feeding stock. Mr. J. B. Lawes in his paper "On the Sewage of London,"* first proceeded to point out what constitutes value in a manure, and next directed attention to the composition of sewage. Considering that human excrements were the main items to be taken into calculation, he estimated the amounts of carbon and nitrogen consumed per day in the food of individuals of different classes, ages and sexes; registered the amounts of carbon expired daily by the lungs; and then quoted or calculated from various experimenters the amounts of solid and liquid excrements and the valuable constituents contained therein. Mr. Lawes calculated that the sewage of London, if entirely freed from water, would amount to 51,286¾ tons, of which about one-sixth was nitrogen, namely, 8,859¾ tons, equal to 10,758¼ tons of ammonia. This is, however, unfortunately distributed through such a vast bulk of water, that the cost of its distribution would be enormous, whilst it was questionable how far it would be beneficial for corn crops. Various attempts have been made to solidify the sewage, but Mr. Lawes thinks that with our present knowledge the manufacture of a solid sewage manure is quite impracticable. He therefore recommended that a few thousand acres at no great distance from the Thames should be devoted to grass, as the most suitable crop for the application of liquid sewage, and this would return to the metropolis milk and cream, with which the inhabitants are at present most inadequately supplied. The discussion on this subject extended over two evenings, and was well sustained by the several speakers who had taken part in the discussion on Mr. Mechi's paper, (which may be said to have been the means of obtaining for the Society the valuable investigations of Mr. Lawes,) as well as by Mr. Chadwick, Mr. F. O. Ward, Professor Way, Mr. T. Scott, Messrs. Bazalgette and Haywood, (Engineers to the Metropolitan and City Commissions of Sewers,) Mr. Paine, of Farnham, &c. There was universal agreement as to the desirableness of freeing the metropolis and the river Thames of the sewage, but great diversity of opinion was exhibited as to whether the cost of the collecting and distributing works would be realised; whether, in fact, the value of the article would repay the expenses incurred in pumping, &c.

* *Vide* ante, page 263.

Another branch of sanitary engineering, that of Water Supply, was treated of by Mr. S. C. Homersham, in his paper on "The Chalk Strata Considered as a Source for the Supply of Water to the Metropolis."* In many districts of Great Britain, where the soil rests on impermeable strata, the water that falls flows off by means of rivers, canals, brooks, and streams, and is collected in reservoirs and used for supplying towns. On the other hand, where the soil rests upon chalk, as on the Chiltern Hills and the North Downs, the water sinks into the earth and goes to supply subterranean reservoirs, flowing from thence, through the interstices in the planes of stratification, into the sea. The proposal of Mr. Homersham is, that before the water reaches the sea, it should be intercepted for the supply of the metropolis. The only drawback to the use of this water is, that it contains about 17½ grains of bi-carbonate of lime per gallon, but this, by the softening process of Dr. T. Clark, of Aberdeen, which he described, may be precipitated. In the discussion, objection was taken by Mr. F. Braithwaite, the Rev. J. C. Clutterbuck, and Mr. Evans, as to the quantity of the water to be derived from this source, and Mr. Braithwaite took exceptions to its quality, on the ground that the water of the deep wells under London was becoming salter and salter every year, showing that there must be an infiltration of salt or brackish waterinto the so-called London basin. To this it has since been replied that though the presence of salts in the water in question cannot be denied, yet that they are becoming less and less in quantity year by year, and that their presence at all is to be accounted for not by any supposed infiltration of sea-water, but rather to the fact that the chalk being a marine formation, contains within itself a large per centage of salts, which are gradually being washed out, and that this would explain how it comes to pass that they are less in quantity in water obtained from wells in the higher districts of the chalk, than in that derived from the low-lying beds.

In the same class may be mentioned the paper by Mr. G. W. Muir, "On the Smoke Nuisance considered Morally, Historically, Scientifically, and Practically."† This gentleman does not at all doubt but that the nuisance of smoke may be got rid of, but he argued that before the government took legal proceedings against offenders, they should be prepared to show how it might be done. For his own part, he believed that it involved a question of dimensions and not inventions. Also, that by Dr. D. B. Reid, "Notes on the Revision of Architecture in connection with the Useful Arts, with Special illustrations of the Ventilation of St. George's Hall, Liverpool,"‡ in which he advocated that the architect

* *Vide* ante, page 168. † *Vide* ante, page 134. ‡ *Vide* ante, page 379.

should make acoustics, warming, lighting, ventilation, and drainage, his special study, and that in designing buildings all these things should be taken into account. In regard to this paper, it should be mentioned that it was produced at a few days' notice, owing to some doubt having been expressed as to whether that originally intended for the evening in question could be ready in time.

Remembering the vast mineral wealth of this country, it is not surprising that so many evenings should have been devoted to the consideration of papers treating of our metallic industries. These papers were partly manufacturing, and partly commercial and statistical. That by Mr. Harry Scrivenor, whose treatise on the Iron Trade has been so generally appreciated, and is so well known, "On the Growth and Expansion of our Foreign and Colonial Trade in Iron, and the Fiscal Obstructions to its Extension,"* showed that in all countries the requirement of iron was progressive, and that the railroad was the great step in advance. In his opinion, the extension of our trade depends principally upon the cost of production, and not upon the duty,—and, holding this view, he expressed the belief that a reasonable rate of wages would be found more advantageous to the men and their families than the high rates sometimes contended for, and that a moderate cost of iron was likely to be of more permanent benefit to the ironmasters. In the discussion on this paper, Mr. W. Bird combatted several of the views which had been expressed, remarking that the advancement of a country depended upon its ability to obtain a plentiful supply of *cheap* iron, and this it could not do so long as any fiscal restriction remained. Prussia, he said, had been destroyed as a consuming country, because, in the hope of making it a producing one, the prices had been unduly advanced by high duties. He then followed a pig of iron from the Elbe to Austria, showing the number of places at which it was stopped to pay toll, and concluded by arguing that such proceedings could not but prove serious obstacles to the extension of trade in these directions. In Professor John Wilson's paper "On the Iron Industry of the United States,"† it was shown that, notwithstanding the enormous mineral resources of that country, the make of iron was not equal to the consumption, owing, as he believes, to that industry being as yet in its infancy, and to the want of capital The deficiency is supplied from Great Britain, our exports of iron to that country alone exceeding by about one-third the gross exports to other countries. To retain this good customer "economy of production" was most essential, and this depended not alone upon cheap labour, but upon the ironmasters seeking for and adopting improved processes. The difference in price between the two countries is 80 per cent., of which 50 per cent. is a natural protection due to freight, commission, insurance, &c., and 30 per cent. is an artificial protection, being the present *ad valorem* import duty. Professor Wilson concluded by calling attention to the manufacture of wrought-iron *direct* from the ore—an aspiration in all iron producing countries for years back, and by which the blast and refinery furnaces were hoped to be dispensed with. The paper by Dr. W. H. Smith, of Philadelphia, on "The Utilization of the Molten Mineral Products of Smelting Furnaces,"* described a process in which the slag is worked out of the furnace into a chamber, or else by covered conduits into a waggon or car, or large ladle. Here it is refined by subsidization, and from thence it is run into moulds. When the slag is "set," the articles are transferred to an annealing furnace close at hand, which is kept at a bright red heat until fully charged, and then it is brought up to a higher degree of heat for a few hours, when all the apertures are hermetically closed, and the whole is allowed to cool, occupying some four or five days. The articles on removal are found, it is said, to be strong, compact, devitrified masses, varied in colour, and capable of being polished. The importance of rendering this material commercially useful, may be judged from the fact that there are at present from six to eight millions of tons produced yearly in this country, and this is not only useless, but is attended with enormous expense for removal and "tipping." "The Mineral Industries of Great Britain"† were reviewed by Mr. Robert Hunt, F.R.S., Keeper of Mining Records. In this paper he traced the progressive development and future prospects of our respective mineral industries, treating of each metal in its historic order, and concluded by calling attention to the want, up to the present time, of anything like a system of education specially directed to these great industries, to which may be attributed in some degree the loss of nearly 1000 men annually in coal mining. Mr. Charles Sanderson, of Sheffield, in his paper "On the Manufacture of Steel, as carried on in this and other Countries,"‡ gave the results of 30 years' experience in almost all parts of the world where steel is produced, in regard to a manufacture about which little is known and less has been written. He described the processes of production of natural or raw steel, from crude iron as obtained from the blast furnaces, of cemented or converted steel, by the carbonization of wrought iron, and of cast steel, by the fusion of either natural or converted steel, but principally the latter. In contrasting the steel manufacture of England with that of America and the

* *Vide* ante, page 65. † *Vide* ante, page 247.

* *Vide* ante, page 335. † *Vide* ante, page 363. ‡ *Vide* ante, page 450.

Continent of Europe, he estimated the weight made in each country, and therefrom its value as an article of commerce. Following the pathological investigations set in motion by the Society, Mr. Herbert Mackworth, Government Inspector of Mines, read a paper "On the Diseases of Miners,"* in which he advocated improved ventilation, the removal from the mine of all putrescent matter, the provision of an accident room, and the establishment of a Benefit Society, at the joint expense and under the joint management of the proprietors and the workmen.

If in papers on our mineral industries this Session has been rich, the same cannot be said of our textile manufactures. The paper by Mr. Thomas Dickins, of Middleton, on "The Commercial Consideration of the Silk-worm, and some of its Products,"† was the only one of its class. In this the question was considered whether it was possible to reel silk in this country, and it was argued that the French reelers had partially solved the problem, for they had imported immense quantities of cocoons from Greece and Syria, and reeled them in their own filatures, so that our manufacturers have been using many thousands of pounds of so-called French silk, but which, in reality, came from Greece or Syria. He then proceeded to describe an invention of Mr. John Chadwick's, of Manchester, for simplifying the usual processes of silk reeling, by which, in one operation, the silk is reeled direct from the cocoon on a bobbin, and "thrown" at the same time.

Mr. Alfred Smee, F.R.S., in his paper "On the New Bank of England Note, and the Substitution of Surface Printing from Electrotypes for Copper-plate Printing,"‡ stated that the object of the alteration was to effect a saving of expense in the production of Bank notes, and to give them increased identity of appearance. The original design having been fixed upon, recourse was had for the duplication to the processes of Electro-Metallurgy. For the purpose of obtaining moulds where the original is of wood, gutta percha is generally employed—the surface being black-leaded. Moulds of the Britannia, which is engraved on steel—are, however, made by striking it upon pure soft lead. When perfection is desired, electro-moulds alone are depended on. Mr. Smee also referred to the manufacture of the paper for the Bank notes, at Mr. Portal's mill, in Hampshire, and stated that in the new note considerable improvements had been effected in the water-marking. Heretofore the device or water-mark which was required had been produced by an infinite number of wires stitched and sewn together—now it is engraved in a steel-faced die, which is afterwards hardened, and is then used as a punch, to stamp the pattern out of plates of sheet brass. This invention is due to Messrs.

* *Vide* ante, page 347. † *Vide* ante, page 197. ‡ *Vide* ante, page 81.

Smith and Brewer. A subsidiary paper by Mr. W. Stones, "Observations on the Means Available for Securing Bank Notes, Cheques, and Similar Documents against Counterfeit and Alteration,"* urged that in commercial documents of importance, cheques, drafts, &c., greater precautions should be taken against forgery than was now the case. He then reviewed the means at our disposal for the purpose, which were: 1st. Peculiarities in the pulp or manufacture of the paper. 2. Chemical preparations, introduced at the time of manufacture or subsequently. 3. Water-marks or devices for distinguishing any given paper from all others. 4. The style and subject of the engravings; and 5. The inks used in printing.

Herr Joseph Kumpa, of Dresden, in his paper "On a New Method of Teaching Drawing, involving the Principle of a Natural System of Architecture,"† argued that in teaching drawing, the first thing to teach a pupil was how to draw a straight line. After this was done he might be told to copy a square, and then to divide it into quarters, diagonals, and various other mathematical figures. From straight lines he would proceed to arcs and curves, and eventually into some practice in the use and combination of the elementary colours. The discussion on this paper was well sustained by Mr. R. Redgrave, R.A., Mr. G. Wallis, Mr. Digby Wyatt, Mr. John W. Papworth, Mr. F. S. Cary, Mr. H. Twining, Mr. H. Mogford, Mr. Burchett, Mr. J. D. Harding, Professor Donaldson, and others, when it appeared that the system recommended was by no means new, but that it had been considered so good in England, that it was the plan followed in all the Government Schools of Art, and had been practised in them for some time.

The Special Meeting was held on Friday, the 2nd of February, to receive a short paper from Mr. Leone Levi, "Observations on the Congress proposed to be held at Paris, for the Improvement of International Commercial Law,"‡ as introductory to a discussion on that subject. Mr. Levi advocates an International Code, by which the rights of traders as partners, as debtors, and as creditors,—as shipowners,—as insurers,—as shareholders in national enterprises, as well as the rights of authors and artists should be alike, and governed by the same forms of procedure in all. In the discussion, in which Mr. John Howell, Mr. Headlam, M.P., Mr. Collier, M.P., Dr. Waddilove, Mr. Lyne, Mr. H. T. Hope, Mr. Chadwick, C.B., Colonel Sykes, F.R.S., Mr. W. Hawes, Viscount Ebrington, M.P., and others took part, it was recommended by some of the speakers, that before asking other nations to a Congress to bring about any such assimilation, it was desirable that the government of this country

* *Vide* ante, page 89. † *Vide* ante, page 287. ‡ *Vide* ante, page 187.

should review the charters and the laws in force in our own colonies, in which nearly every European code might be met with, and some even that were obsolete, and that then, when assimilation had been attained between the mother country and her dependencies, we should be better prepared to meet the jurists of other nations.

The desirableness of decimalising our coins and accounts, now almost universally admitted, again formed the subject of discussion, three papers being read on the same evening. That by Mr. J. A. Franklin, "On the Expediency of at once Decimalising English Moneys and Weights,"* advocated the pound as a unit; that by Mr. Hugo Reid, "On Decimal Coinage,"† recommended that the florin, or two-shilling piece, should be taken as the unit—which is practically the pound system—as it resolves itself merely into the question where the decimal point shall be placed; whilst the third, by Mr. F. J. Minasi, "On the Basis of a Decimal System of Money for the United Kingdom,"‡ urged that the penny should be taken as the basis. The choice of a unit seems now to lie between the pound and the penny. The general feeling would appear to be in favour of the former, though there are undoubtedly some difficulties to be met, as several of the daily affairs of life are governed by the penny, as for instance postage and receipt stamps, bridge and road tolls, parliamentary railway fares, &c.

Colonel Arthur Cotton, late Chief Engineer, Madras, who has for the last 20 or 30 years steadily contended for the extension of public works in India, in his paper "On Public Works for India, especially with Reference to Irrigation and Communications,"§ pointed out that at the present moment there were scarcely 50 miles of imperfectly made road in any district of 10,000 square miles. The valley of the Ganges, the Agra Presidency, the Punjaub and Mysore, formed rare exceptions. Also, that at the rate at which railways are now being made, it would take 130 years to provide India to the same extent as England was furnished at the present moment with similar communications; and even then several hundred thousand miles of common roads, or light railways, or canals, would be required. Colonel Cotton is a staunch advocate of the canal system, by which works of irrigation and communication might go hand-in-hand, and which he believed might be executed and maintained at far less cost than the railway. With the latter it is necessary to provide a large and costly rolling stock, involving a heavy outlay in the first instance, and serious disbursements to maintain; whereas in the case of canals there would be a number of small, local proprietors, by whom the traffic would be carried on, they finding the boats and crews, and paying toll to the Canal Company. It was also a question whether heavy goods traffic could be so profitably transported by railways as by canals. The discussion on this subject was extended over two evenings, Mr. Gregson, M.P., Mr. Ayrton, Mr. Cornelius Nicholson, Col. Sykes, F.R.S., Mr. Dickinson, Mr. F. Carnac Brown, Mr. S. Sidney, Mr. R. Lowe, M.P., Mr. W. Bridges Adams, Mr. Hyde Clarke, Col. Sir Frederick Abbott, C.B., Mr. Andrew Henderson, Mr. R. W. Crawford, Mr. R. F. Davis, Mr. Chadwick, C.B., Mr. John Bourne, Colonel Cotton, and others, taking part in it. The discussion, unfortunately, was carried on as if it were a question between canals and railways, whereas the real point at issue is, whether or not a regular system of public works ought not to have been, or at least should not now be, provided for that vast empire. The East India Company have been blamed for negligence in this respect, but it should be remembered, that had it not been for the success of their political and military rule, there would have been no need of such works, and that up to this time all the energy and resources of the empire have been thrown into these departments of the State, rather than into the development of her vast resources, the creation of great industries, the extension of commerce, and the social improvement of her population, now it is to be hoped, speedily to be accomplished.

Mr. Jelinger Symons, B.A., one of H. M. Inspectors of Schools, called attention, in his paper "On Juvenile Crime as it affects Commerce, and the best means of repressing it,"* to the fact that gaols, so far from effecting the reformation of juvenile delinquents, harden the offender, if they do not confirm him in crime. In Mr. Symons's opinion punishment and reformation ought to go together; but others think that the latter element is the only appliance that is necessary. He considered also that the treatment of juvenile offenders belongs properly to the state. The conclusions at which Mr. Symons had arrived were warmly combatted by Mr. Power, (Recorder of Ipswich), and the following gentlemen among others also took part in the discussion, Dr. Waddilove, Mr. J. H. Elliott, Mr. Slaney, Captain O'Brien, Mr. W. A. Shields, Lord Lyttelton, and Mr. Muntz, M.P.

"The Capability for Mercantile Transport Service of Steam Ships,"† by Mr. Charles Atherton, Chief Engineer of H.M. Dockyard, Woolwich, was considered in reference to the mutual relations of their tonnage, displacement, engine-power, steaming-speed, distance to be run without re-coaling, tons weight of cargo, and the expenses incurred per ton weight of cargo conveyed. Although during the last year the government contracts for the transport service amounted to three millions sterling, these were en-

* *Vide* ante, page 211. † *Vide* ante, page 222. ‡ *Vide* ante, page 219. § *Vide* ante, page 395.

* *Vide* ante, page 415. † *Vide* ante, page 466.

tirely based on the indefinite terms "tonnage" and "horse-power." No legislative enactment has hitherto defined the standard unit of quantity that is meant by the tonnage of a ship, as denoting the measure of a ship's capability for transport service, or what is meant by "nominal horse-power," as the standard unit of the measure of the amount of force which a marine engine may be legally required to be capable of exerting. Some examples were given of war-steamers, all having the same "nominal" horse-power, but in which the "effective" or real horse-power actually stood in proportion to the numbers 1, 2, 3, and 4. The Right Hon. the Earl of Hardwicke, the Astronomer Royal, F.R.S., Captain J. M. Laws, R.N., Mr. J. Scott Russell, F.R.S., Mr. Andrew Murray, Mr. Chatfield, and Mr. Henderson, entered into the discussion of the paper; and it was elicited that previous to the introduction of steam into the Royal Navy, the fittings of every vessel of the same class were uniform in size and alike in kind, so that the spare stores of one were available for the supply of any other that might require them. Now, as was expressed by Captain Laws, though line-of-battle ships might be fitted with the same power, "both engines and boilers were as unlike in pattern as a knife was to a fork."

On the occasion of the opening of the Collection of Specimens of Animal Produce and Manufactures, forming the first division of a general Trade Museum, Professor Edward Solly, F.R.S., read a paper "On the Mutual Relations of Trade and Manufactures,"* in which he pointed out their mutual dependence the one upon the other, and showed the evils that had arisen in all times from unfair monopolies and restrictions. He then referred to the Museum itself, described what it should be, and expressed the belief that to be useful to merchants and others likely to desire the information it would be calculated to give, it should be situated in London.

The last paper of the session was by Mr. Colin Mather, "On Earth-boring Machinery."† After alluding to the various processes and mechanism in use in England for this object, the paper went on to describe a machine of new construction, the chief novelties in which consisted in the form of the boring head and the shell pump, and the mode of acquiring the percussive motion. The latter is accomplished by means of a steam cylinder, the steam being admitted at the bottom only. A cast-iron rod in connection with the piston raises the pulley over which the guide-rope is passed, and so lifts the boring-head. When the piston has reached the top of the stroke, a projection in the same rod is made to act on a cam, by which the steam is shut off, and the exhaust port is opened. The boring-head and piston then fall by their own weight. Very favourable results were said to have been attained by the use of this machine, but it is right to add that Mr. Herbert Mackworth stated in the discussion, that still higher results had been attained in Germany, by the use of an apparatus invented by Herr Kind.

* *Vide* ante, page 487. † *Vide* ante, page 503.

A paper by Mr. A. Henderson, on "The Past and Present Position of Life-boats,"* was to have been read on the 18th of April, but the time at the disposal of the meeting did not allow of this being done. It has, however, been recently published in the Journal.

The Council think it needless to express to the members any opinion upon the value and importance of the papers which have been read, and of the discussions which have taken place during the session, and of which the foregoing is a very imperfect *resumé*.

The Council feel that the meetings of the present session have been appreciated by the members, and it is, therefore, unnecessary, and would be a useless task on their part, to endeavour to impress upon the members that which is already acknowledged. They have great satisfaction in announcing that to the authors of five of the papers read during the present year, the Society's Silver Medal has been awarded. These gentlemen are—Mr. Charles Atherton, Col. Arthur Cotton, Mr. J. B. Lawes, Mr. Charles Sanderson, and Mr. P. L. Simmonds. They have also determined that Dr. Forbes Royle's paper "On Indian Fibres fit for Textile Fabrics, or for Rope and Paper Making,"† read during the last session, should be similarly acknowledged.

The Committee on Industrial Pathology has continued its labours, and its first Report, "On Trades which affect the Eyes," has already been printed in the Journal. The Committee have this year undertaken to report on the injuries arising out of Dusty Trades, and are endeavouring to obtain such information on this division of their subject, as will render their report of practical value to those engaged in and suffering from such occupations.

The Council, viewing the great benefit to Arts and Manufactures likely to arise from the artizans of this country visiting the Paris Exhibition, at the close of the last session called the attention of the members of the Society and of the Institutions in Union to the subject, and suggested the formation of Local Clubs for raising, in weekly or monthly subscriptions, a fund to enable the workman to meet the expenses of such a visit. A Committee of correspondence was appointed in connection with this subject, to collect and publish in the *Journal* such information as might facilitate these excursions by the working men. An establish-

* *Vide* ante, page 510.
† Vide *Journal of the Society of Arts*, Vol. II., page 336.

ment for the reception and accommodation of the artizans has been started in Paris, mainly, it is believed, in consequence of attention having been called to the subject by the exertions and correspondence of the Committee. Her Majesty's Government, too, has accorded the privilege of passports free of all charge to artizans purposing to visit Paris this summer. The details of these arrangements have already been given in the *Journal*, and the Council have the satisfaction of stating that the correspondence with the Institutions shows that clubs have been formed, and that many of the members of the Institutions contemplate a visit to the Exposition Universelle.

The Committee for investigating the manner in which the improvements in the city of Paris are effected, and how far the proceedings adopted in France in reference to such matters are or are not superior to those of this country, has collected a considerable amount of valuable and instructive information, which will be embodied in the report of that Committee. For a large portion of this information the committee are indebted to the kindness and liberality of the Prefect of the Seine, who at their request at once placed at the disposal of the Committee all the information which the records of his office could supply. The report of this Committee will appear in the Journal during the recess.

The subject of a Parcels Post was adverted to in the opening address of the Chairman of Council as one to which the Society would apply itself during the session. Accordingly a Committee has been appointed, who have very carefully considered the importance and practicability of establishing such a system, and the report of the Committee is now in course of preparation, and will appear in the Journal during the recess.

The great value of an improved system of International Commercial Law was brought to the notice of the Council by a number of the members of the Society specially and practically conversant with the anomalies at present existing, and the impediments such anomalies present to the free course of commercial transactions. On a requisition by these members the Council convened a special meeting of the Society to discuss the question, which was introduced to the meeting in the paper by Mr. Leone Levi, previously referred to. The Committee are now in correspondence with M. Achille Fould, Ministre d'Etat, urging on him the importance of taking advantage of the numerous distinguished persons who will visit Paris during this summer to hold a Congress there for the discussion of this subject.

It is not inappropriate here to allude to the subject of Limited Liability in Partnership—one in which the Society has taken so warm an interest. The members will have seen with pleasure that Parliament has under its consideration bills brought in by the Ministers of the Crown for amending the law in this respect.

The arrangement between the Royal Commissioners of the Great Exhibition of 1851 and the Council in relation to the formation of a collection of raw and manufactured animal produce, as the first step towards the establishment of a General "Trade Museum," expires in July next. The Council congratulate the members on the valueable collection which has been got together, and which is now exhibited in the Model Room of the Society, open to the inspection of the members and their friends. The collection is entirely due to the skill, zeal, and judgment of Professor Solly, to whom its formation was entrusted. Professor Solly has had many difficulties to contend with, arising from the novelty of the undertaking, the fears and jealousies of some, and the indifference of others; but his energy has overcome them, and the Society has reason to be proud of what has been accomplished. The task, however, of the Council is not fulfilled until means have been attained for placing this collection where it may be completed on a permanent basis, and rendered readily available for the commercial public. For this end the Council have worked, and will continue to work, during their remaining short term of office, earnestly hoping that their successors will pursue the same course of policy, and not relax their endeavours until this important end shall be attained.

The premium list issued by the Council at the commencement of the session was carefully revised, and subsequently a list of special prizes was published, for two of which the Society are indebted to the liberality of Benjamin Oliveira, Esq., M.P., who placed at the disposal of the Council two prizes of £25 each, or a gold medal of equal value, for such subjects as the Council should determine. These were offered—

"For two pounds of the best and finest Flax Thread, spun by machinery suitable for lace-making."

And the other—

"For the best Essay on the Means of Preventing the Nuisance of Smoke arising from fires and furnaces."

The awards for these two prizes are still under consideration.

Another of the special prizes—viz., £5, to which the Society added its medal—

"For a Composition for the feeding rollers used in printing paper-hangings by cylinder machinery, similar in consistency and action to those used in letter-press printing, but adapted for working in water-colours,"

is due to Mr. S. M. Hubert.

The important position which the Microscope now holds, not only in relation to pure but to applied science, and its great value in assisting to form those habits of observation which it is the object of all sound education to impart, induced the Council to believe that the pro-

moting the production of a good instrument at a price which should render it more readily accessible to the many, was an object worthy of the Society; and, accordingly, under the advice and with the assistance of a Committee, composed of Mr. Busk, F.R.S.; Dr. Carpenter, F.R.S.; Mr. Jackson; Dr. Lankester, F.R.S.; Mr. Quekett; and Mr. W. W. Saunders, F.R.S., the following prizes were offered:—

For a "School" Microscope, to be sold to the public at a price not exceeding 10s. 6d.—*The Society's Medal.*

For a Teacher's or Student's Microscope, to be sold to the public at a price not exceeding £3 3s.—*The Society's Medal.*

The Council undertook to purchase 100 of the smaller, and 50 of the larger instruments for which the medals should be awarded.

The members will be glad to learn that for these prizes there have been numerous competitors. After most careful examination of all the instruments by the Committee, they unanimously reported to the Council that the instruments sent in by Messrs. Field and Co., of Birmingham, fulfilled all the conditions required, and the Council have, therefore, awarded to that firm the medals offered, on Messrs. Field and Co. entering into the necessary undertakings to comply with the requirements of the Prize List. The Council congratulate the members on this result. Those members who are desirous of securing any of these instruments, which will shortly be supplied to the Society by Messrs. Field, at a discount of 10 per cent., should at once send in their names to the Secretary.

In addition to the papers and objects alluded to above for which medals have been awarded, some few of the inventions which have been sent in for consideration by the Society's Committees have been deemed worthy of reward, but as the labours of the Committees are not yet completed, the Council deem it right to withhold the publication of any partial list.

The Exhibition of Inventions was held this year in April, it being considered that that time of year was preferable to December, the period at which it has hitherto been held. The number of exhibitors each year continues to increase, and notwithstanding arrangements were this year made giving a much larger space for Exhibition, it must be admitted on all hands that the Society's Model Room does not afford sufficient room for the proper display of the articles exhibited.

The Journal has now become a necessary and permanent feature in the Society's action. To Lady Bentham, His Excellency Sir. Wm. Reid, (Governor of Malta), Mr. Bridges Adams, Mr. Charley, Dr. Macgowan, Mr. Harry Scrivenor, and the Honourable R. Temple, (Chief Justice of Honduras), the thanks of the Council and of the Society are eminently due for their contributions to the pages of the Journal. It is much to be wished that in our Colonies the example of Sir. W. Reid, Mr. Temple and Dr. Macgowan were imitated, and that we could obtain information from our other Colonies and dependencies like that afforded by those gentlemen. This want has this session been to some extent supplied by the articles of Mr. P. L. Simmonds on the Colonial Contributions to the Paris Exhibition.

The Council this year has revived the series of Picture Exhibitions which was commenced by that of Mulready, followed by that of Etty The present collection contains the works of the late J. J. Chalon, R.A., with a selection from those of A. E. Chalon, R.A., Portrait-painter in water colours to her Majesty.

The great success which attended the Society's Centenary Festival at the Crystal Palace last summer, led many to express the hope that the Council would each year give the members and their friends a similar opportunity of meeting. It has, therefore, been determined that the One Hundred and First Anniversary Dinner shall be held at the Crystal Palace on Tuesday, the 3rd of July, when his Grace the Duke of Argyll, F.R.S., has kindly consented to preside. The following gentlemen have already undertaken to act as Vice-Chairmen:—Viscount Ebrington, M.P., Chairman of Council, Professor Owen, F.R.S., as representing Science, F. Crossley, Esq., M.P., as representing Manufactures, and J. M. Rendel, Esq., F.R.S., as representing Mechanics and Engineering.

The Union of Institutions continues to increase steadily. 36 have been this year added to the list, and the Union now includes 368 Institutions, omitting those that have declined, and that have ceased to exist.

The financial statement of the Society's income and expenditure and balance-sheet is given below, and if it appear not to be so favourable as that of last year, the members should bear in mind that the Society has not diminished in numbers, but that there have been 206 new members elected this session. It must not be forgotten that the loss on the Educational Exhibition of nearly £400, and the expenses of the Trade Museum go far to account for the result. These, however, are items which will not occur again in our annual expenditure. When these circumstances are taken into consideration, the financial position of the Society must be deemed satisfactory, and the members will feel no regret that the funds of the Society have been applied in promoting successfully objects of such national importance.

## ANNUAL STATEMENT OF RECEIPTS, PAYMENTS, AND EXPENDITURE, FOR THE YEAR ENDING 31st MAY, 1855.

**Dr.**

| | £ s. d. | £ s. d. | £ s. d. |
|---|---|---|---|
| To Subscriptions for the year ending May 31st, 1855:— | | | |
| From Members and Institutions in Union with the Society:— | | | |
| Annual received | 2759 7 0 | | |
| Outstanding | 934 10 0 | | |
| | | 3693 17 0 | |
| Deduct on former years | 153 6 0 | | |
| Estimated not recoverable | 156 4 9 | | |
| | | 309 10 9 | |
| | | 3384 6 3 | |
| Life Contributions | | 205 16 0 | |
| | | | 3590 2 3 |
| To Dividends on Stock:— | | | |
| £3166 13s. 4d. Consols | | 89 9 0 | |
| 1969 10s. 6d. ditto, held in special trust | | 55 13 0 | |
| 388 1s. 4d., 3¼ per Cent. | | 12 1 2 | |
| To Interest on Life Subscriptions | | 3 3 8 | |
| | | | 160 6 10 |
| To Special Objects:— | | | |
| By Balance of Subscriptions at Commercial Bank on account of Educational Exhibition | | 14 6 1 | |
| Ditto in hands of Mr. Davenport | | 17 16 6 | |
| | | | 32 2 7 |
| To Royal Commissioners of Exhibition of 1851, on account of Trade Museum | | | 200 0 0 |
| To Journal | | 1 6 0 | |
| Barry's Etchings | | 6 6 0 | |
| Gurwood Despatches | | 8 8 0 | |
| Exhibition of Inventions | | 7 12 6 | |
| Breakages | | 3 9 0 | |
| | | | 27 1 6 |
| Subscription from T. Twining, Esq., in aid of the Working Classes Museum | | | 70 0 0 |
| Institute Book Orders | | | 818 12 2 |
| | | | 4898 5 4 |
| By Excess of Expenditure over Income | | | 98 15 11 |
| | | | £4997 1 3 |

**Cr.**

| | £ s. d. | £ s. d. |
|---|---|---|
| By General Establishment Expenses:— | | |
| Rents, Rates, and Taxes | 153 18 8 | |
| House and Office | 147 15 6 | |
| Salaries, Wages, and Commissions | 799 10 7 | |
| Postage Stamps and Parcels | 146 12 6 | |
| Stationery and Printing | 182 4 11 | |
| | | 1430 12 2 |
| By Special Objects:— | | |
| Medals and Rewards | 1 0 0 | |
| Strikes and Lockouts | 12 4 11 | |
| Trade Museum | 505 13 9 | |
| Working Classes' Museum | 75 13 0 | |
| | | 594 11 8 |
| By Journal | 879 14 9 | |
| Less charged to Union of Institutions | 175 18 11 | |
| | | 703 15 10 |
| Exhibitions:— | | |
| Exhibitions of 1854-55 | 92 5 5 | |
| French Exhibition, 1855 | 5 0 0 | |
| Educational Exhibition | 363 9 5 | |
| Chalon Exhibition | 31 5 11 | |
| | | 492 0 9 |
| Committees:— | | |
| Union of Institutions, including Journal, Postage, Printing, Stationery, and other charges | 734 2 10 | |
| Institute Book Orders | 817 5 0 | |
| Gurwood Despatches | 8 8 0 | |
| Pathological Committee | 5 4 8 | |
| | | 1565 0 6 |
| Conversazione | | 48 5 8 |
| Library, Pictures, &c. | 10 2 0 | |
| Bell's Manual | 3 0 6 | |
| | | 13 2 6 |
| Repairs and Alterations | 85 7 3 | |
| One Year's Interest on Debenture of £1000 | 43 13 8 | |
| | | 129 0 11 |
| Dinner, 1854 | | 20 11 3 |
| | | £4997 1 3 |

### Balance Sheet, 31st May, 1855.

**Dr.**

| | £ s. d. | £ s. d. |
|---|---|---|
| To sundry Creditors, viz., | | |
| To Tradesmen's Bills | £1236 16 7 | |
| Salaries and Commissions | 18 14 9 | |
| Debenture at 4½ per cent | 1000 0 0 | |
| Interest on ditto | 10 13 8 | |
| | | 2266 5 0 |
| To Trust Liability in respect of Government Stock (Consols) held for specific purposes, as per contra, viz., | | |
| Set apart to answer:— | | |
| Swiney Prize Bequest | 1333 6 8 | |
| Acton Trust | 536 3 10 | |
| Stock Trust | 100 0 0 | |
| Fothergill Trust | 388 1 4 | |
| | £2357 11 10 | |
| By Excess of Assets over Liabilities | | 1836 18 1 |
| | | £4103 3 1 |

**Cr.**

| | £ s. d. | £ s. d. |
|---|---|---|
| By Cash in hand, | | |
| At Messrs. Coutts and Co. | £117 15 7 | |
| At Commercial Bank | 265 15 7 | |
| In hands of Secretary | 14 2 1 | |
| At Commercial Bank on account of Educational Exhibition | 12 6 1 | |
| In the hands of Mr. Davenport, Do. | 17 16 6 | |
| | | £427 15 10 |
| By Dividends due April 5th, on £388 1s. 4d., 3¼ per cent. | | 5 18 9 |
| By Consols, £3166 13s. 4d., at 91 | | 2881 3 3 |
| By Subscriptions in arrear, £934 10s., estimated to be not recoverable to the amount of £156 4s. 9d. | | 788 5 3 |
| By Government Stock held in trust, applicable to specific purposes, viz.:— | | |
| Consols | 1969 10 6 | |
| 3¼ per Cent. | 388 1 4 | |
| | | £4103 3 1 |

W. F. Harrison, M. Marshall, } *Auditors.*
P. Le Neve Foster, *Secretary.*

## APPENDIX.

List of Lectures Delivered in Connection with the Educational Exhibition at St. Martin's Hall.*

Rev. W. Whewell, D.D., F.R.S., Master of Trinity College, Cambridge, "On the Material Helps of Education." (II., 593, and Parker.)

Professor de Morgan, "On the Relation of Mathematics and Logic to other Branches of Knowledge." No 1 of a series. (II., 593.)

* The references to each lecture are to the abstracts in the Journal, and when the lecture has been printed to the publisher.

Rev. J. S. Howson, "On Teaching Geography." (II., 594.)

Dr. Arnott, F.R.S., "On Warming and Ventilating Schools." (II., 609.)

Dr. Carpenter, F.R.S., "On the Training of the Will, and the Formation of Habits." (II., 611.)

Dr. R. G. Latham, F.R.S., "On certain Points of Geographical Teaching." (II., 611.)

Mr. Arthur Henfrey, F.R.S., "On the Relation of the Science of Botany to other Branches of Knowledge." No. 3 of a series. (II., 612, and Routledge.)

Rev. F. Trench, "On good and bad Delivery in Reading." (II., 612, and Parker.)

Herr Hoffman, "On Playthings and Occupations for Early Childhood." (II., 613.)

Mr. Horace Grant, "On Writing." (II., 613, and Routledge.)

Professor Rymer Jones, F.R.S., "On Modern Discoveries by the Microscope." (II., 623, and Routledge.)

Dr. A. W. Williamson, F.R.S., "On the Relation of Chemistry and Physics to other Branches of Knowledge." No. 2 of a series. (II., 624.)

Dr. Carpenter, F.R.S., "On Natural History as a Means of Education." (II., 625.)

Mr. T. Huxley, F.R.S., "On the Relations of Physiological Science to other Branches of Knowledge." No 4 of a series. (II., 625, and Van Voorst.)

Dr. Guy, F.S.S., "On the Use of Common-Place Books in Self-Education." (II., 626, and Routledge.)

Rev. Dr. Booth, F.R.S., "On the Influence of Examination as an Instrument of Education." (II., 627, and Routledge.)

Mr. Hullah, "On Music as an Element of Education." (II., 628, and Parker.)

Rev. Professor Baden Powell, V.P.R.S., "On Elementary Instruction in Mathematics." (II., 629.)

Mr. Sopwith, F.R.S., "On Models and Diagrams." (II., 635, and Routledge.)

Rev. J. P. Norris, "On School Discipline and its Effects on the Behaviour of Children." (II., 636.)

Rev. Professor Baden Powell, V.P.R.S., "On Elementary Instruction in Astronomy by means of Models." (II., 637.)

Dr. R. G. Latham, F.R.S., "On the Studies connected with Geography, and on the Relations of that Science to other Branches of Knowledge." No. 5 of a Series. (II., 637.)

Hon. Henry Barnard (Superintendent of Common Schools in Connecticut, U.S.), "On the Public Schools of New England." (II., 638.)

Professor Creasy, "On the Relations of History, Biography, and Political Economy to other Branches of Knowledge." No. 6 of a Series. (II., 667.)

Mr. Jelinger Symons, "On Industrial Schools." (II., 641, and Routledge.)

Rev. C. Marriott (Dean of Oriel Coll. Oxford), "On the Digestion of Knowledge." (II., 642, and Routledge.)

Dr. R. G. Latham, F.R.S., "On the Phonic and Phonetic Systems of Teaching to read in the Ordinary Print." (II., 643.)

Rev. C. H. Bromby, "On the Aims and Instruments of Real Education." (II., 644.)

Dr. Scott, "On Teaching the Deaf and Dumb." (II., 651, and Routledge.)

Rev. E. Sidney, "On Teaching the Idiot." (II., 651, and Routledge.)

Professor Tennant, F.G.S., "Mineralogy and its Application to Geology and the Arts." (II., 680.)

Henry de Laspée, "On the Principles and Teaching of Gymnastics," practically illustrated. (II., 653.)

Mr. Hugo Reid, "On Mathematical Geography and easy methods of Teaching it." (II., 653, and Routledge.)

The Dean of Hereford, "On 'Common Things' and School Fees." (II., 654, and Groombridge.)

Hon. and Rev. S. Best, "On Village Reading Rooms and Libraries." (II., 656, and Groombridge.)

Rev. W. Mitchell, "On Teaching Crystallography." (II., 658.)

Mr. Knighton, "On Stow's Training System of Education adapted for large Towns." (II., 658, and Routledge.)

Mr. W. Ellis (Champion-hill, Camberwell), "On Economic Science." (II., 667, and Routledge.)

Mr. Herbert Mackworth, M. Inst., C.E., Inspector of Coal Mines, "On Science in the Mines." (II., 669, and Routledge.)

Professor Nichol, "On the Right Teaching of History, illustrating the Right General Method in Education." (II., 681.)

Rev. Sidney Turner, "Reformatory Schools."

Rev. Vincent Ryan, "On the Relation of Foreign to English History." (II., 670.)

Mr. Arthur Hill, "On Punishments and Rewards." (II., 671.)

Rev. G. E. L. Cotton, "On the Necessity of an Extended Education for the Educator." (II., 672, and Routledge.)

Professor Hunt, F.R.S., "On Familiar Methods of Instruction in Science." (II., 672, and Routledge.)

Rev. A. B. Power, "On School Organization, with Special Reference to the Use of Parallel Desks." (II., 682.)

Cardinal Wiseman, "On the Home Education of the Poor." No. 1. (II., 683, and Routledge,)

Mr. W. A. Shields, Master of the Peckham Birkbeck School, "On Object-Teaching;" illustrated.

Cardinal Wiseman, "On the Home Education of the Poor." No. 2. (II., 695, and Routledge.)

Professor Hunt, F.R.S., "On Classes for Scientific Observation in Mechanics' Institutes." (II., 684, and Routledge.)

Rev. John Curwen, "On the Tonic Sol Fa Method of Teaching Singing;" illustrated. (II., 695.)

Rev. W. W. Cazalet, "On the History of Musical Notation." (II., 711.)

Mr. John Yeats, F.R.G.S., "On Public Instruction in Holland and Switzerland." (II., 685.)

Mr. W. Bridges Adams, "On the Paths of Physical Progress." (II., 696.)

Rev. M. Mitchell, "On the Study of the Arts, Architecture, Painting, and Sculpture, with Non-Artistic Education." (II., 698.)

Mr. W. A. Shields, (Peckham Birkbeck School,) "How to Teach Economic Science in our Ordinary Schools." Illustrated by a Lesson to Fifty or Sixty Children. (II., 699.)

Mr. Harry Chester, "On Mechanics' Institutes." (II., 731.)

Mr. J. C. Morton, "On Agricultural Instruction in Parish Schools." (II., 699.)

Madame Ronge, "On Infant Training (Kindergärten.)" (II., 711.)

Mr. Hugo Reid, "How to Teach Reading." (II., 712.)

Mr. W. A. Shields, (Peckham Birkbeck School,) "On the Inspector and the Schoolmaster." (II., 725, and Routledge)

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After the reading of the Report it was moved by Mr. Hyde Clarke, seconded by Mr. H. Twining, and

Resolved,—That the Report of the Council and the Financial Statement of the Auditors be received and adopted.

The Secretary stated that the General Meeting for the Election of Officers would be held on the evening of Wednesday July the 4th, when the ballot will be kept open from 7 to 9 o'Clock, in accordance with the Bye-Laws.

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MEETINGS FOR THE ENSUING WEEK.

Mon. Architects, 8. Mr. G. R. Burnell, "Practical Observations on Pile Driving."
Chemical, 8.
Statistical, 8. Mr. W. B. Hodge, "On the Mortality from Naval Operations." Mr. Charles Babbage, "An Analysis of the Statistics of the Clearing House, during the Year 1839." Dr. Guy, "On the Nature and Extent of the Benefits conferred by Hospitals on the Working Classes and the Poor."
Tues. Linnæan, 8.
Wed. Microscopical, 8.
Thurs. Numismatic, 7. Anniversary.
Antiquaries, 8.
Royal, 8½.
Fri. Philological, 8.
Sat. Royal Botanic, 3¾.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, June 8th*, 1855.]

*Dated 22nd May*, 1855.

1152. J. Cruickshank, Marcassie, N.B.—Cavalry equipment.
1154. H. Holland, Westfield, U.S.—Treating metalliferous sulphurets.
1156. J. Morgan, Manchester—Platted wicks for candles.

*Dated 23rd May*, 1855.

1160. F. Leeshing, Busby, near Glasgow—Preparing dyestuffs.
1162. T. McLow, 6, Middle-row, Holborn—Paddle wheels.
1164. W. Smith, 10, Salisbury-street, Adelphi—Safety apparatus for mine shafts. (A communication.)

*Dated 24th May*, 1855.

1166. W. Smith, Snow-hill, and N. F. Taylor, Gloucester-terrace, Chelsea—Gas-meters.
1168. A. F. G. Seegers, Paris—Paper-hangings.
1170. J. Park, Bury—Paper pulp.
1172. C. Rawlings, Sherborne—Writing desks.
1176. O. R. Chase, Boston, U.S.—Machine for making confectioners' "pipe," &c.
1178. T. McLow, 6, Middle-row, Holborn—Paddle wheels.
1180. G. Horrocks, Pilkington—Shuttles.

*Dated 25th May*, 1855.

1182. T. M. Greenhow, Newcastle—Iron ships.
1184. L. de Parienté, Schaerbeck, next Brussels—Sawing wood. (A communication.)
1186. E. Aldridge, Boston—Water meters, &c.
1188. J. and W. Allen, Newcastle—Alkaline salts.

*Dated 26th May*, 1855.

1190. R. W. Waithman, Bentham-house, York, and J. Waithman, Manchester—Lint.
1194. R. Maclaren, Glasgow—Prevention of smoke.
1196. J. Aspinall, Fenchurch-street—Extracting moisture from various substances.
1202. T. M. Rabatté and J. Rettig, Paris—Bruising, graining, or currying leather, skins, or hides.
1204. D. Methven, 9, Pembroke-cottages, Caledonian-road—Stoppers for bottles.
1206. F. T. Botta, Paris—Mixed furnaces.
1208. A. E. L. Bellford, 32, Essex-street, Strand—Flax machinery. (A communication.)

*Dated 28th May*, 1855.

1210. S. Rowlands, Birmingham—Purifying gas. (A communication.)
1216. F. de Moriès, Montmartre, near Paris—Obtaining motive power.
1220. T. P. Salt, Birmingham—Artificial legs.

*Dated 29th May*, 1855.

1224. J. B. Acklin, Paris—Substituting paper for pasteboard in Jacquard looms.
1226. E. J. Payne, Birmingham—Covered thread. (A communication.)
1228. W. Langshaw, Eagley, near Bolton, and G. and W. Jelley, Leicester—Fancy fabrics with both sides alike.
1230. G. Rogers, Alfred-place west, Thurloe-square—Apparatus for aerated liquors. (A communication.)
1232. J. H. Johnson, 47, Lincoln's-inn-fields—Casting metals. (A communication.)
1234. T. McLow, 6, Middle-row, Holborn—Screw-propellers.

*Dated 30th May*, 1855.

1236. A. V. Newton, 66, Chancery-lane—Calculating apparatus. (A communication.)

## WEEKLY LIST OF PATENTS SEALED.

*Sealed June 8th*, 1855.

2607. William Bemrose, jun., and Henry Howe Bemrose, Derby—Improvements in the mode of, and machinery for, punching and perforating paper and other substances.
2612. George Henry Bachhoffner, Upper Montagu-street—Improvements in the construction of fireplaces for the better consumption of smoke, and in lighting and maintaining fires.
2640. William Clark, Upper-terrace, Islington—Improvements in anchors.
736. William Lund and William Edward Hipkins, Fleet-street—Improvements in the manufacture of corkscrews.

*Sealed June 12th*, 1855.

2613. Timothy White, Landport, Portsmouth—Improvements in constructing portable houses and other buildings and structures.
2621. John Louis Jullion, Combe House, Tovil, Kent—Separating certain vegetable fibres from mixed fabrics for varous useful purposes
2635. William Charles Scott, Warner-road, Camberwell—Improvements in paddle-wheels.
2637. Louis Cornides, 4, Trafalgar-square—Improved apparatus for coating or covering surfaces of glass or other material with collodion.
2644. Francis Archer, Bishopgate-street, and William Papineau, Stratford—Improvements in distilling peaty, schistose, bituminous, and vegetable matters.
2657. Juliana Martin, Soho-square—A safety apparatus for effectually cleaning windows from the inside of a room.
2662. William Hartley, Bury—Improvements in safety valves for steam boilers and in steam engines.
2669. James Pritchard, Portsea—Improvements in the construction of screw propellers.
2674. Frederick Augustus Robert Glover, Bury-street, St. James's—Improvements in or applicable to the construction of carriages.
2691. George Bell, 21, Cannon-street-west, and George Charles Grimes, Wandsworth—Improvements in the manufacture of lucifer or congreve matches and other instantaneous lights.
2692. William Bertram, 5, Upper Harden-street, Woolwich—Improvements in the manufacture of iron ships, steam and other boilers, bridges, and other structures where numerous sheets of iron are used.
2715. George Anderson, Gas Works, Rotherhithe—Improvements in purifying sewers and buildings, or other places of noxious vapours.
2721. Charles Edward White, Fulham, and Francis Robinson, Putney—Improvements in signalling for railway purposes.
2729. John Lang Dunn, Glasgow—Improvements in working up certain waste sulphates and nitrates, and for the manufacture of useful products therefrom.
2731. John Comstock, New London, U.S.—Improvements in trip hammers.
2753. Henry Richard Fanshawe, and John Americus Fanshawe, North Woolwich—Improvements in the manufacture of various kinds of waterproof garments.
2756. Eugéne Mayeur, 62, Tredegar-square, London—A new hydraulic pump or machine, based on the centrifugal principle, for the purpose of raising, forcing, or exhausting (even muddy) waters or other fluids, and applicable to the wants of agriculture, industry generally, and to the salvage of ships. (A communication.)
2672. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in obtaining motive power. (A communication.)
5. Stephen Giles, Caledonian-road, Islington—Improved ratchet-brace.
8. Henri Louis Dormoy, Paris—Improvements in manufacturing and twisting silk, cotton, wool, and other fibrous substances.
39. John Scott, Sunderland—Improvements in the construction of anchors.
74. Robert Oxland, Plymouth—Improvements in the manufacture and revivification of animal charcoal.
110. Henry Adkins, Edgbaston, near Birmingham—Improvements in bleaching or decolorising oily and fatty bodies.
153. Matthew Boulton Rennie, 21, Whitehall-place—Improvements in preserving animal and vegetable substances for food.
179. James Webster, Birmingham—Improved method of changing the direction of and multiplying motion.
218. John Imray, 64, Bridge-road, Lambeth—Improvements in locks.
238. Jacques Roux Delguey Malavas, Montbrison, France—Improved machinery for obtaining and applying motive power.
244. Thomas Ogden Dixon, Steeton, near Keighley—Improvements in machinery or apparatus for turning, boring, cutting, and shaping wood and similar materials.
398. William Hartcliffe, Salford, and Joseph Waterhouse, Manchester—Improvements in looms for weaving.
400. John Norton, Dublin—Improvements in the construction of cartridges for fire-arms.
781. Manning Prentice, Stowmarket, and Thomas Richardson, Newcastle-upon-Tyne—Improvements in the manufacture of manures.
713. Manning Prentice, Stowmarket, and Thomas Richardson, Newcastle upon-Tyne—Improvements in the manufacture of manures.
718. Charles Whitley, Manchester—Improvements in machinery or apparatus for drilling.
733. Rob rt Stirling Newall, Gateshead-on-Tyne—Improvement in the standing rigging of ships and other vessels.
739. Henry Chapman, Kingsland—Improved electro-mechanical apparatus for supplying and adjusting the electrodes used in the production of the electric light.
761. Charles Goodyear, 42, Avenue Gabriel, Champs Elysées, Paris—Improvements inself-inflating pontoons and life-preservers.
765. Herbert Mountford Holmes, Derby—Improvements in the manufacture of tyres for wheels.
766. Peter Arrive, 7, Spencer-street, Darnley-road, Gravesend—Improvements in safety valves of steam boilers.
801. Samuel Holt, Shaw-heath, Stockport—Improvements in weaving plush or pile fabrics.
803. Philippe Amédée Devy, 10, Old Jewry Chambers—Improvements in the construction of coke ovens.
813. Alexander Cuninghame, Glasgow—Improvements in the manufacture or production of sulphuric acid and sulphates of iron and alumina.
842. Robert Milligan, Harden—Improvement in the manufacture of woven fabrics made of wool, mohair, or alpaca.
844. Charles Crapelet, 4, Rue des Fossés, Montmartre—Improvements in the construction of tompions for cannon and other fire-arms, which improvements are applicable to stopping bottles and other vessels.
874. John Atherton, William Boyes, and William Lancaster, Preston—Improvements in temples employed in the manufacture of textile fabrics.

Journal of the Society of Arts.

FRIDAY, JUNE 22, 1855.

## ONE HUNDRED AND FIRST ANNIVERSARY DINNER.

The One Hundred and First Anniversary Dinner of the Members of the Society, of the Representatives of the Institutions in Union, and of their friends, will take place at the Crystal Palace, Sydenham, on Tuesday, the 3rd of July, at 4½ for 5, p.m., precisely. His Grace the Duke of Argyll, F.R.S., will preside, supported by the following gentlemen as Vice-Chairmen:—Viscount Ebrington, M.P., as Chairman of Council; Professor Owen, F.R.S., as representing Science; J. M. Rendel, Esq., F.R.S., as representing Mechanics and Engineering; Frank Crossley, Esq., M.P., as representing Manufactures; John Griffith Frith, Esq., as representing Commerce.

It is requested that early application may be made for tickets, as the Crystal Palace Company cannot make arrangements to receive nearly so large a company this year as on the former occasion, when it will be remembered between 700 and 800 gentlemen were present.

## FOURTH ANNUAL CONFERENCE.

The Fourth Annual Conference of the Representatives of the Institutions in Union with the Council of the Society, will be held at the Society's House, John-street, Adelphi, on Monday, the 2nd of July, at 11 o'clock precisely. Viscount Ebrington, M.P., Chairman of Council, will preside. It is requested that Institutions will have the goodness to communicate to the Secretary, at their *earliest* convenience, the name and address of the Representative whom they may appoint to attend the Conference. The Council will be glad if Institutions would send in suggestions as to the subjects to be discussed. The Secretary would feel much obliged by Institutions forwarding him immediately a copy of their last Annual Report.

## GEOGRAPHICAL ESTABLISHMENT AT BRUSSELS.

The following report, from Mr. T. Twining, Junr., Member of Council, and the accompanying letter from M. Corr Van der Mäeren, Honorary Member, will be read with interest:—

Twickenham, Feb. 23, 1855.

Sir.—The printed documents presented to the Society of Arts by M. Corr Van der Mäeren, an honorary member, through the medium of our worthy colleague, Mr. Winkworth, give interesting proof of the persevering and successful exertions of a Belgian *savant*, M. Van der Mäelen, in forming and maintaining an establishment of national importance, called the *Etablissement Géographique de Bruxelles*.

The print contained in one of the pamphlets affords us some assistance in appreciating the manner in which various branches of scientific knowledge, represented by well developed collections, have been grouped round the science of geography. This, which M. Van der Mäelen considers the *mother science*, is truly such in this instance, for, being carried on commercially, it furnishes, as it seems, the chief support of the establishment, the public being admitted free of charge to the gardens and collections, except on a limited number of days in the year, when a small contribution is levied for the benefit of the poor.

The government, though it affords earnest support and valuable assistance, does not grant any regular subvention. With a view to supply this deficiency, and to develope still more the practical usefulness of the undertaking, an attempt was made, in 1846, to found a *Société Encyclopédique*, but its aspiring attributes, which would have required a permanent staff of twelve first-rate intellects, were found too heavy for its limited number of promoters.

Another feature of the operations described in the pamphlets before us, is more deserving of attention. It is the publishing, under the name of *Epistémonomie*, of a *classified index* to all that appears in print, worth reading, on every branch of science or practical improvement. On this subject, M. Corr Van der Mäeren expresses himself as follows, in a letter to Mr. Winkworth:—"The *Epistémonomie* was never published in a regular manner, nor do I think it would answer to publish it periodically; however, you will be the best judge of what would be best to do in England. My proposition goes to get the Society to establish a practical index, where would be enregistered daily, upon small square tablets, in scientific classification, every occurrence, fact, and publication, that might interest science, art, commerce, and industry, and this, of course, to be done *au point de vue de l'Angleterre*. I propose M. Van der Mäelen's as a model as to form, and, judging from what has been done by the feeble means and exertions of one private individual, I am of opinion that, if taken up by your enlightened and persevering body, you would produce in a short time such a mass of information by such a simple process, as would astonish the public, and prove to be a *treasure of knowledge*."

I may be allowed to say that I take a peculiar interest in this scheme, having many years ago conceived a plan, not indeed for compiling so complete a register as the one mentioned, but for arriving at a somewhat similar result in a less elaborate manner. I contemplated (of course only in idea) the publication of a daily journal, furnished once a week with illustrations, and containing, besides a repertory of condensed information which would have entitled it to bear the name of *The Lens*, an impartial abstract of the summaries of other useful periodicals. The latter feature I ventured to recommend for the *Journal of the Society of Arts* at the time we established it, and it was in fact carried out to a limited extent in some of the first numbers. Whether it proved abortive from intrinsic difficulties, or from not having had a fair trial, it certainly was very soon dropped; but I must say that I have not ceased to entertain the idea that some expedient of the kind for obviating the perplexity in which we are perpetually kept by the dispersion of scientific and practical data amongst an unreadable number of periodicals, isolated from each other by pride and jealousy, might, under proper arrangements, be adopted with signal success, and I must beg to add that the example given, and the opinions expressed by our Belgian friends very much confirm my conviction.

I quite agree with Mr. Corr Van der Mäeren as to the desirableness of a personal inspection of the *Etablissement Géographique de Bruxelles* by some official delegate of the Society of Arts, and, if no earlier opportunity should offer itself for obtaining that result without the expense of a special mission, I shall be happy to undertake the

task the first time I pass through Belgium on my way to or from Wiesbaden.

In conclusion, I beg leave to propose that the thanks of the Council be officially communicated to M. Corr Van der Mäeren for the papers transmitted to us, and the suggestions accompanying them, and that M. Van der Mäelen be appointed a Corresponding Member of the Society, as a testimony of the high estimation in which we hold the services rendered by him to the cause of scientific and practical knowledge.

I have the honour to be, &c.,

T. TWINING, Junr.

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Brussels, January 17th, 1855.

SIR,—As honorary member of the Society of Arts, I consider it my duty to avail myself of every opportunity likely to enable me to be useful in promoting the great objects of the Society. I now beg to call your attention to a subject which appears to me to be of the greatest importance to science.

The celebrated "Geographical Establishment" of Brussels was founded in 1830, by Monsieur Philipe Van der Mäelen, with the object of promoting the study of geography taken in all its bearings, so as to embrace the study of the universe, of its natural productions, and to make of that science a centre around which would converge the different branches of human knowledge. I send to you with this letter some printed papers, which will show you some of the results obtained by 25 years' intelligent perseverance and constant labour by Monsieur Van der Mäelen. I wish to draw your particular attention to his "Epistemonomia," or what I should prefer calling, his "Practical Encyclopædia," or general tables of indications to every branch of knowledge. You will observe by the paper No. 3, that ever since 1834, Monsieur Van der Mäelen has been incessantly collecting the necessary elements to form a "Société de Renseignments." Pursuing that object without interruption, he is now in possession of many thousand notes or "bulletins." The paper No. 4 will give you a tolerable idea of the interest of those general tables, of which the classification has since been continued in a variety of subdirections, so that the "Practical Encyclopædia" is at present a room, fitted up with an endless number of small drawers, containing, in alphabetical order, notes and references to all the publications existing, and that appear daily, upon every subject relative to art, science, manufacture, and commerce. This mass of information is doing useful service to public writers, who visit it daily. Monsieur Van der Mäelen's establishment must be well known to many of the members of your Society, and I have seen upon his visitors' book many names of English celebrities, who could give you an opinion upon the subject.

No country has practised more or better than yours the maxim of "time is money," and it occurs to me that this valuable maxim could not be applied to more perfection than by transferring a copy of Monsieur Van der Mäelen's "Practical Encyclopædia," to your Society's house, and by having it followed up with that scientific precision and perseverance of which you have shown us so many examples in carrying out useful discoveries. I have already mentioned the subject to this persevering friend of science, and I found him willing to enter into my views in the most disinterested manner. If you think it worth while, perhaps you would kindly communicate my "project" to your Council, and if they entertain it, I put myself at their disposal to give them more detailed information, and I offer my aid, as honorary member of your Society, to carry it out.

I remain, dear sir,

Yours very sincerely,

CORR VAN DER MAEREN.

P.S. I hope you will excuse my clumsy English in favour of the object in view.

## DIRECT NATURE-PRINTING FROM WOOD, IN AN ENDLESS WAY, APPLIED TO THE DECORATIVE ARTS.

By FELIX ABATE, OF NAPLES.

In the first communication I had the honour to make to the Society of Arts* on this invention, I described two different processes which I employ for the purpose; the one of them depending upon the effects produced by the joint action of acids and heat upon vegetable substances; and the other, a more complex one, as it comprises the different processes upon which the art of dyeing and printing textile materials rests. Both these processes, by different means, produce nearly identical results.

In order to bring my invention to practical utility, and make it serve the various purposes of the decorative arts to which it may be applied, I thought it was requisite that the nature-prints should be made in an endless way, as is done for woven stuffs, which, besides being an essential point for the application of the invention to house decoration, is undoubtedly the most suitable way to obtain that cheapness of manufacture which is the first condition for the general adoption and success of every new invention. I had then to choose between the two above-mentioned processes to which of them I should give the preference, and I found the second one to be in many respects superior to the other.

A machine, constructed upon the principle of the cylinder printing-machine, was then requisite for my purpose, in which the printing cylinder should be made, either solid or veneered, of the wood from which impressions are intended to be taken. However, this contrivance, which in the last quarter of a century has brought such important results in the art of printing textile manufactures, could not be applied to the above purpose without meeting with peculiar difficulties, against which, in fact, I had long to contend. The most serious of these difficulties were two—the one was, in contriving a self-acting apparatus for feeding the cylinder with the requisite fluid, at such a constant and controllable degree as experience has found suitable in the printing with flat blocks by manual labour; the other was in the discovery of some new means to dispense with the bathing of the printed stuff either in a mordant or in a colouring bath, whenever paper is the stuff to be printed on; as unsized paper, which is the most suitable for the purpose, will not bear, in a wet state, being drawn through the machine. Besides, it was desirable that the different successive operations which are performed in printing textile manufactures should be done at one time and in a single revolution of the machine, in order to reduce the cost of manufacture to its minimum.

I have made the cylinder-feeding apparatus in the shape of a trough, in which the wetting fluid is kept at a constant level through a reservoir from above and a discharge from below. A cloth, one side of which is immersed in the liquid, acts by capillary attraction as a syphon, and communicates the liquid in a continuous supply to the revolving cylinder with which it is in contact from the other side—an elastic cushion placed between the trough and the cloth securing the requisite equality of pressure of the latter upon the cylinder, while a pair of screws pressing on the back of the trough serve to regulate at will the degree of such pressure. This apparatus answers the purpose perfectly well.

In order to dispense with the bathing of the printed stuff, I had recourse to the metallic sulphurets, which are known to produce more lasting colours than the vegetable dyeing stuffs. Therefore I contrived to obtain the required effects by using for the printing menstruum any of those metallic salts, such as copper, iron, &c., which by the action of hydrosulphuretted acid or alkalies are precipitated in the state of metallic coloured sulphurets; I use such reagents in the gaseous form, such

* See *Journal of the Society of Arts*, Vol. ii., p. 539.

as hydrosulphuretted ammoniacal gas. The printed stuff is made to pass direct from the cylinder after it is printed, through a box, which is kept constantly supplied with a current of gas; it comes out of the box completely finished; then, passing through a stove kept at a moderate heat, dries—and lastly winds itself round a reel, ready for sale. In this way the thorough printing of the stuff in a single revolution of the machine is performed.

The principle of using the hydrosulphurets in the gaseous state in the art of dyeing, which, as far as my knowledge goes, has never been done before, is of considerable importance in that branch of manufacture, as it produces the most satisfactory results with the greatest convenience and cheapness, while it entirely obviates the evil arising from the noxious evaporations of the hydrosulphurets when used in the liquid state and left to evaporate in the open air.

## BANK NOTES.

The following is the second part of the paper on Bank Notes,* &c., read by Mr. Thomas Grubb, M.R.I.A., at a meeting of the Royal Dublin Society :—

In that portion of my paper on Bank Notes, &c., which I had the honour of communicating to the last sectional meeting, it will be recollected that I had proceeded so far as to show that the economic production of a bank note would be incomparably better consulted by procuring a sufficient general excellence for it, by or through the merits, or other suitable qualities, of the subject-matter, or design printed in the paper, rather than by an elaborate water-mark formed in the paper itself. This economic advantage of "printing" over "paper," as a vehicle for including adequate protection against forgery of bank notes, will be evident on considering, first, the relative cost of note paper and note printing; secondly, the large additional expense incurred by adopting a highly water-marked paper; and thirdly, the small additional expense of adopting a high class of subjects for a portion of the printed matter of the note. To exhibit this advantage more clearly, I have constructed the following table, in which the cost of printing a plain note without designs, by the usual or copper-plate process is represented by the number 10. The cost of printing an elaborate note by the same process by 11; and cost of printing a note by the surface or type-printing process by 7. I further represent the cost of the best note paper, having a small quantity of water-mark, by 20; and the same quality of paper highly water-marked, by the number 40. By combinations of these we obtain as follows :—

| | Relative Cost. |
|---|---|
| Plain water-mark paper ........................ | 20 |
| Plain printed subject ........................ | 10—30 |
| Plain water-mark paper ........................ | 20 |
| Best printed subject........................ | 11—31 |
| Highly water-marked paper .................. | 40 |
| Plain subject........................ | 10—50 |
| Highly water-marked paper .................. | 40 |
| Best subject ........................ | 11—51 |
| Highly water-marked paper .................. | 40 |
| Surface printing ........................ | 7—47 |

The numbers in this table are to be understood as representing approximately the relative cost of the several items. The table itself illustrates at a glance the previous assertion as to the manner in which the economic production of the note will be best consulted.

I now proceed to discuss that important question connected with the production of bank notes, viz., the best means of rendering them non-liable to fraudulent imitation. As a preliminary, it is desirable to consider what, in respect of this quality, we should, if practicable, accomplish—the more so, as some persons appear to form a much lower estimate than others of what should or need be here attained. It has been elsewhere stated of a bank, that a forgery of its notes has never escaped eventual detection, let it be inquired what this means—a bank cannot be supposed to issue notes of duplicate number and date in the course of many years, therefore whenever it receives a forgery of one of its own notes, without immediate detection, and that the genuine note of corresponding number and date either had previously returned to the bank, or does subseqently return to it—the bank will then find that it has received duplicate notes, one of which must of necessity be a forgery, and a minute inspection must tell which is the genuine, however indifferent it may be in execution or design—its very defects will help the discovery. Therefore, we must conclude that eventual discovery is in such cases certain, and no proof of the excellence of a note, and that a bank which adopt the precaution of requiring the name and address of each party from whom they receive notes (genuine or forged), and do not reissue their notes, will run but little risk, and an individual who adopts the same precaution, and in addition marks each note sufficiently for after-identification likewise runs but little risk, while the general adoption of such inconvenient practices would indeed render forgeries nearly as convenient a representative of money as the genuine notes. Experience, however, shows that the public will adopt no such precautions unless driven to them by repeated losses, nor can nor should it rest satisfied so long as forged notes appear, which are only to be discovered as such by the comparison of duplicates or a scrutiny of trained eyes. No bank or public should, in my opinion, rest satisfied (so long as it can be otherwise provided) with a less amount of protection against forgery than that derived from a note of which there is no present probability of its being forged in a manner likely to avoid detection when examined by what may be termed a glance of an educated eye, or a moderate inspection of an ordinary one. I have in the course of my argument to encounter several, to my mind, erroneous assumptions and conclusions. One of these being opposed to the preceding view I shall allude to first. A gentleman, a director of an English bank, on being questioned why his bank did not print on their notes a subject more difficult of forgery, stated that as any note, however difficult, could be imitated, and as their note was well known to the public, they considered it better not to alter it. While I admitted the latter part of this reasoning to have force in itself, I illustrated my opinion of the former part by asking would he, because any lock might be picked, approve of putting a half-crown lock upon their iron safe, or would he not rather put the best which could be procured although it might be picked. The argument of the director is indeed untenable, either on general principles or on our knowledge of the case under consideration. If the plundering of the safe be rendered much less likely by the adoption of a Bramah or Chubb's lock instead of a common one, the successful forgery of the note is rendered still less likely by the adoption of a suitable engraving. An ordinary pick-lock may, by what is termed "chance," pick the good lock, but a good copy of a good historical engraving never was nor is it ever likely to be a work of "chance," while experience shows us that no artist of even moderate acquirements in historical engraving is likely to debase his burine by the execution of a forgery.

There is a class of protections against forgery which may be defined as one in which the remedy proposed is nearly as bad as the disease. One of this class is a proposal to print on the paper of the note a design which shall be generally invisible, but capable of being rendered visible whenever it is desired to ascertain the genuineness of the note by immersing it in hot water, which brings out the design if the note be genuine. The author of this ingenious process has not stated the only advantage it seems to possess, viz., that its general adoption would in itself be sure to keep every one in "hot water." A scarcely more unpracticable or inconvenient test of the

* The first part was printed in No. 118, of this Journal, pages 238 *et seq.*

genuineness of a note has been lately suggested in the unvarying number of lines in the background of a vignette. To make this test available would require 1st, a magnifier; 2nd, a pointer; 3rd, a steady hand and practice; and 4th, some minutes devoted to each note. The hot-water system, after all, may be preferable. There is a class of work which from its minuteness was expected to be a preventative both of alteration and forgery; I allude to that very fine writing in which the amount of the note is repeated some thousand times. The letters are too small to be read without a magnifier, consequently they are of little use for preventing the alteration of the sum of the note, while the writing is too easily forged to prevent imitation. In an impression from a forged plate of such a note I find this band of fine writing the best executed portion of the work. For the prevention of alteration in the sum of the note, some American banks caused their notes to be engraved with such difference of device for each denomination that the public were left without a general resemblance for their guidance. This has led to a curious and unforeseen result. The forgers ceased to be imitators, and issued notes of their own designs in lieu, which, in the confusion arising out of the multitude of designs of the genuine notes, pass current.

The watermark in the paper of the note is a distinct class of protection in itself, and requires a special consideration. Used in connection with other means of protection, it is valuable and by no means to be dispensed with, but I must be allowed to differ *in toto* with those who would place their all but entire dependence upon its protective power; nor can I agree with the reasoning of those who because that which is done by one man may be copied by another, apply this truism at once to the rejection of all improvements in the printing of the note, and the utmost refinement of the water-mark. There appears, indeed, to be no slight mystification, if not misunderstanding, with respect to the principle on which the protection afforded by the use of a water-marked paper rests. The genuine water-mark, or a good imitation of it, cannot be formed after the paper is made, and therefore to procure a good fraudulent paper requires the apparatus of a paper-mill, while, to make a single sheet of paper with or without a water-mark, within the British Isles, is to come under the surveillance of the excise. Secondly, any additional difficulty in making a sheet of paper, the mould being once prepared, arising out of excessive water-mark, is almost nothing, provided the mould be in size only sufficient for the paper of a single note, or two such. It is, therefore, evident that, with the exception of the preparation of the mould, a small amount of water-mark is just as great a bar in the way of forgery as the most elaborate. And now, to consider this difficulty of the mould, will the man who would sit down to make a fraudulent mould, requiring, it may be, a score of letters to be formed in wire and stitched down on the surface, be deterred by having a second score to imitate and a double quantity of stitches to perform? And whether, I would also ask, is it more likely that forgery will be prevented by a contrivance requiring, perhaps, a couple of days' additional time of a mould-maker or wire-worker to copy, or by the adoption of such engravings for the note as would require for the production of a reasonably good copy as many months of the time of an artist following a respectable profession.? Partly, therefore, to the quantity of utensils and the outlay required for the production of a single sheet of paper, but chiefly to the excise surveillance of this kingdom, are we indebted for the preventive effect of any water-mark—whether it be much or little—in respect of forgery. But as our Continental intercourse increases, this sort of prevention decreases, and factitious water-marks, as they may be termed—which are produced by pressure and varnish, and easily distinguished as such—are being replaced by genuine forgeries (to use an Hibernicism), or water-marks oduced in manner similar to the genuine; that is to say, in the manufacture of the paper. In corroboration of the foregoing may refer to the recent accounts in the newspapers of forgeries of the £5, £10, and £20 notes of the Bank of England, which are stated to have come from the Continent, and of which upwards of £200 in apparent value had already appeared at the bank. The water-marks in these were, as in the genuine, different for each value of note, and are stated to be perfectly well executed, and produced in the making of the paper. This instance of rather wholesale water-mark forgery is a striking illustration of the error of depending too much upon the paper of the note for protection.

Let me be clearly understood as being equally far from agreeing with those who suppose that a note can be made inimitable; and others, who because it cannot be made so, will not adopt all means, within reasonable limits, for rendering it non-liable to fraudulent imitation. It is scarcely matter for surprise that amongst the many suggestions for the prevention of forgery much of error should be found. To prove that any means is adequate to the desired purpose, it is not sufficient to show that it prevents forgery by the aid of any one or other specified process—it must be shown that it prevents its accomplishment by any process extant, and within the forger's reach. This is all but equivalent to proving a negative, and hence some serious mistakes. One such mistake, committed many years back, was that of assuming, that by engraving a single head or figure, and with the aid of the rolling process—alluded to in the former part of this paper—forming from it a line of fac-simile heads or figures, and printing the latter on the note—the forger, not having access to the machinery required for such processes, would lie under the necessity of engraving the whole line seriatim. The late Sir W. Congreve showed the error of this assumption. By means of a fine wood-cut copy, and a repetition of the printing process only from it, he produced a line of heads, perfect fac-similes, and sufficient in other respects for the forger's purpose. Here, however, it must be admitted that the forger was placed at disadvantage, in having to imitate that which in the original was produced from an engraved plate by the coarser processes of wood cutting and surface printing. Another instance of such errors of recent occurrence, consists in assuming that by the adoption of surface printing from electrotype copies of finely cut type or blocks, protection is obtained from the difficulty of cutting such superior type, forgetting that it is by no means necessary that a forgery should be produced by the same process as the genuine note. In the instance before us, the forger has the option of using the much easier method of imitating the surface-printed note by an engraved plate and copperplate printing. The error is here rendered of more importance by the circumstance, that in the adoption of a process of medium delicacy for the production of the genuine note, the forger is placed on 'vantage ground by the power thereby gratuitously presented to him of copying it by means of a process of higher delicacy. It may be supposed by some, that the more delicate the process the greater care or experience it requires. It is not so in the case before us, which is that of producing a given result by either a finer or a coarser process; planing (for example) is a more delicate process than chiseling, yet the best surface, plain or grooved, cut by a chisel, would be readily equalled by indifferent planing. A few letters, or a word, which could be engraved in the best manner in three hours, would require a week's time of a good artist to cut in type, and after printing, the latter would give an inferior result to the engraved word. The special difficulties appertaining to the adoption of a "surface printed" note go all to the wrong side; they have to be borne altogether by the fabricators of the genuine note—the forger goes scot-free.

I shall conclude this enumeration of errors by an allusion to one, of which a slight mention was made in the former paper, and which bids fair to eclipse the rest, viz.,—that of adopting such means for the production of the genuine note as facilitates its successful imitation by lithography or analogous processes. Now, there are two ways in which this error may be committed,

one of which lies in the use of a description of ink well suited to lithographic transfer; the other in the adoption of a description of printing, which, in its general effect, approaches that obtained from lithographic processes. There can scarcely be supposed a more striking instance of this error than in the employment of surface printing, as not only is the general effect produced by it well represented by lithography, but the ink employed in such printing is, so far as I can learn, necessarily of a nature well suited to be transferred (from a note so printed) directly to the stone, and so enable an ordinary lithographer to print fac-similes of itself.

It now becomes me, in conclusion, to mention shortly those things which practical experience proves to conduce mainly to render bank notes non-liable to fraudulent imitation. The paper should have a water mark, which, for reasons already mentioned, need not in its quantity be such as would materially increase the cost of the paper. For the printing "copper-plate" so called, should be the process used, as possessing at once the greatest delicacy and the greatest power of light and shade; also as being farthest removed, in its general effect, from that of any other and lower method of printing, more especially lithography; also as the printing-ink used is of a nature badly adapted to lithographic transfer; also as being the only process extant capable of rendering on bank-note paper, and with rapid printing, that combination of delicacy and force which gives effect to an historical engraving. For the subject matter or design, in addition to the needful mercantile portion, I would include both historical and machine engraving. I would use both these, because they are branches of the engraving art scarcely ever combined in the practice of one individual; and experience shows that by increasing the number of hands requisite to produce a forgery, we throw a great obstacle in the way of its perpetration. I would use historical engraving, because it is only to be copied by hand, also as being the highest class of engraving; and as those who attain any proficiency in the art are, from their position, little liable to be tempted to descend to forgery. I would use machine engraving, because, if it be chosen of a suitable description, it will be most difficult to imitate without the aid of a machine, and we know that forgers are not likely either to incur the expense or brook the delay of obtaining such. Lastly, in the selections of subjects, both historical and machine-engraved, I would be governed by previous experience, selecting such subjects as are best adapted to being engraved in single line, without cross hatching, and with strong effect of light and shade, avoiding work of a very fine character, and selecting that whose lines and markings can be seen as such by an ordinary unassisted eye. With a combination of such paper, designs, and printing, we obtain a note, which not only has the recommendation of being in a high degree economic, but which, also, experience proves, to be not liable to successful forgery. Such a note is liable to be well imitated only by artists of respectable standing, from whom we have nothing to fear: or, if copied by low art, the deception is sure to be nipped in the bud, and the forger certain to find that he is running a serious personal risk for that which will not pay. This will have the effect of discouraging both himself and others of the same craft from further attempts on such notes. In a country where one-pound notes are the chief medium of currency, it would be a serious drawback to business if, to insure their genuineness, it were necessary to make a minute scrutiny of the notes, or examination of the water-mark. Our present one-pound Bank of Ireland note, in which my views are sufficiently carried out to render it a type of the system advocated in this paper, has, as already mentioned, had a five years' perfect immunity from forgery, a circumstance which, in itself, may give some weight to my statements, and, perhaps, I may be allowed to add, some claim to that attention with which this paper—on, as it must be confessed, a rather uninteresting subject—has been received.

# Home Correspondence.

## THE NATURAL PRODUCTIONS OF BRITISH HONDURAS.

Belize, British Honduras, April 16th, 1855.

Sir,—I have forwarded to Sir William Hooker, the manager of the royal gardens at Kew, by this packet, a bunch of Cahoun nuts. It measures about four feet in length and nearly two in breadth. There are bunches even larger than this. I have also sent to him, at his request, a bottle of Cahoun oil. I indulge a hope, from the fact of men like Sir William Hooker, so eminent in science and social position, taking an interest in the subject, that this valuable commodity will soon become very extensively known and duly appreciated. I will take an early opportunity of forwarding to your Society a similar bunch of these nuts.

I have made some ineffectual attempts to obtain specimens of the Guaco, but the natives confiding implicitly in its medicinal virtues in cases of snake bites, are so eager to procure it, that it has become exceedingly scarce within a considerable distance of the town of Belize. In the southern portions of the settlement, amidst the silence and solitude of the almost impenetrable forest, where human footsteps rarely tread, that plant, with innumerable others, as yet unsubjected to botanical scrutiny, may be found in great abundance. I have, however, succeeded in obtaining a small quantity of the tincture of this extraordinary vegetable product, which I send to you by the present packet. Whether it will be found equally efficacious with the fresh plant I am unable to say, but an experiment might be tried. You will perceive that it is a very strong bitter.

A rather amusing, if not a veracious account, is given of the manner in which the guaco was first discovered. It is said that "once upon a time" a curious and observant traveller, whilst wending his dreary way through one of the forests of this country, and not unwilling to enliven his solitary route by any passing circumstance capable of affording him amusement or food for thought, halted to watch a deadly encounter between two formidable snakes; "they were too busy to *dart* at him." In the course of a little time one of them was severely bitten, when, to his great astonishment, it *fled* from the scene of combat, scuttling along the ground and winding with great rapidity

"Amongst the untrodden ways;
"A *snake* whom there were none to praise
"And very few to love."

He had the curiosity as well as the courage to follow it, and by-and-bye he perceived that it stopped near a creeping plant, of the leaves of which it partook with greediness. That plant was the guaco. He secured the reptile, and also brought away the plant of the leaves of which it had eaten. The snake, although bitten by one of a most deadly species, quite recovered,—it was supposed in consequence of the remedy to which instinct had directed it. As Herodotus would have said, "This I was told (not, however, by the priests), but I do not vouch for its correctness; you can believe it or not." Another account is given. It is said that the snake will not come near any place where the guaco grows, and its careful avoidance of such localities having been observed, the cause had been investigated. Many persons are so firmly persuaded that the snake will not approach the guaco, that when travelling in the bush they carry a small piece of the root of that plant in their pocket.

There is another plant which the unskilled natives of these tropical wilds esteem as little inferior, if at all, to the guaco. It is called the rat root. It is also a creeper,

* It will be observed that several of these letters are dated some weeks back. Want of space has prevented their insertion earlier.—Ed.

and it is considered to be a certain remedy for all snake bites. The odour of the plant is extremely offensive, and not unlike the fragrance of that proscribed animal whose name it bears. It is administered in the following manner:—A decoction made of the leaves is taken internally, and a blister, composed of the scraped root, garlic, and salt, is applied to the wound. I shall procure some of this plant and forward it to your Society, for I think that even savages would not adopt as a remedy for certain diseases preparations of particular plants, if those plants did not possess *some* virtue. I mean, of course, when they are applied in a rational manner, not used superstitiously, as charms and amulets, nor when the efficacy is supposed to depend upon their being gathered when the moon is at the full, or when a certain star is in the ascendent. Such plants, therefore, as the one which I have been describing, which have obtained amongst a rude and uncultivated people an experimental remedial notoriety, are well worth the attention of the naturalist, and merit an analytical investigation of the scientific. Even if the exact qualities ascribed be not discovered, others may be perceived equally, or more valuable, as the alchymists, in the vain pursuit of a phantom, stumbled upon the substantial discoveries of gunpowder and alcohol.

There is a considerable variety of the cactus in these regions, the most prevalent of which is the prickly pear. The leaf of this cactus is broad, and is covered with strong sharp prickles, about two inches in length, as well as an infinite number of almost imperceptible thorns, both of which inflict a very painful wound. This plant is admirably adapted for fences, it being completely impervious to every animal. It bears rather a large yellow flower, and a fruit, the juice of which is a rich crimson, very similar to the dye obtained from the cochineal, which insect, it is well known, derives its colour from another species of cactus, on which it feeds. I cannot help thinking that the juice of the prickly pear is capable of being turned to valuable account, and under this impression I have ventured to send you two small bottles of it.

This country, from the nature of its climate, and the vast quantity of swampy land which it contains, might be made to produce as fine rice as that which is grown in Carolina or the East Indies. I have sent you a sample of the rice of Honduras, a grain which has not yet been cultivated here to any extent, if at all. The sample which I have forwarded was grown by a Mr. Rohr, a German, possessing very considerable agricultural knowledge and great energy, who has within the last two or three years purchased a large tract of land, which he is cultivating with much success. If the quality of the rice submitted be approved of, he would lose no time in sowing a large portion of his property with that nutritious grain, with a view to exportation. I should observe that he is able to produce a much finer rice than that which I have sent, for no pains were taken in its cultivation, either by keeping the ground clear, or any other necessary proceeding.

I have also sent a small sample of the wild cotton of this country. It will not, I dare say, be considered of much value, but I think it will readily be believed that if such be the spontaneous growth of the soil, a much superior article might be produced with care and attention, and the appliance of those means which science and skill would suggest.

I have likewise directed to be forwarded to you some seeds of the marengo tree. This is a large, wide-spreading tree, the wood of which is extremely brittle, and the leaves small, delicately formed, and drooping from the branches in graceful clusters. It bears a small, white, waxy flower, faintly tinged with yellow at the base of the leaves. From the seeds of this tree an excellent oil is extracted, which is said to be highly efficacious when applied to capillary purposes. The small roots of the tree are a very good substitute for horse radish.

On the Mosquito shore there grows a nut called the Ebol nut, from which a valuable oil is made, which is also said to be highly productive of "ambrosial curls." The natives of that coast have remarkably long, straight, black, shining hair. Whether the fertility of their heads (and they are fertile in more ways than one) arises from the use of this oil, I cannot say, but I have been told that they *do* use it very profusely. I have been promised some of these nuts, as well as some of the oil, both of which I shall have the honour of forwarding to you as soon as they are received.

I purpose to transmit to you by the next mail, if you think it will be interesting, a brief historical sketch of British Honduras. The early history of this country is contained in an excellent work, entitled "The History of Yucatan, from its Discovery to the Close of the Nineteenth Century;" published in 1854. The author of this book is Colonel Fancourt, a gentleman of great ability and industry, who for a space of eight years administered the government of British Honduras with singular skill and success, contributing largely to its prosperity, adding to the town of Belize a number of handsome public edifices, and introducing many sound political reforms. The account given of Honduras by Mr. Montgomery Martin, in his book called "Statistics of the Colonies of the British Empire," is very incorrect; and that contained in M'Culloch's Geographical Dictionary is scarcely more accurate. Mr. Martin says: "The British settlement of Honduras, in the province of Yucatan, is situate in the southern part of the American continent." The most southerly portion of British Honduras is 17·28 to the north of the equator, and seven degrees north of the Isthmus of Panama. Neither is British Honduras in the province of Yucatan. That portion which is north of the river Belize is said to be in the above-mentioned province, but all to the south of it is in the province of Guatimala. He says, "The inland boundaries are ill-defined. According to Henderson, the line which includes the settlement commences at the mouth of the Rio Grande or Hondo." The Rio Grande and Rio Hondo are not one and the same river, as he supposes, but two distinct rivers, the mouths of which are considerably apart from each other. He says, "The sea coast of our territory of Honduras is flat, and the shore studded with low and verdant isles." If he means by verdant, simply that they are green, that is true enough; but if he means that they are fertile, he is in error. They are nothing but mere sandbanks, producing nothing but mangrove bush. Some of them have not a foot of dry ground, and are called water-kegs. He says, "Veins of fine marble, and mountains of alabaster, are known to exist. Valuable crystals have been found within 180 miles of Belize. * * Gold has at various periods been found in the Roaring Creek, a branch of the Belize river." This is perfectly new to me, and must be, I am persuaded, to every resident in Honduras. Veins of marble, and mountains of alabaster, are an amusing fiction; valuable crystals are yet to be discovered; and Roaring Creek may roar until it is hoarse, before anyone will believe in its auriferous qualities. That the existence of gold in British Honduras is not only possible, but probable, I verily believe, for in the neighbouring states of Honduras, Costa Rica, and Guatimala, gold and silver mines have been worked for many years, although not so profitably as they might have been had European science and capital been brought to bear upon them, and they had been entirely taken out of the hands of the feeble-minded and apathetic people who had control over them; for the inhabitants of all the Central American States, being a mixture of the old Spaniard and the Indian, are a degenerate race, possessing not one estimable quality, but given up to sloth, dissoluteness, and every filthy and disgusting vice which can degrade the human character. I do not think that in British Honduras gold has ever yet been discovered. Not very long ago, the late Dr. Rhys, a gentleman of intelligence, planned and executed an expedition, the object of which was the discovery of gold, but it ended in disappointment. A few years since a captain of artillery got it into his head

that he had found a gold mine, and he commenced a correspondence with the Government upon the subject, who believing in his representations, sent out the terms on which they would dispose of crown lands containing gold. The gallant officer had resolved to retire from his profession, turn his spear into a pickaxe, his sword into a mattock, and become a miner. But instead of a gold mine it turned out to be a mare's nest. I think, however, it would be very much to be regretted if gold *were* to be discovered. The true and most permanent source of a country's wealth are its vegetable productions. A sudden and unlaborious leap into the possession of immense wealth has the same effect upon nations as upon individuals; the latter indeed may under peculiar circumstances preserve their moral and intellectual balance, and make a prudent and good use of unanticipated riches, but a nation it invariably demoralises. To eat bread by the sweat of one's brow is the lot of man; and bread so eaten is assuredly sweet. It is sweet both physically and morally, for the consciousness of having earned our food produces an inward glow of satisfaction. The gradual approach to wealth which the cultivation of the soil or commercial or professional occupations exhibit, educates those who attain to it for the judicious employment of it. Such employments are accompanied by all the virtues, an harmonious train, producing peace, health, good-will, and love. Industry, steadiness, sobriety, respect for the laws, —these are the accompaniments of those who select that road to wealth which the loom or the plough mark out. But indolence, depravity, selfishness, extravagance, rapacity, disregard of all laws, human and Divine, ever attend those who have been precipitated into the possession of wealth by the discovery of gold. But all this has been said before fifty times; I will, therefore, return to Mr. Martin. Not dissimilar from his marble dreams, and alabaster visions, his "crystal palaces," and golden prospects, was the story by which a "simple shepherd swain" was deluded to abandon his work, throw away his oaten pipe, forsake his bleating companions, and bid adieu to the "sunshine and the shade" of the green hills and sequestered vales of his "faderland," to visit the burning sands and inhospitable shores of the torrid zone. He was told that it was the "land of the turtle" and the region of punch; that he could pick up the former *ad libitum* ready dressed, and drink the latter *au naturel*, for rivers of rum flowed through groves of lime trees and fields of sugar cane.

I merely quote these passages from Mr. Martin's account of British Honduras, for the purpose of showing the necessity which exists for a correct account of that settlement. I will trouble you with only one more quotation. Mr. Martin says, "The militia of Honduras is a very fine body of men, about 1,000 strong, and consists of a brigade of Royal Artillery and a regiment of the line." This speaks for itself. When we are informed that the *militia* of Honduras consists of the *Royal Artillery* and a *regiment of the line*, nothing more need be said.

Apologising for this long, rambling, epistolary effusion,

I have the honour to be, sir,

Your very obedient servant,

R. TEMPLE.

## PUBLIC WORKS FOR INDIA.

SIR,—Having experienced the inefficiency of set speeches in eliciting information on such subjects; having been frustrated in my endeavour to introduce the mode of question and answer at your late meetings, and being hopeless of making the subject of "Public Works for India" plain by epistolary correspondence, I had not intended to address you, although you politely offered the pages of your *Journal*. The letter, however, of my friend Colonel Cotton, which appeared in your publication of the 25th ult., requires notice, and I must crave a small space in one of your early numbers.

Colonel Cotton, in reply to my question, "How rivers which wander through wide beds of sand can be made navigable for large and speedy steamers?" says that rivers may be made navigable by storing up water in the wet season, to be flushed into the beds during the dry; and he thinks I am ignorant of the fact that boats of 400 tons are *towed* on the Ganges.

With regard to the expedient of storing water to be used in deepening the channel of a river, certain conditions appear to me to be necessary. First, the country must be undulating, offering valleys of great extent as reservoirs. Secondly, the channel must be of tolerably compact section.

Now, the Ganges, Jumna, Sutlej, and nearly all the great rivers of the plains, after breaking through the tertiary ranges of the Himalaya mountains, traverse a country which I can compare to nothing more aptly than a table slightly tilted at one end. The difficulties of storing water in such a country appear to me to be insuperable at any reasonable cost. Within the hills the slope is too great to admit of any large body of water being collected in the river's bed.

That the section of channel to be deepened must be tolerably well defined, in order that it may be improved efficiently by the reserved waters, will, I think, be evident on consideration. Thus, in a channel bordered by well-defined banks, a certain additional volume given to the stream might deepen the channel by two feet, but where the stream flows in flat banks of sand, where a rise of a few inches would spread the water to a great width, this expedient must fail of producing useful results.

I am aware that the experiments on the Jumna, alluded to by Colonel Cotton, appear to favour his views. The water-gauges were, however, placed for the sake of convenient registry at large towns. Such towns are usually situated at spots most favourable for river communication, that is, where the bed is best defined. Two of those places alluded to, Agra and Delhi, I know to be so. At both, the dry season supply is collected, by circumstances of ground, into single channels, enabling the authorities to keep boat bridges across the river during the four seasons. These are the very places where assistance is not needed.

With regard to canals: when at your second meeting I expressed a doubt as to the practicability of making high-speed steam boat canals in India, a gentlemen who followed, misunderstood me to say that, "Indian rivers were not susceptible of *canalisation*." If by this term is meant diverting the waters of rivers into canal channels, it is only necessary for me to state that I have been officially connected with the finest canals in India, and that I have ever been a steady and zealous advocate for canals, and that I used all my little influence in supporting Sir Proby Cautley's noble project of the Ganges canal. It is my knowledge of Indian canals that makes me doubt whether they can be made serviceable for speedy steamers. It is quite true, as Colonel Cotton states, that the Ganges canal is to carry a head of water ten feet deep. But this is on the solani aqueduct, where the water is curbed by walls of masonry; but no one hopes to retain that depth in sandy soil. Then, again, the trunk soon becomes divided into several branches. Each branch grows "fine by degrees and beautifully less," as the waters are expended in fertilising the fields, until they become small filaments of water, quite incapable of floating a steam boat.

The navigation for slow boats could, of course, be opened to Allahabad, but it must be done at the sacrifice of irrigation. Thus another field of controversy may be opened out. I will, however, only remark, *en passant*, that having already a cheap downward transit by the rivers Ganges and Jumna for the produce of the Doab, I think it better to devote all available water to the purpose of increasing the produce, leaving the return or up transit to be made by railways.

I am an old Bengalee, and am, of course, aware that boats of large size are *towed* upon the Ganges, but this fact does not prove the river to be fit for large and fast steamers, or why are we to consider the question of Gan-

ges improvements. Surely we have the very water trunk required by my gallant friend, and surely some English company will be found to run such vessels as the Mississipi steamers from Calcutta to the north-western provinces. But, if this illustration of the river capabilities be fallacious, if the navigation be really impeded by numerous shallows, if we fail of scouring the channel for want of stored water, there is still another remedy projected by Colonel Cotton. It is, to dam the bed at places sufficiently numerous to give a series of deep and nearly level pools or basins, connected with each other by means of locks.

To this expedient I urge the old objection; it is applicable only to certain rivers, amongst which the great rivers of the plain cannot, I think, be classed. The Ganges is a good specimen of the rest. Its bed is a hollow, often five miles in breadth, and from 20 to 40 feet deep, scooped out of a gently sloping plain, consisting of a superstratum of light arenaceous clay, from six to twenty feet thick, overlying a bed of sand of unknown depth. To dam such a river would be attended with enormous expense, and, I think, with unstable results. But even were we to succeed in curbing the river by this dam, the waters would, during freshes, make for themselves new channels, turning the flanks of the dam. Persons unacquainted with the plains of India can hardly imagine the difficulties which an engineer has to contend with in dealing with rivers in sandy soils.

I regret that the interesting subject of "Public Works for India" has assumed the form of a battle-royal between canals and railways (as well as of hostility towards the government of India). There is room in that vast empire for both. Railroads will do work where canals cannot reach—canals will carry at cheaper rates than railroads. Let them select their appropriate lines of country. If we are urgent that government should lay out their money in developing the resources of India, it is inconsistent in us to quarrel with them for adopting heartily the first scheme of general improvements brought before them by a substantial company. If the friends of water transit are satisfied of the soundness of their views, let them organise a company, as their opponents have done, and lay before government an offer to pervade every district or any number of districts with water trunks, and I feel persuaded that their scheme, if worthy of trial, will meet with the same favour that railroads have done at the hands of the government of India.

Yours, &c.,

F. ABBOTT.

Addiscombe, June 2, 1855.

P.S.—In the report of my remarks on the 7th of May I notice a little inaccuracy, which makes me say the reverse of what I meant. It occurs at page 438, column 2, lines 18, 19, 20, and 21 from top, which now read, "and insufficient to carry steamboats of large burthen—he meant in the peninsula of India. He could understand that it might be so in a hilly country; where we caught," &c., instead of "and insufficient to carry steamboats of large burthen. In the peninsula of India, in a hilly country, where we caught," &c.

## EXHIBITION OF INVENTIONS AT MECHANICS' INSTITUTIONS.

Sir,—The idea has been proposed, I do not recollect by whom, that Mechanics' Institutions should offer to inventors constant opportunity of exhibiting any novelty in practical science or the useful arts. We are ready to act upon this suggestion, and I would especially mention that our annual "Institutional Reunion," a fête attended by 30,000 to 40,000 persons from all the neighbouring counties, would offer an opportunity for any such purpose not easily surpassed. This year it will be held in the Sheffield Botanical Gardens, on Monday, July 16th.

I shall feel glad, both for inventors to avail themselves of the offer, and for other Institutions who may be able, to make similar arrangements.

Respectfully submitting these suggestions to consideration, I have the honour to remain,

Sir, yours obediently,

JULIAN W. SLATER, Principal.

Sheffield Mechanics' Institution, June 9th, 1855.

## REMARKS ON MR. SANDERSON'S PAPER ON THE MANUFACTURE OF STEEL.

Sir,—I was much pleased, in Mr. Sanderson's most valuable paper "On the Steel Manufacture," to notice his intelligent remarks on a subject of such national importance as Mr. Heath's patent improvements, and likewise the letter on the same topic from Mr. Scrivenor. Mr. Sanderson says well it is a pleasure as it is a pride to refer publicly to the merits of such inventors as Mr. Cort. Yet it is said that, proud as we justly are of their achievements, a feeling of shame clouds the recollections of those merits. Cort expended a fortune in perfecting the puddling process; he left it a legacy to wealthy recipients, who give his memory praises which cost nothing to bestow, while his descendants have received no public reward or acknowledgment. The ungracious treatment which inventors have but too often received in this country must surely be added to the catalogue of "sore evils under the sun." Cort's process took a lifetime to perfect; Mr. Heath's invention, by its extreme simplicity, came into operation in a moment, causing, as Dr. Ure correctly states, an immediate reduction of £30 to £40 on the price of good steel, and up to this date two millions sterling is not an exaggerated computation of the saving which has been effected to British purchasers of steel, with the addition of rendering our country comparatively independent of foreign import. Yet, instantaneous as the change, and speedy as the promise of advantage to the inventor, Heath has fared no better than Cort. The leaden Saturn seems to reign lord paramount in the destiny of inventors. Mr. Heath lived year after year to see the profit of his labours handed over to aliens by the interpretation of those laws which were framed to guard his rights. In a Journal devoted to the Encouragement of Arts, there can hardly be found a subject of more importance than the manufacture of steel, and, as connected with it, a recapitulation of the main facts of this extraordinary patent case. It is well-known the basis of the invention was the discovery of a means by which the intense affinity of metallic manganese for oxygen, and of its oxide for the earths, could be successfully and certainly controlled. By closely incorporating the oxide of manganese with coal tar, Mr. Heath was enabled to smelt with regularity and obtain from the ore any required bulk of carburet of manganese. Manganese has remarkable affinities with iron, as evinced, for instance, in magnetic phenomena, and a further resemblance is presented by the carburet of manganese, which is a compound with carbon precisely analagous to white pig iron. By this union the manganese loses its highly oxidizable character, and maintains a permanent metallic existence. For the want of any certain means of combining the metal with carbon, the carburet was a mere chemical curiosity precariously obtained in very small quantities, but the new means of procuring it in quantity enabled Mr. Heath to investigate substantially the perplexed and long disputed question of the action of manganese on the qualities of iron and steel, and he found that a small quantity of the *permanent metal*, less than 3 per cent. of the weight of steel to be melted, being introduced into the melting pot, uniformly improved the quality of the produce, raising inferior steel to the properties of the best, and thus enabling it to be welded to iron with facility. And I would here remark, that I believe Mr. Sanderson is perfectly correct in his explanation of the *rationale* of this improvement. It entirely corresponds with the view held by the inventor himself, and

on which he based other processes for the improvement of iron and steel, namely, that the manganese has the action of a *detergent*, and by its intense affinity under fusion for earthy matter removes from the iron or steel all such particles into the slag which Mr. Sanderson describes as resulting in his experiments. Mr. Dodds, in the discussion, alluded to a process of his own for effecting a similar purification with the aid of alkali. The peculiar difference, in a practical sense, in the use of alkalies arises in their low specific gravity. The greater weight of the manganese approaching to that of the steel or iron, maintains the detergent longer in contact with the fused and fusing metal, and the purification is more complete and certain. But in illustration of the correctness of Mr. Dodds' principle, I may state that in the innumerable experiments made by my father with every variety of foreign and native ore, in the attempt to obtain by de-oxidation without fusion, a pure steel iron, his efforts were perfectly successful with *one ore only*, and this is remarkable for the large amount of soda and potash which analysis exhibits in its composition. The alkali is here placed by nature in that intimate contact with the molecules of iron which is needed for its complete action as a purifier.

But to proceed with the narrative of Mr. Heath's case. The immediate purpose of his experiments had reference to the renowned Wootz ore of Porto Novo, where he had established the iron works now carried on by the East Indian Iron Company. He had no intention of patenting the process, until he found some one else was about to do so, and tax him for the use of his own details. A person at Sheffield was then recommended as an agent for introducing the carburet of manganese to the steel trade; and its amazing properties were speedily recognised and adopted. In proceeding with his operations in London on the Wootz ore, the thought occurred that it would be a great abbreviation to place the requisite quantity of the compound of tar and oxide direct in the crucible with the melting steel, instead of adding the already manufactured metallic carburet. The result was perfect, the deoxidation of the manganese and its combination into a carburet evidently took place, whilst the bulk of steel was undergoing fusion, as precisely the same improvement was effected as when the metallic substance had been introduced. A great economy resulted from doing away with the separate operation of previously manufacturing that metallic substance. Mr. Heath was enabled to reduce the license charge by two-thirds, which he accordingly did and transmitted to his agent *packets* of the *composition*, comprising the *elements* of the carburet in place of the *carburet itself*. It was by this act that he unsuspectingly opened the door to piracy and litigation. The patent claim was for the *use of carburet of manganese* in improving iron or steel, and being aware, as every scientific person must be, that the same effect was produced by the *same cause* in both cases, it never occurred to him to take a patent with a different claim, for any method of *making carburet of manganese*, and which indeed under a correct scientific exposition of the law, would have been worse than unnecessary. To the common eye, however, a black paste and bright medal have a different appearance, and so much so in the eye of Mr. Unwin, that this trustworthy agent commenced on his own account the manufacture of the improved cast-steel with the elements of the carburet; and an importation in the London market of a cheap cutlery, in which the cast-steel was welded to the iron backs, was the first information Mr. Heath had of his agent's fidelity. An action for infringement followed, before Lord Abinger; a scientific witness was explaining to the jury that the small mass of paste of tar and oxide subjected to heat must of necessity form into carburet of manganese, while the larger quantity of steel was melting down, when his lordship asked him if he had been in the pot to *see that done*, or at what time he could put in his finger and take out a piece of the carburet. These highly scientific questions not being satisfactorily answered, the judge directed a non-suit for want of evidence, a decision which was upheld by the full court on application. Mr. Unwin being thus secured the possession of Mr. Heath's property, others were not slow to avail themselves of that which every one might possess except the owner, and the astounding revolution in price described by Dr. Ure was speedily effected. After some time a second action was brought against the agent for further infringements. The judge, Baron Parke, evinced no great leaning towards science, but he did not stop the case like his predecessor, though the evidence had equally warranted it. The verdict was for the plaintiff, but the judge's opinion was obviously the other way, and the defendant obtained from the full Court of Exchequer a reversal in his favour, on the ground that there was neither direct nor *colourable* infringement, for the defendant did not *know* the two elements would form carburet of manganese, and not *knowing that* there could be no *intention* to infringe. After two years of hesitation how best to apply to Chancery for relief, it occurred that this decision, recorded in the reports, was quoted to Lord Cottenham on an argument. His lordship expressed such surprise at a doctrine which subjected the remedy for a civil injury to the *intention* of the wrong doer, that Mr. (now Sir Richard) Bethell was encouraged to move upon the point, and he obtained an order for a new trial. After an infinitude delays, this next act was accomplished in November, 1850, of *eleven years of the patent right having been consumed in fruitless litigation.* No one in court who heard the case, could doubt which way twelve men of common sense would decide, but the judge, Cresswell, interfered, on the ground that he could not, as a single judge, permit the decision of a full court to be shaken, but that the judgment of the Exchequer ought to be re-argued on a bill of exceptions in a Court of Error. Mr. Heath, in failing health, occasioned by the constant annoyance of litigation, felt so keenly this unexpected re-opening of the whole question, that he sunk a few weeks after the trial, and death was added to the other achievements of piracy. His legacy to the widow and the orphan was a law suit, and to the public and to the steel makers the millions sterling which he had saved them. The next scene of these extraordinary legal performances was enacted in June, 1852. A masterly decision of the Court of Error reversed the subtleties of the Exchequer, and maintained the indirect and colourable infringement, by the reasonable assertion that the use of the component parts of a substance was an evasive use of the substance itself. The patent right was thus restored merely to the position where a jury had placed it ten years before. The defendant, not satisfied, of course, appealed to the House of Lords, where it appears the cause is still suspended. Meanwhile the patent having expired, the Privy Council, on the evidence of the extraordinary merit and novelty of the invention, granted the widow an extension of seven years, which appears to promise her an equally beneficial interest as the previous fourteen years. Three costly trials at law, three arguments in court, and the proceedings in Chancery and in the Peers, through years worn out in suspense and anxiety, are hitherto the recompense for a public benefaction. The rare acuteness of the judges of the Exchequer has created the whole mischief. Their science was that fat and soda are not equivalent to soap; that the use of the elements of a dye producing a certain colour is not an evasion of the use of the colour itself, or that bark and sulphuric acid do not originate sulphate of quinine.

Prolonged instruction in the art of opposing a valuable patent leads naturally to perfection. One further detail has to be added to this quasi-legal catalogue. An action for infringement against other defendants was tried at Liverpool in August, 1853. It had now become necessary to find some new kind of evidence. The old was used up. The previous defendant's witnesses had all admitted the novelty and value of the invention, and the only ground of resistance, the denial of a colourable evasion, had been destroyed by the last decision. Fortunately, therefore, half-a-dozen steel-makers were discovered who

could swear to having used everything—coal tar, oxide of manganese, &c., &c.—twenty years prior to the date of Mr. Heath's patent. Some of these had actually testified to his originality at the former trials; a curious metaphysical fact is therefore revealed on the properties of age in clearing the memory and revivifying a recollection of the events of youth. A lapse of ten or fiteen years more had brought forgotten things to mind. This evidence gave the defendants a verdict, but it appearing the alleged use had been strictly secret, the court was moved that there had been no publication sufficient to invalidate a patent claim. But Lord Campbell ruled, no doubt correctly, that if the evidence was true, it was impossible to consider that to be a patentable secret which half-a-dozen manufacturers had commonly used. The fact remained unexplained why a process which occasioned such extraordinary changes after being patented had produced neither public nor private benefit in the hands of these six men.

The moral of the tale appears to be the utter powerlessness to save which resides in the arm of the law concerning patent rights. Had the makers of steel received a proposal that for a remuneration of five per cent. on the profits to accrue, a means would be imparted to them which could certainly add £30 to £40 per ton to the value of inferior metal, or if such a process had been freely imparted, leaving it to their honour to make the inventor an adequate compensation, we can hardly doubt what course Englishmen would have taken. But when his merit is brought before the tribunals of justice there exists such a variety of acuteness in the judicial minds that they are unable to agree during the space of fourteen years, whether the law entitles such a public benefactor to any benefit for his discovery, even to the amount of fees paid to the fountain of justice purposely to secure a right. Mr. Sanderson may well express pride at the development which such inventors afford to their country, though feeling less proud of the return which it makes them. Let us hope for a change; there is a great promise at present of putting the right men in the right places, and we may trust to see patentees placed rightly also, not the pirate in possession and the inventor in the grave.

When a safe and certain method of using a difficult material has been once established a power of experimenting is obtained, which leads to great simplifications. The obstacle to any regular course of experiment on the supposed effect of manganese on the quality of steel was the intense affinity of its oxide for the earths of the crucible, the melting pots being rapidly cut through, and the charge lost, as repeatedly proved in Court. And no means existed for preserving this highly oxidizable metal so as to apply it in a metallic form. A means of arresting its oxidation being once discovered by Mr. Heath, the simple modification followed of employing those means at great economy in the one operation of melting steel, the most suitable *time* for inserting the detergent being then ascertained by experiment. I am informed that a change of still greater simplicity has been effected. As soon as the fusion of the steel commences, and the bottom of the pot is covered by a liquid stratum sufficient to protect its earthy substance, I am told that a small quantity of oxide of manganese, *without any mixture of coal tar or other carbonaceous matter*, is carefully placed upon this liquid couch, and deriving a competent dose of carbon from the steel itself to convert it into carburet, it effects the purification of the whole material of the ingot gradually melting down. Surely it would be to the honour of our legal code were it able to dictate that he who opens the door to such a course of progressive advancement should have some other recompense than paying costs while judges dispute. These disputes encourage the meanest passions, and sacrifice the substantive rights of the clearest merit to verbal altercation. The *letter* of the patent law is, that where the patentee's *merit* is clear, *words* shall be interpreted in his favour. It is said that further simplifications have been attained as a consequence of Mr. Heath's demonstration that steel may be purified and refined, but we must receive these assertions *cum grano*, especially the report that a general improvement is independent of the use of manganese. It is most natural that all who can be connected even by the remotest implication with the opposition to this patent should seek some excuse or cover from sharing the stigma attached to such determined proceedings.

I shall be greatly pleased to hear of the progress and success of Mr. Sanderson's deoxidizing arrangements. He will realise a great desideratum, if he obtains that homogeneous texture of metal from the Cumberland and Lancashire hæmatites which my father could never accomplish in this way. Mr. Heath proposed to use the detergent qualities of manganese in such a process, and it certainly is the most promising adjunct. Though these hæmatites are highly silicated, they are the purest British ores which can be obtained in bulk. The rich alkaline ore to which I have refered, and from which alone by the direct process my father manufactured a steel equal to the highest foreign marks, as exhibited in the fine cutlery made from it by Mr. Pepys, is too precarious in quantity, and he abandoned all hopes of employing it in a profitable manufacture.

I know not in what year Vanoccio flourished, but I would remark that the process ascribed to him of making steel by immersing wrought-iron in liquid cast-iron appears of considerable antiquity. In Julius Agricola's work on Metallurgy, dated 1566, it is described as commonly in use in Saxony, and it was found by Mr. Heath to be one of the native operations in the East Indies for making steel from the Wootz ore. Considering how ancient are the traditions of the east, we are warranted in assuming the remarkable fact that grey cast-iron was known and made many centuries prior to its application in the manufacture of castings.

I am, Sir, your obedient servant,

DAVID MUSHET.

May 15th, 1855.

P.S.—Most gratifying is it to see the farmer of Hendon who taught us a new way to plough the deep, receiving so noble an offering from the engineers; one public benefactor at least will be rewarded in his lifetime by those he has eminently served; the gratitude of the Sheffield trade can now flow only to the representatives of *their* benefactor.

## BOARD MANAGEMENT *VERSUS* INDIVIDUAL RESPONSIBILITY.

Sir,—The Earl of Hardwicke, when in the chair last week at a meeting of the Society of Arts, observed that it seemed desirable to institute a Board for the examination of proposals for improvements. The same opinion had been entertained towards the end of the last century by Lord Barham, then Sir Charles Middleton, and the matter was discussed by ministers. After much consideration, it was determined to institute the office of an Inspector-General of Naval Works, making it a part of his duty to report his opinion to the Admiralty of all proposals for improvements. Accordingly the Inspector-General (Sir Samuel Bentham) did so during the thirteen years that elapsed ere his office was abolished. During that long period the plan was found to work well. It must be noted, however, that he acted under the strictest personal responsibility for the opinions he submitted to their Lordships of the Admiralty; he had no associate signatures to cover errors, or to conceal partialities, to both of which a *Board* is liable. The Inspector-General uniformly stated the *reasons* on which his opinion was based, and it was on that basis that their Lorships were left to decide, he having had no authority himself. Several applicants refused to disclose their plans, probably feeling they would not stand the test of scientific examination; other proposals were recommended for experiment, some to be adopted, but no one was objected to without a full statement of the *reasons* which rendered it inapplicable.

During that long course of years it was only on *one* occasion that the Inspector-General was accused of *partiality*, and in that instance he had refused a considerable bribe, and on a repetition of the offer in *writing* he sent the letter to the Board of Admiralty.*

Such is the effect of *individual responsibility*, a doctrine which Sir Samuel Bentham uniformly upheld, and endeavoured to introduce in the Civil Naval Department as it already exists in the military branch with such preeminently good results.

I am, Sir, your obedient servant,
M. S. BENTHAM.

May 22nd, 1855.

## Proceedings of Institutions.

ROYSTON.—During the past sixteen months great efforts have been made to raise a fund for the erection of a Building to contain a Lecture Hall, and Rooms for a Museum, a Library, and for Reading and Class Instruction in connection with the Institute. The efforts have been so far successful as to justify the trustees and committee in undertaking the erection of the structure; and early on Saturday morning, the 16th inst., the ceremony of laying the foundation-stone took place. The meeting having unanimously called upon Henry Thurnall, Esq., to preside on the occasion, he addressed the assembly, concluding by announcing that Miss Phillips, daughter of one of the most zealous supporters of the Institute, had most kindly consented to lay the first stone. He then presented to her a handsome silver trowel, which had been purchased by the inhabitants of Royston, and was presented to Miss Phillips in commemoration of the event of the day. Some coins of the realm, and a small bottle containing some documents, having been placed in a suitable receptacle, the Foundation Stone of "The Royston Institute" was carefully laid over them. Mr. John Warren (of whom the chairman said that "had there been no John Warren there would have been no Royston Institute)" stepped forward and said that as long as life lasted, he should cherish the remembrance of the liberality of all the subscribers to the building, and he would strive to feel as thankful to the poor man for his penny as to the rich man for his pound He could not avoid, however, remarking that some of his townsmen, and many in the neighbourhood, had not yet subscribed; he hoped eventually to number all among the subscribers, and he urged all present to aid him in collecting more money. He was proud to say that some of their subscribers resided even in Australia.—A certain additional amount of money being required to complete the undertaking—say £500—it was self-evident, the more they collected the less they would have to borrow, and everybody would agree that a large debt was undesirable. A vote of thanks to the chairman concluded the business of the meeting.

## To Correspondents.

ERRATUM.—In Mr. G. H. Bengough's letter on "Reformatory Discipline," in No. 133, page 525, col. 1, last line, and col. 2, first line, for "certainly more sinned against," read "certainly *not* more sinned against," &c.

## MEETINGS FOR THE ENSUING WEEK.

MON. Actuaries, 7. Herr Rath G. Hopf "On the Results of the Operations of the Gotha Life Assurance Bank for the First Twenty-five Years, particularly as regards the Mortality amongst the Lives Assured."
Geographical, 8½. 1. Capt. Collinson, R.N., "On the Geographical Results of his late Researches in the Arctic Regions in Her Majesty's Ship *Enterprise*." 2. Dr. R. A. Philippi, "Exploration of the Desert of Atacama"

TUES. Med. and Chirurg. 8½.
Zoological, 9.

WED. Royal Soc. Literature, 8½.

* See Naval Papers No. 2, pages 132 and 133.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 7th June*, 1855.

Par. No.
255. Cholera—Copies of Letters.
256. Committee of Selection—12th Report.
264. Register of Voters—Abstract Return.
271. Dublin Port—Account.
278. Geological Survey (Ireland)—Return.
244. Public Health Bill, and Nuisances Removal Bill—Report from the Select Committee.
275. Spirits (Navy)—Contracts (a corrected Copy).
154. Bills—Jurisdiction of the Stannary Court Amendment (amended).
155. Bills—Stamp Duties Repeal on Matriculation and Degrees (Oxford).
156. Insurance on Lives Abatement of Income Tax Continuance.
Cathedral and Collegiate Churches—3rd and Final Report of the Commissioners.

*Delivered on 8th June*, 1855.

209. Militia—Return.
279. East India Company's Stock—Return.
293. Navy Surgeons, &c.—Return.
153. Bills—Youthful Offenders.
158. Bills—Gold Finger Rings.
159. Bills—Assay Offices (York, &c.)—Abolition.

*Delivered on 9th and 11th of June*, 1855.

283. Transports—Return.
259. Loan Fund Societies (Ireland)—Report from Committee.
110. Local Acts (35, East Kent Railway) (Extension to Dover)—Reports from the Admiralty.
232. Irish Reproductive Loan Fund—Account.
272. East India Railways—Return.
280. East India Loans—Extract of a Despatch.
286. Education (Scotland) Bill—Copy of Correspondence.
294. Dublin Hospitals—Copy of Commission.
296. Church Affairs (Victoria)—Copy of an Act.
157. Bills—Dwelling Houses (Scotland) (amended).
160. Bills—Spirits (Ireland) Act Amendment (amended).
162. Bills—Excise Duties.
163. Bills—Spirit of Wine.
164. Bills—Acts of Parliament Amending.
165. Woolmer Forest (amended).
Cathedral and Collegiate Churches—2nd Report of the Commissioners.
Loan Fund Board of Ireland—17th Report of the Commissioners.
Incumbered Estates Inquiry Commission (Ireland)—Report.

SESSION 1854.

449. Titles, Contents, and Indexes to the Sessional Printed Papers.

*Delivered on 12th June*, 1855.

285. Draftsmen of Bills in Parliament—Return.
297. Receipt and Draft Stamps—Return.
290. Civil Service Provident Fund—Copy of a Letter, &c.
289. Cheese—Account.
292. Ecclesiastical Commission and Church Estates Commission—Return.
161. Bills—Cinque Ports (amended).
166. Bills—Validity of Proceedings (House of Commons).

*Delivered on June 13th*, 1855.

287. Coals, cinders, and culm—Account.
288. Iron, &c.—Return
301. New South Wales—Copies of Petitions.
167. Bills—Railways (Ireland) (amended.)
War with Russia; correspondence relative to addresses, &c., received from the British Colonies.
Consumption of smoke—Copy of a letter &c., &c.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, June 15th*, 1855.]

*Dated 21st February*, 1855.

379. J. A. Telle, Paris—Railways for cities and towns.

*Dated 13th March*, 1855.

557. E. Bourseret, Paris—Bolts, rivets, &c.

*Dated 22nd March*, 1855.

635. J. Snowden, Dartford—Furnaces and fire places.

*Dated 26th March*, 1855.

667. H. C. Hill, Parker-street, Kingsland—Waterproof flocked cloth and other fabrics.

*Dated 3rd April*, 1855.

745. L. Cornides, 4, Trafalgar-square—Rendering leather, paper, and textile fabrics impervious to water.

*Dated 13th April*, 1855.

817. W. Weallens and G. A. Crow, Newcastle-on-Tyne—Marine engines.

*Dated 19th April*, 1855.

865. T. Jackson, Commercial-road, Pimlico—Railway signals.
869. C. M. Congreve, New York—Iron. (A communication.)

*Dated* 12*th May*, 1855.
1073. J. Beckett, Preston—Spinning machinery.
*Dated* 18*th May*, 1855.
1121. C. C. E. Minié, Paris—Breech-loading fire-arms.
1123. E. Morewood and G. Rogers, Enfield—Coating wrought iron.
1125. W. H. D. Granville, Stokenchurch, Oxford—Fire-arms and cartridges.
*Dated* 21*st May*, 1855.
1127. W. H. Tucker, Fleet street—Locks.
1129. H. H. Watson, Little Bolton, and J. Oliver, Over Hulton—Fuel.
1131. P. F. Didot, Paris—Bleaching paper pulp, &c.
1133. F. W. Mowbray, Shipley, near Leeds—Looms.
1135. E. H. Bennett, Birmingham—Roasting jacks.
1137. H. Whitaker, Buffalo, New York—Propulsion of steam vessels.
1139. I. J. Silbermann, jun., Paris—Printing.
1141. W. Longmaid, Victoria-cottage, Stoke Newington, and J. Longbottom, Leeds—Heating coppers, pans, and boilers.
1143. T. G. Shaw, Old Broad-street—Conductor for decanting wine, &c.
1145. W. Mac Naught, Manchester—Steam boilers.
1147. J. Shanks, Arbroath—Mowing machines.
1149. J. H. Johnson, 47, Lincoln's-inn-fields—Vulcanising and rendering hard, india rubber and gutta percha, and application of to parts of machinery, &c. (A communication.)
*Dated* 22*nd May*, 1855.
1151. H. E. Scott, Brixton—Ships.
1153. G. Collier, Halifax—Looms.
1155. T. Holt and J. Sagar, Blackburn—Looms.
*Dated* 23*rd May*, 1855.
1157. J. J. Meyer, Rochdale—Shaping wood.
1159. J. Eden, Lytham—Drying fabrics.
1161. D. L. Davis, Dedham, Massachusetts—Elastic bearings for chairs and rails.
1163. A. V. Newton, 66, Chancery-lane—Beehives. (A communication.)
1165. W. Smith, 10, Salisbury-street, Adelphi—Safety apparatus for steam boilers. (A communication.)
*Dated* 24*th May*, 1855.
1167. J. A. Longridge, Newcastle-on-Tyne—Artillery.
1169. J. Mitchell and J. Entwisle, Bury—Presser flyers for roving frames.
1171. J. Hudson, Laurel-place, Dalston, and G. R. Williams, Stanley-street, Chelsea—Water meters.
1173. G. W. Muir, Glasgow, and M. Gray, Bonhill, N.B.—Admitting air to furnaces.
1179. J. Addenbrooke, Bartlett's-passage—Machinery for folding envelopes.
*Dated* 25*th May*, 1855.
1181. E. Haseler, Wolverhampton—Picture frames.
1183. A. Melville, 50, Baker-street, Portman-square—Breech-loading fire-arms and projectiles.
1185. J. H. Poullain, Paris—Penholder.
1187. H. H. Henson, Parliament-street—Goods wrappers.
1189. A. P. Jaccard, Ste. Croix, Switzerland—Centre seconds movement for watches. (A communication.)
*Dated* 26*th May*, 1855.
1191. F. H. Maberly, Stowmarket—Fire-arms.
1192. J. L. Lorand, 11, William-street, Hampstead-road—Railway break.
1193. T. Mather, Preston—Pistons.
1197. A. J. H. Parent, Paris—Buttons, nails, and metallic and plastic articles.
1199. C. W. Harrison, Woolwich—Metal ropes, cables, and rods.
1200. A. E. L. Bellford, 32, Essex-street, Strand—Envelope machinery. (A communication.)
1201. A. E. L. Bellford, 32, Essex-street, Strand—Steam engine regulator. (A communication.)
1203. J. Avery, 32, Essex street, Strand—Conveying heavy weights for bridge building, &c. (A communication.)
1205. G. Neuffer, 39, Finsbury-square—Producing patterns upon floor cloths and other ornamental coverings.
1207. T. Waterhouse, Sheffield—Actuating forge hammers and pile driving. (A communication.)
*Dated* 28*th May*, 1855.
1209. J. B. Howell, Sheffield—Consuming gaseous products in combustion of fuel.
1211. B. Fullwood, 6, Kirby street, East India-road—Purification of mineral, vegetable, and animal matters containing oily, bituminous, &c., qualities.
1213. J. Morrison, 10, Arlington-square, New North-road—Railways.
1215. E. M. Roch, Paris—Reading or bringing into sight advertisement bills, &c.
1217. A. E. L. Bellford, 32, Essex-street, Strand—Sewing machines. (A communication.)
1219. J. Whitehead, jun., and R. K. Whitehead, Elton, near Bury—Finishing woven fabrics.
1221. H. Grafton, Rolles-buildings, Fetter-lane—Heating and cooking apparatus.
1222. A. Coleman, Chelmsford—Land rollers and scarifiers.
*Dated* 29*th May*, 1855.
1223. D. Dunn, 9, King's-road, Pentonville—Steam boilers.
1225. E. J. Lalond and Count L. A. de Chatauvillard, Belleville, near Paris—Obtaining oils, essences, paraffine, &c.
1227. E. Clowes, King's Bench-walk, Temple—Spring. (A communication.)
1229. T. V. Lee, Dulwich—Generating steam.
1231. W. A. Henry, Sheffield—Vices.
1233. J. H. Johnson, 47, Lincoln's-inn-fields—Stamping and embossing presses. (A communication.)
*Dated* 30*th May*, 1855.
1235. R. D. Aked, 28, Matilda-street, Caledonian-road—Stands for crotchet reels.
*Dated* 31*st May*, 1855.
1237. E. Wharton, Birmingham—Ordnance and fire-arms.
1238. E. Wharton, Birmingham—Metal tubes.
1239. E. Wharton, Birmingham—Steam engines.
1240. J. L. Jullion, Tovil—Paper, &c.
1241. J. Leetch, Westminster—Helmet.
1242. W. Rimington, jun., Craven, Yorkshire—Spring hinge for swing doors.
1243. C. T. Dunlop, Glasgow—Chlorine.
1244. Sir J. W. Lubbock, Bart., Mansion-house-street — Telescopes, &c.
1245. H. Sachs, Newgate-street—Fountain pen.
1246. S. Bickerton, Oldham—Oil lubricator.
1247. Baron Espiard de Cologne, Paris—Diving apparatus.
1248. R. Ashworth and S. Stott, Rochdale—Spinning machinery.
1249. T. Worsdell, Birmingham—Lifting jacks.
1250. R. A. Brooman, 166, Fleet-street—Dyeing cotton, threads, yarns, and twists. (A communication.)
*Dated* 1*st June*, 1855.
1251. A. Jackson and E. Kershaw, Manchester, and J. Roberts, Failsworth, near Manchester—Looms.
1252. P. A. le Comte de Fontaine Moreau, Paris—Oils. (A communication.)
1253. R. Peyton, Birmingham, and A. S. Stocker, Poultry—Bedsteads.
1254. C. J. C. Venant, Amiens—Roasting coffee.
1255. J. C. Pellenz, Aix-la Chapelle—Iron wheels.
1256. R. Whytock, Edinburgh—Colouring yarns.
1257. H. Spencer, Rochdale—Twisting and winding spun yarns.
*Dated* 2*nd June*, 1855.
1258. J. Boyd, Ashbocking—Letter press printing machines.
1259. J. Lane, Liverpool, and J. Taylor, Birkenhead—Engine.
1260. T. Taylor and W. Smith, Manchester—Railway chairs.
1261. C. Coe, Manchester—Druggets, pilot cloths, blankets, &c. (A communication.)
1262. C. Little, Derby—Envelope machinery.
1263. H. Cartwright, Dean, Broseley—Steam cock.
1264. F. C. Armelin, jun., Dragnignan—Ploughs.
1266. J. T. Dore, Southampton—Needle and button cases.
*Dated* 4*th June*, 1855.
1268. P. A. Godefroy, 3, King's Mead-cottages, New North-road—Gutta percha.
1272. W. Eley, 38, Broad-street, Golden-square—Caps for fire-arms.
*Dated* 5*th June*, 1855.
1278. J. Gedge, 4, Wellington-street South, Strand—Securing contents of bottles. (A communication.)
1280. D. N. B. Coffin, jun., Massachusetts—Stop cocks.
1282. C. Curtice, Massachusetts—Burglar annunciator. (A communication.)
1284. E. Allen, Massachusetts—Breech-loading fire-arm.
1286. W. E. Newton, 66, Chancery-lane—Rolling bar iron. (A communication.)
*Dated* 6*th June*, 1855.
1288. J. Gedge, 4, Wellington-street South, Strand—Preserving grain. (A communication.)
1290. J. Fielding and W. Hopwood, Blackburn—Looms.
1292. G. Hopper, Houghton-le-Spring—Rolling and shaping metals.
1294. J. Robertson, Ardrossan—Transmitting motive power.
1296. J. Boucher, 3, Surrey-villas, Camberwell New-road—Powder flasks, and sights and ramrods.
*Dated* 7*th June*, 1855.
1300. J. Buncle, Springfield, Linlithgow—Bleaching resinous substances (calophane) for the manufacture of soap.
1302. T. Ogden, Manchester—Spinning machinery.
1304. J. A. Reynolds, Elmira, New York—Machinery for discharging vollies of shot.
1306. C. C. J. Guffroy, Lille—Smoke-consuming apparatus.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3727 | June 9. | Portable Camp Cooking Apparatus ...... | Edmund Cobbett ............... | 34, Villiers-street, Strand. |
| 3728 | ,, 13. | A Compound Valve for Hydraulic Presses and other purposes ............ | Peel, Williams, and Peel..... | Manchester. |
| 3729 | ,, 13. | The Allied Army Tent ........................ | John Hill........................ | 212, Piccadilly. |
| 3730 | ,, 19. | A Sun Shade or Parasol........................ | Charles Burton ................ | 162, Regent-street. |

Journal of the Society of Arts.

FRIDAY, JUNE 29, 1855.

## TRADE MUSEUM.

On Friday, the 22nd instant, H.R.H. Prince Albert, President of the Society, attended by Captain the Honourable Dudley de Ros, inspected the Trade Museum (Animal Collection) at the Society's House; and on the following day the collection was visited by their Royal Highnesses the Prince of Wales and Prince Alfred, attended by Colonel the Honourable C. B. Phipps and Mr. Gibbs.

## WROUGHT IRON ORDNANCE.

The project of employing wrought iron for ordnance, has brought to light a collateral circumstance in proof of this material, namely, that on the bursting of a gun it does not break up in fragments as does cast-iron, and that thereby the persons who serve the piece are little exposed to danger. Mr. Berkeley has said, that on the second day's trial of the 9 pounder he witnessed at Woolwich, "they did burst the gun, that is it was ripped open about ten inches half way up." It must be observed, however, that the gun in question had apparently been fabricated by welding bars of wrought iron together, the manner in which ancient ordnance was made, and of which many examples still remain, among others, the piece called "Mrs. Peggy," which is preserved in Edinburgh Castle. The bore of this gun is about 12 inches diameter.

It has already been said in the *Journal of the Society of Arts*, that the perfection of large articles of wrought iron depends much upon the velocity and force of the hammer by which it is beaten; since then a gentleman conversant on the subject has given an instance which appears to be in point. At one time, wrought iron anchors for the navy were hammered subsequently to their being forged, but without regard to the weight or velocity of the strokes at different periods of the operation. The result of this hammering was remarkable, an exterior shell of the anchor became of the quality of steel, as it were, but within this indurated coat the remainder of the anchor exhibited the crystallized appearance of cast iron, and was, like it, brittle, and of little strength compared to wrought iron. In the Royal Dockyards, anchors are no longer hammered after being forged, yet, as wrought iron has its strength increased a seventh by hammering, it would seem that, under proper management of the hammer, this practice might be advantageously resumed.

As to steel as a material for fire-arms, "An Engineer" proposed in the *Journal of the Society of Arts*, of the 15th inst., to use steel as a lining for the bore of ordnance; but even for such a lining it would seem essential that some previous experiments should be instituted, for we know not the power of steel to resist without loss of elasticity such violent shocks and strains as are inevitable in the bore of a gun. Carriage springs do afford examples of resistance to sudden shocks, whilst, on the other hand, the springs of locks frequently give way by slamming-to a door; but these examples are but of small force in comparison with that of the explosion of gunpowder in propelling a missile, and we know not what effect the decomposition of gunpowder might have in destroying the elasticity of steel, or otherwise altering its quality. Steel watch springs are, indeed, exposed to that degree of heat which gives a blue colour, and the late mechanist, Mr. Rehe, of Fetter-lane, had, in private trade, to furnish caps for priests in India, which caps were required to be uniformly blue, without diminution of the elasticity of the steel of which they were wholly made. Mr. Rehe effected the purpose by *roasting* the caps; that is, he placed them before a hot, clear fire, upon a frame, continually turning horizontally, so that the caps were exposed alternately to great heat and to a cooling process; he told me that otherwise neither could uniformity of tint be given, nor could the elasticity of the steel be preserved where large masses of it were employed. A piece of ordnance has not time for cooling during an engagement with the enemy, but easy experiment would determine the fitness of steel either for the gun itself or for the lining of it.

It seems now to be a generally admitted fact, that cast-iron ordnance *wears out*. How is this to be accounted for? It could hardly have been so during the wars at the early part of this century; at least, at that time, ordnance, though often changed, never was so on board ship, because worn out. For instance, the guns were the same from first to last that were mounted in the experimental vessels of 1795, and many of which were in constant service to the termination of the war in 1814; those vessels also were more frequently engaged with the enemy than, perhaps, any other vessels, the *Netley* schooner having taken more prizes in the Bay of Biscay, than were made by *all* of the many other vessels on the same station; so in the Helder, at Dunkirk, Copenhagen, &c., those sloops and schooners made much and frequent use of their artillery, but their several successive commanders never hinted that their guns were the worse for wear.

Speaking of those experimental vessels recalls a peculiarity of them all, namely, their shallow draught of water—a quality the want of which seems to have crippled the operations of our splendid fleets in the Baltic as in the Black Sea. Ships of the line could not venture amongst the shoals and islands in the Gulf of Finland; Sir Charles Napier and Admiral Chads were obliged to shift their flags to smaller vessels from the noble first-rates they were usually on board of. In the Black Sea, the place of debarkation for our troops was determined more from the depth of water at Eupatoria than from its vicinity to Sebastopol. General opinion is at present in favour of large ships drawing a deep draught of water, both for ships of war and for commercial purposes, and certainly those of considerable tonnage possess several advantages over smaller craft; the large vessel affords superior accommodation for passengers and for officers; more splendid decorations can be afforded where the expense of them is to be divided amongst many; and, what is of infinitely more importance, officers of superior skill and experience can be engaged with ample remuneration for their services, and in vessels of war the importance of the commander is apt to be estimated according to the size of the vessel he is appointed to. But on the other hand, when a large ship is lost, the sacrifice of human life is proportionately immense, as has but too fatally been experienced in the large passenger vessels, the *City of Glasgow*, the *Tayleur*, the *Arctic*, and in the Government steamer the *Prince*. The loss of cargo, too, is not the less a *national* loss because those vessels and their contents were insured—insurance only shifting the damage from perhaps an individual to an aggregate of persons. In a commercial point of view it would seem more desirable to supply a market by means of ships of comparatively small burthen, than to risk the destruction of the whole demand by embarking it in a single ship. The loss of the *Prince* affords a strong example of the fatal consequences of trusting an enormous quantity of goods and missles to the safety of a single ship, for on board of the *Prince* was the whole supply of clothing for our troops in the Crimea, of medicines for the sick and wounded at Scutari, and an immense provision of munitions of war, all, all, lost together! Now, had these articles been shipped in, say, four separate vessels instead of a single one, had only two

of the four escaped destruction, their cargoes would have sufficed for the immediate wants of our army in the East.

It is for the mercantile community to calculate the different amounts of loss inherent on the employment of large ships instead of smaller ones, but in regard to vessels of war there are many other points to be considered. It is very true that in open seas, and so long as an enemy may use large ships, it might seem expedient that we should have similar ones to cope with them, and that notwithstanding examples of victories gained by smaller vessels over ships of the line. It is not, however, pretended that a little vessel, armed with tiny six-pounder guns, can successfully combat a first-rate man-of-war, carrying a hundred or more 32 pounders, but it is believed that were the hundred 32-pounders carried in half a score of small ships, they would prove more than a match for the 100-gun first-rate man-of-war. But, as has been above observed, so long as bravery and skill continue to be rewarded by the command of a first-rate, so long a preference to such ships will be given by naval officers. It would seem to be only by a strong effort of the naval administration that this propensity might be conquered. They might give the command of a thousand men and officers to a single captain, though the guns and men were divided on board the half-score vessels. Commodore is already the title of the commander of a small squadron; under this same title, or some more appropriate one, the Admiralty might designate the commander of the ten or twelve vessels of about ten 32-pounders each.

Ships of deep draught of water are unsuitable for many a warlike purpose. They cannot approach a shallow shore, nor enter shallow harbours to annoy the enemy, and capture his vessels sheltered there, as was experienced by the Baltic fleet, not a single ship of the line having ventured high up the Gulf of Finland. Ships of deep draught cannot enter rivers, whereas both the *Arrow* and the *Dart*, each of them armed with 30 pieces of ordnance, all 32-pounders, actually went high up the Scheldt on our expedition against Holland in the year 1799.

One serious objection to shallow vessels has been obviated by Captain Shanks, R.N., who invented *sliding keels*. This improvement in navigable vessels has not, however, been regarded as of the importance it well merits, particularly as against a ship's making lee-way in deep water. The neglect of sliding keels has arisen from their liability to cause leakage, but since iron has been so much employed in naval architecture, there could be no objection to that metal for the formation of keel cases; this part of a vessel would be exempt from injury by shot, the keels and their caps being along the middle line of the vessel fore and aft, and need not to be raised much above the water line. By dividing the sliding keel into two or three parts, the great advantage is obtainable of giving at pleasure a greater draught of water to either the head or stern of the vessel, as circumstances might require.

M. S. BENTHAM.

27th December, 1854.

## PARIS WATER SUPPLY.

(From the *Journal des Debats*.)

For several years past public attention has been very much occupied with a matter which greatly affects the health of the capital—we mean the distribution of water in Paris. We have already informed our readers several times in our columns of the improvements made in this important service by the municipal engineers. We laid before our readers, especially in 1852, the full details of a system then proposed by the administration, and which consisted in devoting a sum of 2,800,000 francs for the construction of new reservoirs and new pipes for the purpose of utilising all the water, 104,000 cubic metres, which the city had the right to abstract from the Ourcy canal.

We must now take notice of a consultation made by the Municipal Council in its last sitting, on the subject of a public report by the Prefect of the Seine in last November, upon the water question, and upon a plan of a new system of subdivision, intended to make a complete revolution in the economy of this service. This report comprises two parts: the first contains an account of the source from whence the water is derived, and its distribution in Paris; the second treats of what may be called the drainage of the capital, that is to say, the carrying off under Paris of filth, of rain, and water from the houses. As has been previously said, this new proposal for management is a real revolution. It consists of substituting spring-water for the water of the Seine, and bringing into Paris, by enormous aqueducts, an immense mass of water, drawn from the vallies of the Marne, situated between Chalons and Epernay.

The capital is at present supplied from five sources,—the Ourcy canal, the Seine, the aqueduct of Arcueil, the wells of Grenelle, and lastly, from the water of Belle Ville, and from the Près Saint Gervais, more generally termed the Springs of the North. The canal of Ourcy is the most important of these sources of supply; it was made by the First Consul (29 floreal, year 10); it distributes its water by an aqueduct, embracing a space which extends from Villette to the barrier Monceaux, through a course of 4,033 metres. From different points of this aqueduct large mains are laid, which descend towards the Seine, pass over the bridges, and empty themselves into large reservoirs. These great mains, of which the principal are those of the Hospital of St. Louis, the Faubourg St. Antoine, the Marais, the Hotel de Ville, the Halles, the Carousel, &c., &c., are themselves pierced by smaller pipes, supplying the water by numerous openings to the squares (*places*) by public fountains, to the streets by plugs, and lastly to houses through the taps of private individuals. The water of the Ourcy circulates by pressure alone, without machinery, and without trouble, the level of the basin of La Villette being higher than the surface of almost all Paris. As far as regards the water of the Seine, it is distributed by the works at Chaillot and the pumps at Notre Dame and of Gros-Caillou. The waters of Arcueil and of Grenelle, on their side, fall into the reservoir of Estrapade, used also for the water of the Seine. Lastly, as regards the springs of the north, some of those of Belleville are directed into the reservoir which serves the Abattoir Menilmontant; the others, those of the Près Saint Gervais, enter Paris at the Barriere Pantin, and supply the surrounding districts. In short, there exists under the streets of Paris about 312,000 metres of pipes of all sizes, employed in distributing water; 18 reservoirs, capable of containing 60,000 cubic metres, feed these pipes. The aqueduct "*de ceinture*," the basin of La Villette, and the Ourcy canal, contain, besides, a reserve of more than 20,000,000 cubic metres.

This quantity of water is divided into two services, the public service, which comprises 102 fountains, 1,779 plugs, 58 fire-plugs, 105 openings under the foot pavement, and 111 stands for giving water; and the private service, in which are classed 13 market fountains and 7,771 supplies made, either to the State, to municipal and departmental establishments, or to private consumers; in fact, the city can distribute 7,390 inches of water, which, constituting a mass of 147,800 cubic metres, or 148 million of litres of water per day, gives about 148 litres per day to each inhabitant. However, this system of supply having appeared to the government to want uniformity, and, besides, the water of the Seine not appearing to them to unite in itself the three indispensable qualities of all good water, namely, wholesomeness, clearness, and freshness, the Prefet of the Seine directed M. Belgrand, chief engineer of the bridges and highways, to search in the basin of the Seine for purer water than that now used by the Parisians. After numerous experiments, M. Belgrand has discovered

a stream called Somme-Soude, which divides itself into two branches, the Somme and the Soude, and falls into the Marne between Chalons and Epernay. The water, says M. Belgrand, taken from these sources, is very fresh, of extreme purity, and most agreeable to the taste. One thousand litres of water can easily be obtained every second from this stream, or 86,400 cubic metres of water in 24 hours. The water leaves its source at an altitude of 106·86 metres, and will arrive at Paris at an altitude of 80 metres, after passing through the plains of Champagne, between the confluence of the Somme and Soude and Epernay, the left bank of the Marne between Epernay and Meaux, and between Meaux and Belleville, the right bank of the Marne, and the foot of the hills situated to the east of Paris. The distance from the source will be 172 kilometres, and the expense from 22 to 25 million francs. But the quantity of water now necessary to feed all the services being 86,777 cubic metres, that is to say, 56,040 metres for public and 30,737 metres for private consumption, the following calculations form the ground-work of the new scheme:—In making a large allowance for the future, 110,000 cubic metres is estimated, instead of 56,040 cubic metres, as the quantity of water necessary for the public service, though for private service, since at the present time 30,737 cubic metres are consumed by only 13 market fountains and 7,771 other supplies, upon a total of 31,500 houses, forming the whole of the property of Paris, we shall arrive at a distribution of 90,000 cubic metres in calculating the number of buildings at 40,000, or a total of 200,000 cubic metres for the general supply of all Paris, public and private. Indeed, the supply for London is not calculated for a larger quantity, though it contains a surface six times greater, and a population two and a half times more numerous than that of Paris. It is reckoned that 107,000 cubic metres of the water of Ourcy, Arcueil, Grenelle, and the northern sources, will be reserved for the public supply, and the private supply would be provided with 100,000 metres of water derived from the aqueduct formed after M. Belgrand's scheme. By this means, more than four-fifths of Paris will be very abundantly supplied by these different sources appropriated to the public use. As to the remaining fifth of the surface of Paris, which the water of the Ourcy cannot reach by its own gravity, and which the water of Arcueil, Grenelle, or the north would not be sufficient to supply, steam-engines must be erected to direct into it that portion of water not required for the use of the rest of the city, or the water of the Seine raised by the pumps of Chaillot, and now intended for the water supply of the Bois de Boulogne. Such is the general arrangement of the first part of the new scheme submitted to the Municipal Council. The remainder, as we have said, relates to the question of the drainage of the capital. In short, it is not enough to supply water abundantly for cleansing streets and for the use of houses in a perfect state of purity, it is also necessary to provide this water with a convenient and regular outlet as soon as it has been used, and use has rendered it unwholesome and inconvenient.

With this view, the decree of the 26th March, 1852, has already initiated altogether a new system, in directing that all rain and waste water from the houses should be directed into special sewers for that purpose. For the requirements of this service, there already exist 163,000 metres of sewer, that is, 140,000 metres more than in 1806. Since the beginning of this century all the uncovered sewers have been successively arched over, and the last of these, the open sewer of Ponceau, disappeared in 1853. Besides, on the two banks of the Seine, large sewers, parallel to the river, have been made, and into these all the smaller sewers empty themselves below Paris.

The sewer of the Rue Rivoli, whose vast dimensions we have already noticed to our readers, is the first application of the system; it now extends from the Place du Marché Saint Jean to the Quai de la Conference, where it empties itself into the Seine. It will be carried as far as the Bastille, in order to communicate with the sewers of the Faubourg Saint Antoine, and on the other side it will be carried from beyond the pumps at Chaillot.

Upon the left bank a main sewer has been made, under the towing-path, from the bridge Tournelle to the bridge Carousel, but the plan of this drain is bad, and its continuation is not yet decided upon. To make the arrangement perfect, every public street should have a sewer with which the property on either side can connect its own house-drain, whilst the channel of the street should only receive the surface water; thus we come to see that there are only 363,000 metres of house drainage, whilst the length of the streets extends to 423,000 metres. Taking the quantity of water distributed for public and private supply, and that which falls in heavy rains, the necessity for new and larger sewers than those which now exist is at once apparent. In short, the whole of this service should be organised in the following manner, according to the terms of the report of the administration. Every principal line of drain should be in connection with a main sewer of large section, having a railway side, as in the sewer of the Rue Rivoli. Sewers of smaller size, but equally provided with rails, and capable of allowing the traffic of workmen and waggons, should follow the secondary lines. A drain of small section, large enough, however, for the passage of wheelbarrows, should surround each block of houses on all sides, which cannot be served direct by one of the principal or secondary sewers. In fine, every other house opposite the partition wall should open into a short cross drain, putting each of these houses in communication with this small drain compassing this block, or directly with the secondary or principal sewer. Into this cross drain the house waters should flow, according to decree of the 26th March, 1852, as well as the clear water from the cesspools, and through this way wheelbarrows should reach the cesspools, and carry off their solid contents.

The better to insure the cleanliness of the town, trapped gullies should be placed in the courts of the houses, through which soil should fall into the sewers, where it would be carried off by the powerful flushing of water, as is now practised at La Villette. Hereafter, by these arrangements, all the pipes would be placed in the main sewer, and the branches for houses will follow the course of the private drains. By this means everything would be placed, visited, and repaired, without the necessity of disturbing the pavement, or interfering with the traffic of carriages or passengers at any point. This same unseen way would serve for the inlet of pure water, and the outlet of muddy and contaminated water. Even the gas-pipes might be laid in this network of drains, the ramifications of which would thus form a subterraneau town, following the plan of the city above.

Such are the arrangements of the scheme the plan of which has been submitted to the Municipal Council. On the report of M. Segalas, the Commission has authorised the drawing up of a detailed plan for the execution of the works relating to the supply of water, and at the same time has opened a credit for the creation of a staff of engineers, who, under the orders of M. Belgrand, will be charged with drawing the plans and completing the experiments.

As far as regards the drainage of the capital, a system which has only been put forth as a possible consequence of the new plan for water supply, the Council has expressed its regret that the necessary works for the drains and subterranean means of removing filth had not been conducted contemporaneously with the works for the water supply, in such a manner that the plan of the Prefect could have been tried in its full completeness. We will take care to supply our readers from time to time with the details of this great undertaking, which we have not time now to discuss at full length.

## LOW-SPEED RAILWAYS AND CANALS FOR INDIA.*

The papers appended to the despatches of the Madras Government, No. 193, dated 24th April last, and No. 358, dated 15th September, 1853, do not go sufficiently into detail to enable me to offer any useful opinion on the local projects severally adverted to by Colonel Cotton, but his general views on the system of communication best suited to the present circumstances of India, may be gathered from the papers referred to, and from a book published by him during the present year, under the title of "Public Works in India," and on these I proceed to offer a few remarks.

2. The consideration of this question has left me deeply impressed with the importance of the subject, and though I dissent from many of the views expressed by Colonel Cotton, and though I dispute many of his calculations, I cannot but feel that he argues from sound principles, and that his plans for the improvement of communications at small cost, in some localities by means of canals and rivers, and in others by an inferior class of railway, are eminently deserving of attention.

3. In reporting to Government the result of my anxious but imperfect investigation, I shall confine myself strictly to engineering questions regarding the cost, economical use under various circumstances, and comparative value of canals and railways of more or less perfect construction. I shall not attempt to analyse closely Colonel Cotton's calculations of the direct and indirect pecuniary value of the several modes of communication. Being based on hypothetical, and sometimes questionable data, they are very open to criticism, but they serve as striking illustrations of the projector's views, and perhaps were intended for nothing more. It may safely be conceded that railways and canals constructed and worked at anything like the estimated rates, would command all the existing traffic on their respective lines, would probably stimulate its growth, would admit of the interchange of commodities between different districts now prohibited by cost of transport, and would certainly diminish the cost of almost every description of export merchandise.

4. As regards railways, the questions for solution may be thus stated:—What are the essential differences between a high-speed and a low-speed railway? What is the description of railway on which goods can be carried at minimum cost, taking all concomitant circumstances into account? What will be the usual velocity on such railways, under the condition of minimum cost? And to what extent ought they to supersede the system of high-speed railways now contemplated for India?

5. The questions of cost, of original construction, and of working railways, should be considered separately, and yet with close reference to each other. It is fallacious to apply to a cheap (inferior) railway the rates for working which are found to obtain in the most perfect works, for the superior solidity and accuracy of construction which cause the difference of expense are intended, and do really conduce, to diminish the draft. The cost of railway traffic consists of working expenses and interest on capital, and there is no invariable rule that when the latter is at a minimum, the total cost is so likewise, for instance, it appears from data specified below,† that the net load moved at 10 miles an hour by a given power on gradients of 1 in 100, and 1 in 1000, are respectively as 73 and 224, or 1 to 3, and that the estimated cost of locomotive engine power to move a ton a mile on these gradients, is respectively, 0·150d. and 0.049d., the difference being one-tenth of a penny per mile, so that with a traffic of 100 tons a day, or 31,300 tons per annum, the saving in locomotive power would be £13 per mile, which, capitalised at 5 per cent., would give £260, or Company's rupees 2600, as the sum per mile which it might be good economy to spend in obtaining the difference of gradients above mentioned; and similarly the retardation from quick curves, from want of rigidity in the rail, and from inaccurate joints, has in each case an appreciable effect in augmenting the working cost.

6. Thus it appears that speed is not the only object in expensive construction, nor is it necessary that railways on which speed is possible, should always be worked at high velocities. Even on the so-called high-speed railways now under construction in India, the rate of speed which will admit of the most economical working will be that universally adopted for goods traffic, viz., 10 to 14 miles an hour.

7. For analagous reasons, the width of gauge, which regulates in some measure the size of goods waggons, should be determined with reference to the cost of working, as well as to that of first construction. The distribution of a given load on a large number of small waggons, is less economical than its concentration on a few large ones. In the latter case the friction is less, and the net load bears a higher proportion to the dead weight. No gauge less than the narrow gauge of England would be in this point of view economical. The difference in cost of construction due to one foot more or less of gauge, is not important.

8. The railways now under formation in India, or at least those of Bengal, are not being constructed with reference to high speed so much as to durability, security, and economical working; and, provided that they are to be worked by engine power, I do not believe that their cost could be materially reduced, even were the speed to be restricted to 10 miles an hour. In this case the weight of the rail might be diminished 30 per cent., and the size of the sleepers and thickness of the ballast might be slightly reduced, but these would not lessen the total cost by more than one-sixth. If it were determined to substitute animal power altogether for engine power, a much greater reduction might be made, and many expensive accessories might be dispensed with. This is, I believe, the only conditions under which cheap railways ought to be constructed in India.

9. In Colonel Cotton's Minute advocating a project for a low speed railway between Cuddalore and the Salem district, he estimates the cost of the works at 6,000 rupees per mile. In his book he variously estimates the cost of such works at 6,000 rupees,* 12,000 rupees,† and 20,000 rupees.‡ The variations refer apparently to various modes of construction, but in all the estimates of which any details are given, I observe the omission of some items of unavoidable cost, or of some parts usually admitted to be essential to an effective railway. In the estimate for 6,000 rupees § per mile, for instance, where he proposes to use a rail of 25½ lbs. to the yard, resting on a broad flange, but having no chairs or sleepers, he has provided no ballast or cross-ties. The sectional area of such a rail is 2·583 square inches,—a very light rail, even without the flanges which are to give it a hold on the ground. I calculate the smallest sectional area of rail capable of being used without chairs and sleepers at 5·8 square inches. It would weigh about 58lbs. per yard, and would require cross-ties and fishing plates at 8lbs. per yard of single track, and even then there would be need of ballast to bed the rails, and to form a hard surface for the feet of the draught cattle. In the piled railway (page 139 of Colonel Cotton's book) no road or bridges are provided for the cattle, supposing animal draft to be employed, nor, if engine-power is to be used, has he estimated for fencing, turn-tables, watering apparatus, &c., which form such

* Memorandum by the Consulting Engineer in Bengal, on "Low-Speed Railways," as proposed by Colonel A. Cotton, Madras Engineers, and on certain projects by the same officer for the improvement of internal communication by means of canals. Called for in Under-Secretary Mr. G. Couper's letter, No. 613, dated 9th June, 1854.

† A table in the Aide Memoire Royal Engineers, page 181 part I., vol. III.

* Page 139. † Page 122. ‡ Pages 129 and 181.
§ Minute dated 10th June, 1853.

considerable items in railway estimates, neither has he provided for sidings—an indispensable part of a single track railway, nor for stations, nor for engineering and surveying expenses, which in a cheap railway would bear a higher ratio to the total cost than in an expensive one.

10. No estimate for a railway not based on a carefully-taken section can be entirely relied upon; but the following, which I have prepared with due advertence to the considerations stated in paragraphs 5 to 7, is an approximation to the cost, under favourable circumstances, of a railway which would admit of the cheapest description of land transport:—

*Estimate of the Average Cost of One Mile of a Low Speed Railway, Embankment 12 feet wide at top, 3 feet high.*

| | | Rupees. |
|---|---|---|
| Average section 45 square feet; 237,600 cubic feet, at 2 rupees 8 annas per 1,000 | | 594 |
| Brickwork in drains and culverts, about 4,000 cubic feet, at 16 rupees per 100 | | 640 |
| Bridging—average 15 yards, at 170 rupees per yard forward | | 2,550 |
| Ballast—sectional area, 15 square feet; 79,200 cubic feet, at 2 rupees 8 annas per hundred | | 1,980 |
| Fencing and gates | | 1,000 |
| Turntables, goods stations, &c. | | 250 |
| Engineering, surveying, and supervision | | 700 |
| Total, exclusive of permanent way | | 7,714 |
| Permanent way, consisting of bridge rails, 30lbs. to the yard, on longitudinal wooden bearings, with cross-ties at every six feet:— | | |
| 47 tons for one mile, at 100 rupees per ton | 4,700 | |
| Inland carriage at 12 rupees per ton | 564 | |
| 3,960 cubic feet of timber at 1 rupee per foot | 3,960 | |
| Laying permanent way, at 8 annas per yard | 880 | |
| | | 10,104 |
| Total | | 17,818 |
| Add 10 per cent. for sidings, ½ mile at every 5 miles | | 1,782 |
| Add for unforeseen contingencies | | 400 |
| Total estimated cost for one mile (Company's rupees) | | 20,000 |

The above rates refer to actual cost. If the agency of contractors be employed, the amount must be raised from 20 to 25 per cent.

11. Such a railway as I have estimated above is calculated to be worked ordinarily by animal draught, but on extraordinary occasions could bear a light locomotive engine running at moderate speed, with the ordinary carriages and goods waggons of a substantial railway. I have reduced the quantity of iron to a minimum with reference to the present high price of that material, and to the difficulty of freight; but whenever India may supply her own iron, a different mode of construction may be advantageously adopted. The gauge would be 5ft. 6in., corresponding with that fixed for the railway system of India. The inconvenience incident to a break of gauge would thus be avoided in transferring goods from the inferior to the more substantial railway, and the political advantage of being able on an occasional emergency to transport troops or stores with rapidity, would be secured to the Government. I must, however, repeat my opinion that a rail of 30lbs. to the yard is not adapted for habitual use by a locomotive engine, and that where such habitual use is contemplated, more attention to perfect and solid construction than would be covered by this estimate is absolutely necessary.

12. Where animal power is employed, the most economical rate of speed is that of the natural pace of the animal—if a horse, 2½ miles an hour, if a bullock (Bengal) 1½ miles an hour—and to these paces respectively I would limit the goods waggons. The passenger traffic, which, weight for weight, is always willing to pay higher than goods, could afford to sacrifice some useful effect to velocity, and might attain the rate of 6 miles an hour. If higher speed be required, it becomes questionable whether steam power should not be employed. The load which a horse can draw at 2½, 6, and 10 miles an hour respectively, are given by Tredgold as in the ratio of 14, 6, and 3·6.

13. In calculating the cost of transport, which consists partly of interest on the capital expended in making the road, it is necessary to assume some amount of traffic. For the purposes of this comparison, I shall reckon upon 100 tons per day—this being the lowest prospect of freight which would justify the construction of any kind of railway,—and I shall assume that on the low-speed railway the goods traffic will pay three-fifths of the dividend, and two-fifths on the first-class railway, which, from its higher speed, will be more attractive to passengers. The draught on a rail or tram-way compared with that on a good road of similar gradients is stated by Tredgold at 8 to 1. The cost of goods transport on a metalled road in India is a little more than 1 pie per ton per mile, and on a light railway with cattle draught, may be taken at one-sixth of an anna, or two pie. The proportion of interest on 20,000 rupees—the cost of one mile (calculated as above), would be 600 rupees, which, divided on the amount of traffic, (100 tons per day, or 31,300 tons per annum), constitutes an additional charge of 3 pie per mile, making a total of 5 pie per ton per mile. It must be noted, however, that the charge in this calculation of one-sixth of an anna, is the price merely of the draught and the use of the vehicles; it does not include loading and unloading, warehousing at either terminus, protection from weather, and from pillage while *in transitu*, or for maintaining the road in repair.

14. I will not attempt to estimate the working charges on an inferior (light) railway, worked with steam power, for it would be impossible to fix with precision the increase of cost due to imperfect construction. As an illustration, however, of what this difference may be, I may mention that Dr. Lardner gives the actual working expenses of goods transport in America, on the average of 28 railways, at nine-tenths of a penny per ton per mile; whereas on the more solid structures of Great Britain the expenses amounted only to about one-fourth of a penny, or two pie, a rate at which perhaps we may be able to work the traffic on first-class railways in this country, though I fear that, owing to the dearth of fuel, we are not unlikely to exceed it.

15. The average cost of the East Indian Railway, from Calcutta to the collieries, according to the latest estimate, (submitted to government on the 17th March, 1853), was 72,761 Company's rupees per mile; that of the extension from near Burdwan to Allahabad (forwarded on the 22nd idem) was 86,777 Company's rupees per mile; but a large portion of this line passes through the rice grounds of Bengal, and for 80 miles it runs parallel with the Damooda, and is exposed to the necessity of providing against the infrequent but formidable outbreaks of that capricious river. From Burdwan to Allahabad it crosses all the drainage that enters the Ganges from the south and west; the works on this part of the line are, therefore, unusually heavy, but from Allahabad onwards the cost will not exceed 48,000 rupees per mile. The average for construction on the whole line will be about 70,000 rupees per mile, and the total cost per mile, with a fair supply of rolling stock, may be taken at 80,000 rupees per mile. This line may perhaps be accepted as a fair sample, as regards cost, of a high-speed railway for India. The rails are heavy and the construction of the most substantial kind; some saving of first cost might be possible on these items, but would not, in my opinion, eventually conduce to economy.

16. In estimating the cost of transporting goods on a first-class railway by engine power, I will adopt the calculation in the preceding paragraph, and assume the cost

of the road to be 80,000 rupees per mile, giving 1,600 rupees per annum as the proportion of dividend chargeable on the goods tonnage of each mile. From the table quoted in paragraph 5, I take the cost of locomotive power for a ruling gradient of 1 in 500 at 0·057d., and for the use of carriages at 0·062d.; total 0·119d, the terminal charges and those for police and maintenance of way being covered by 0·31d., making together ¼d. or two pie per ton per mile for all working charges. The proportion of dividend as above, on 31,300 tons is ten pie per ton, and the total charge would be one anna per ton per mile.

Before comparing the results obtained in paragraphs 13 and 15, it will be necessary to assign a pecuniary value to the risk and charges omitted in the former. I have no sure data for doing so, but see no reason to estimate them lower than they are found to be on a first-class railway. Goods travelling at 2½ miles an hour, and stopping "anywhere," require more watching than those which are conveyed at 10 miles an hour, and stop only at appointed stations, under the eye of the police. The cost of guarding and the risk of injury from weather are both dependant on the time of transit during which the goods are exposed; and this is four times greater on the low-speed railway than on the other. I consider, then, that one pie per ton per mile (as on the first-class railway) is not too much to cover these risks and sundry charges; we have, therefore, for 31,300 tons per annum, on a low-speed railway, a cost per ton per mile:—

| | |
|---|---|
| For all working charges ............... | 3 pie |
| For proportion of dividend ............ | 3 ,, |
| Total ..................... | 6 ,, |
| On a first-class railway:— | |
| For all working charges ............... | 2 pie |
| For proportion of dividend ............ | 10 ,, |
| Total ..................... | 1 anna |

But if the first-class railway could obtain the carriage of 76,800 tons a year, or 245 tons a day, it could afford to charge 6 pie per ton per mile; and should the traffic reach 640 tons per day, the first-class railway could carry it cheaper than the low-speed railway, even supposing, which is not likely, that by the latter such a traffic could be conveyed at all.

18. Colonel Cotton justly attaches great importance to celerity of construction, and shows that the saving of time would justify and compensate for a considerable increase of cost; but his views of the method of construction best suited to secure this object are directly contradicted by our experience up to the present time. Colonel Cotton supposes that the large use of iron in substitution for wood and brick, and even for earthwork, would expedite this work, but the chief difficulty experienced and anticipated in the Bengal line is that of obtaining an adequate supply of iron. I am inclined rather to reverse Colonel Cotton's proposition, and to state my opinion that the smaller the quantity of iron required for a given railway, the more rapidly can it be constructed and brought into use. For this reason I would reject the piled railway proposed in Colonel Cotton's book (p. 139), if there were no other objections to that mode of construction.

19. I would thus calculate the comparative celerity in constructing second-class railways, such as I have specified in paragraph 10, and first-class railways, such as are now under construction in Bengal. I allow four years as the time within which the most difficult work likely to occur on the first-class line of railway can probably be completed, and three years for a similar object on a second-class railway; and I assume that the embankments, cuttings, and minor works, through any length, may be finished within either of these periods. The first-class railway will require 180 tons of iron; the second-class railway will require 47 tons of iron per mile. Lastly, I assume the tonnage available for importing iron at 15,000 tons per annum. Then we might have in 1 years 3,828 miles of second-class railway, at a cost of Company's rupees 76,560,000 (7½ millions sterling); or 999 miles of first-class railway, at a cost of Company's rupees 79,920,000. In round numbers the same cost in the same time would produce four times the length of second-class railway that it would of first class railway. This is undoubtedly a great difference, but would not, in my opinion, justify the postponement of the political and social advantages which exclusively belong to a trunk line of high-speed railway.

Colonel Cotton most unreasonably calculates the future from the past rate of progress in extending the railway system throughout India, forgetting that the retardation has not been owing to any physical or unavoidable obstacles, that the first operations at each of the presidencies were called "experimental," and were strictly limited to short lines, and that much of the previous delay was incurred in discussing and refuting the class of objections which he is now endeavouring to revive.

21. In the opening chapter of his work pp. 2—3, Colonel Cotton, in reference to the Bengal railway, falls into the error of supposing that its assumed incapability of carrying 10,000 tons a day, besides 1,600 passengers, entirely overthrows the calculations of profit; and this he gives, "as a curious instance of the superficial way in which the question has hitherto been considered." But this supposition is quite unfounded, for I have already shown, in paragraph 15, that a goods traffic of 100 tons per day, at 1d. per ton per mile, would pay a dividend of 2 per cent. on the capital; and a similar calculation will shew that 480 passengers per diem, paying 6 pie (3 farthings) per mile, will give 3 per cent more, bringing the dividend up to 5 per cent., and relieving the government from their guarantee. Any excess beyond this very moderate estimate of traffic, may be applied either in augmentation of dividend or in reduction of tolls.

22. By this and similar argument Colonel Cotton endeavours to establish his position that high-speed railways are uncalled for in the present circumstances of India, and that they will be even mischievous in their results; and though it were admitted that works of this description, constructed by private capital, certain to be eventually and very soon independent of state assistance, inducing the investment of European capital in India, and interesting a large section of the British public in the welfare and good government of this country, though it be admitted, I say that such works cannot but be beneficial to any country, still he would object that these benefits are obtainable by the investment of money in other works supposed to be more useful in themselves, and coming into more immediate operation. It must not, however, be overlooked that there are advantages which exclusively belong to high-speed railways, and which are undeniable; I allude to the facilities they afford for the rapid concentration of troops, for the transmission of mails, and for that rapid locomotion which admits of and encourages travelling for information and amusement, and thus conduces to the moral and intellectual improvement of the more intelligent classes. Railways worked by animal draught can never, in these important particulars, supply the place of high-speed railways, though they would be most valuable as branches to the trunk lines, or in localities not likely to supply traffic for an expensive railway.

23. In concluding this branch of the subject, I may be permitted to express my regret that an officer, apparently so anxious for the welfare and material improvement of India, should have directed the influence due to his abilities and reputation against a system, the value of which, after years of controversy, has at length been recognized, but which is not yet so firmly established as to be safe from the risk of further delay and injury by adverse discussion.

24. It would be superfluous to enlarge upon the importance of inland navigation, whether by canals or rivers. The example and experience of the most industrious nations in the world, England, Holland, America, China,

shew the vastness of the efforts that have been made to obtain canal navigation, and the beneficial results which have invariably followed its establishment.

25. The statement so often advanced, that railways have superseded canals, is denied by Colonel Cotton, and I think justly, for existing canals and navigable rivers will always compete successfully with railways, especially for goods traffic; where neither of these modes of communication already exists, and a choice is to be made between them, it will be impossible to lay down any general rule. The method best suited to each locality must be considered separately, and the rival projects must be judged on their own merits, for the circumstances most favourable to one description of work are sometimes those most adverse to the other.

26. Two of the projects advocated by Colonel Cotton's Minute, dated 28th October, 1853, appear to illustrate this position. The first is for a system of coast canals extending from Ganjam to Tuttacorin; and the second for a canal and river communication from coast to coast from Cuddalore to Poonany, crossing the summit level of 600 feet, and passing through much undulating country. On the coast lines the country seems to be nearly level, while the channels forming the deltas of numerous large rivers, which would prove such formidable obstacles to a railway, would only serve as links in the chain of canal navigation. On the other hand, the east and west line from coast to coast, would require very heavy works in locks and aqueducts, embankments and tunnels, and the formation of reservoirs to supply water for lockage, whereas a railway would far more easily accommodate itself to the undulating surface of the country.

27. But little has been done in the Bengal Presidency for the improvement of the river navigation. In 1828, and for several years following, the Sappers and Miners were employed in blasting rocks which impeded the navigation of the Jumna, but I have never seen any returns showing the effect on the amount of traffic of those measures, nor of those more recently adopted by the Lieut. Governor of the North-Western Provinces for the improvement of the Ganges. The labour annually bestowed on the Nuddah rivers has sufficed to keep their channels open for boats of greater or less burden; a return of traffic on these rivers from 1837 to 1853 is appended to this Memorandum, but shows no growth of the traffic.

28. I have seen no details of the works proposed by Colonel Cotton for the improvement of the Godavery navigation, and have no reason to question their suitableness, but I do not attach much value to the suggestions he has offered for the improvement of the Ganges, or for supplying its place by a parallel navigable canal.

29. The proposed weir, or anicut, across the bed of the Ganges, below the head of the Bhaghiruttee river, would be a stupendous work, and in the absence of stone within reasonable distance, from the dearth of fuel, and from the treacherous nature of the soil, would be of almost incalculable cost. An inspection of the map (No. 1) attached to the Report on the Nuddah Rivers (No. 2 of the selections, Bengal Government) will show that the limits of navigation in the course of the river at this particular point have extended to 8 or 10 miles between 1825 and 1847; and if this occurred under the operation of natural causes, it is impossible to say how much further the river might cut into a yielding soil, when checked and exasperated by artificial obstacles; or how far the line of works must be extended to prevent its flanks being turned by so active an enemy.

30. The proposal to extend the Ganges canal from Cawnpore to Allahabad, and thence down the valley to Calcutta, appears to me still less practical. A project for the easiest portion of this line, from Cawnpore to Allahabad, was drawn out by Colonel Cautley, at Lord Ellenborough's desire, and was rejected by the Government, as inexpedient. The remaining length, following either bank of the Ganges, and on either, crossing numerous tributaries (not navigable in the dry weather, but subject to formidable floods in the rains), would be a work beset with difficulties insuperable at any advisable cost.

31. His third suggestion, being one of a more general nature, whose application is not proposed to be confined to the Ganges, is, as such, worthy of the fullest consideration, though it does not, to my mind, promise success in this particular case. Colonel Cotton proposes to increase the depth of the Ganges during the dry months by the regulated discharge of water stored up in reservoirs, to be formed in and near the Hills, and to be filled annually by the periodical rains. The extension of this well-known expedient for storing water to so large a purpose as that of supplying the deficiencies of navigable rivers, has been suggested by Mr. Ellett, an American engineer, in reference to the improvement of the Ohio and other tributaries of the Mississippi, and by Colonel Cotton himself (p. 96), in reference to the navigation of the Severn, but I am not aware that the plan has ever been put to a practical test.

32. There are some obvious objections to this project, for instance, the uncertainty attending the probable cost of carrying it out; the difficulty of finding space for the artificial lakes without drowning fertile land; the danger of breaches in the high dams, causing destructive inundations; and the slow, but sure process of silting, which must in time render such reservoirs useless. None of those, however, need be considered insuperable, and I am so impressed with the advantage in this country of storing water, and with the certainty that some useful application will always be found for the water so stored, that I would earnestly recommend the encouragement by Government of all investigations having this object in view.

33. The great drain on the resources of the Jumna (and henceforth on those of the Ganges) to feed the irrigation canals of the North-Western Provinces, confers additional interest and importance on any promising scheme of compensation.

34. It may, I think, be assumed with confidence that under certain circumstances, advantage will immediately be taken by the people of any new line of canal navigation that may be opened up to them. Such will surely be the case in the neighbourhood of any river or lake already much frequented by native boats. I may instance the remarkable success of the Calcutta canals, and that when I was employed in Sindh in 1843, I noticed that the inundation canals of the Indus, though dry for six to eight months in the year, were no sooner filled by the overflow of the river than they were thronged with boats conveying to marts on the river bank the agricultural produce, which had apparently been reserved in store for such opportunity.

35. For these reasons I should anticipate that the proposed system of coast canals in the Madras presidency, if carried out, would come into immediate and full use.

36. The navigable capabilities of rivers, especially when more or less imperfect, are not always taken advantage of by the natives, and in localities where boat navigation has hitherto been little known, it would, I believe, be very slow in coming into operation on a canal. The Jumna above Agra, and the Ganges above Ghurmookteesir, are very little used, though they might easily be navigated, by boats of light draught, to the foot of the Hills. The Jumna canals have not been used for the transport of goods, excepting rafts of timber, though on the Western Jumna canal, cargo boats were provided at the expense of government and offered to traders, gratis at first, for the sake of encouragement. One East Indian accepted the offer, and made two or three voyages between Jagadree and Delhi, but had not energy to carry it on, and the experiment was never repeated. Subsequently, when irrigation became fully established, the fluctuation in the level, and the frequent failure of water at the extremity of the canal, would have been quite incompatible with steady navigation.

37. Judging from past experience, I expect that many years will elapse before full use is made of the Ganges canal navigation; nor could I hope that the proposed im-

provement of the Godavery would be attended immediately with the important results anticipated by Colonel Cotton. He mentions in his book (p. 72), that "not a ton of anything but timber is carried by the Godavery, though it is now navigable for at least six months in the year;" and afterwards (p. 96), he states the navigable period at eight months; he attributes this circumstance to "want of enterprize in the natives, and the interference of petty Zemindars on its (the Godavery's) banks." The interferences may be overruled, but I doubt whether the removal of obstructions to navigation during the remaining four months, would obviate the other causes, whatever they may be, of the past and present disuse of the Godavery as a commercial road.

38. The motive power applicable to canals and navigable rivers may be derived from steam, from cattle draught, or from the labours of men in rowing and tracking. Each of these may be aided, and sometimes retarded, by winds and currents. Steam is not applicable in channels of small capacity. Cattle draught requires continuous and firm towing paths, and could not be advantageously used on short lengths of canal, connecting wide rivers or lagoons, such as are (I suppose) called "backwaters" at Madras. The labour of men is resorted to in rivers with irrigation banks; it is more expensive than animal power, but more easily accommodated to varying circumstances.

39. I am not sanguine that inland steam navigation will ever attain in India to the perfection of speed or cheapness of working anticipated by Colonel Cotton. It is no longer in its infancy. The inland steam department of government has had the experience of more than twenty years, during which there has been no bar to the adoption of improvements, but rather the stimulus of competition by private companies, one of which attempting a nearer approach to the American model, has been far less successful than the other. None of these have ever approached the average speed even of sea-going steamers, except when they have had a strong current in their favour, nor have they been able to carry freight at a price that would compete with a railway. To obtain American results we must have rivers of American depth and capacity, and free from the silt which clogs and dissipates in numerous shallow channels the waters of our Bengal rivers.

40. I believe that in such rivers as we have, steam boats will be more usefully employed as tugs, drawing one or more flats after them, than in any other way. And in canals also, a small screw steamer, making two or three miles an hour, with a train of boats, would probably answer well, and would not create a ripple injurious to the banks. I have no data to estimate the cost of traction by this method, but I believe it would be low.

41. The cost of cattle draught at the natural pace of the animal, on a canal with good towing paths, is theoretically one-thirtieth of that on a good metalled road, which I have stated above to be in this country rather more than one anna per ton per mile, so that the minimum cost for traction would be less than half a pie, an immense advantage, which could not but tell upon all descriptions of traffic in which time is not of prominent importance. The cost of river navigation, when the progress is dependent on the exertion of the boat's crew, and on the use which they can make of wind and tide, can only be calculated on the average of actual results, and of these I have entered on the annexed traffic table all (of authenticity) which I have been able to collect. I would take three pie per ton per mile as a fair average, but some indefinite addition must be made for delay and considerable risk.

42. I infer that inland water communication might frequently be found preferable to a low-speed railway, even if the cost of construction were equal, but that it would not answer the important purposes of an ordinary railway, though it might, and in the case of the Ganges valley, probably will, compete with it for heavy goods traffic.

43. In conclusion, I would beg to state my opinion, that no prospect of future better communications should be allowed to interfere with the present construction of good cart roads, since they will be required for many years, and since even the most perfect system of canals or of trunk and branch railways will not eventually supersede their necessity. I believe that the effect of railways will be in India as it has been in England, to increase rather than diminish the aggregate amount of traffic on common roads.

44. I would briefly enumerate the conclusions at which I have arrived in the preceding paragraphs—

1. That an imperial system of trunk lines of railway, such as has been lately sanctioned, is essentially necessary to meet the military, political, and social requirements of India.

2. That the greater expenditure on high-speed railways is chiefly for objects that conduce to economical working.

3. That the ordinary traffic of high-speed railways should be worked at that velocity which will secure the most economical results.

4. That a heavy traffic can be worked more cheaply on a substantial railway than on an inferior one.

5. That a low-speed railway should be calculated for animal draught, though made fit to be used on emergency by light locomotive engines.

6. That the gauge of all low-speed railways should be fixed at 5 feet 6 inches.

7. That such railways are applicable only as branches to trunk lines and in localities where the traffic is light.

8. That celerity of construction, being dependent on the supply of iron, may be four times greater for an inferior railway than for a superior one.

9. That the system of coast canals proposed for the Madras Presidency appears to promise very beneficial results.

10. That canals in localities suited for their construction are preferable to low-speed railways.

11. That great speed in canal and river navigation is not likely to be attained in India.

12. That the improvement of rivers and formation of canals, will not lead immediately to extensive boat navigation in localities where it was before unknown.

13. That the most perfect system of canals or railways will not supersede the necessity for good cart roads.

(Signed) W. E. BAKER, Major,
Consulting Engineer to Government.

C. Allen, Esq.,
Sec. to Government of India.
7th July, 1854.

P.S.—Since closing this memorandum I have received from Captain R. Baird Smith, the following particulars regarding the temporary railway used in the construction of the Solani aqueduct, on the Ganges canal.

"1. The English bridge rails used on our railways weigh from 26 to 27lbs. per linear yard."

"The common flat bar iron used on our railways has varied very much in size, but may be averaged at $2\frac{1}{2}\times\frac{5}{8}$ths and in weight 15.9lbs. per linear yard."

"2. The accounts for the railway have not been kept separately as regards English rails and rails of flat bar iron, but previously to the advent of the English rail, the flat bar iron railroads, formed by us, cost as follows:—

| | | | | |
|---|---|---|---|---|
| "Single roads ......... | 8,809 | 9 | 4 | per mile. |
| "Double do ........... | 18,867 | 12 | 5 | " |

"Since the arrival of the English rails, and on the 31st October, 1853, I find that our roads consist of about three-eights English rail, five-eighths flat bar, and that the average rate on the whole was for double roads, C. Rs. 23,184 11 4 per mile."

"3. It should be borne in mind that our railroads have not to bear the expense of the embankments on which they are raised, and that they are not always ballasted."

"4. Haulage."

| | | |
|---|---|---|
| "By horses, Company's rupees ... | 0.032 | per ton per mile. |
| "By men " ... | 0.041 | " |

"These are simply the rates of merely drawing the waggons by horses, or propelling them by men, and include nothing for maintenance of waggons in proper order."

"5. Our waggons contain 50 cub. ft. of earth, or 33 cwt."

"One horse draws two loaded waggons easily at the rate of 2.85 miles per hour."

"Three men propel one loaded waggon at a speed somewhat less than that of horses."

The cost of construction detailed in paragraph 2, is stated to refer merely to the provision and laying of permanent way materials, including *some* ballast. With the addition of the other items provided in my estimate (paragraph 10), it will stand as follows:—

| | | C. Rs. |
|---|---|---|
| Half of Ganges canal last cost of double way …… | | 11,592 |
| Additional items from my estimate (par. 10) | 7,714 | |
| Less half cost of ballast …………………… | 990 | —6,724 |
| Total ……… | | 18,316 |
| Brought forward ………… …. ………. | | 18,316 |
| Add 10 per cent. for sidings ……… | | 1,831 |
| Grand total …………… | | 20,147 |

which nearly corresponds with my estimate.

The cost of haulage by horses is three times that which I had estimated for animal draught on a second class railway. This is probably owing to my calculation having been based on the results of bullock draught, and tends to prove that on railways worked with animal power, either a more expensive animal must be employed, or the speed must be reduced to that of a bullock. The adoption of either alternative would tell in favour of steam versus animal power.

(Signed) W. E. BAKER, Major,
Consulting Engineer to Government.

10th July, 1854.

## RATES OF LAND AND WATER CARRIAGE.

| LOCALITY. | Nature of Goods. | PARTICULARS AND DETAILS. | Rate per Ton per Mile. As. | Pies. | AUTHORITIES. |
|---|---|---|---|---|---|
| | | **ROADS.** | | | |
| Sova Mookee to Calcutta …… | Sugar. | By cart ………………………… | 1 | $10\frac{1}{2}$ | J. Erskine, quoted by Mr. Stephenson. |
| Mirzapore to Calcutta ……… | Cotton. | By cart on Trunk Road……………… | 1 | 0 | Major W. E. Baker, from inquiry on the spot. |
| Do. to Jaunpore ……… | Do. | Do. District Roads…………… | 2 | 0 | |
| Wallaja Muggur to Madras … | General. | Do. on Common Roads…… .. | 1 | 10 | Major T. Pears, C.B., Railway Reports. |
| Palamaniar to Madras ……… | Sugar. | Do. do. (part of the road very bad) | 2 | 0 | |
| Various places in Madras Presidency ……………… | Salt. | Do. (cost of carriage, deduced from comparison of prices.)…… | 0 | 11 | |
| | | | 2 | 1 | |
| Madras Waggon Trunk Road. | General. | By Cart……………………………… | 1 | 6 | P. W. Commission, Madras. |
| Berar to Bombay ……………… | Cotton. | On Pack Bullocks ……………… | 6 | 11 | |
| Baroda to Tankaria…………… | Miscellaneous. | By Cart in dry weather …………… | 2 | 4 | Captain Trench's pamphlet, Baroda and Tankaria Railway. |
| Do. Do. ……… … | Do. | Do. Do. (by another account) …… | 2 | 6 | |
| Jambooseer to Tankaria……… | Cotton. | Do. Do. ……………………………… | 2 | $8\frac{1}{2}$ | |
| Allahabad to Agra …………… | Miscellaneous. | By "Allahabad and Agra Carrying Company's Waggons" … | 1 | 10 | Advertisement in Exchange Gazette. |
| Agra to Allahabad …………… | Do. | Do. Do. Do……………… | 0 | 11 | |
| Allahabad to Cawnpore……… | Do. | By Government bullock train, Pucca road. Guarding and haulage in dry weather …………… | 1 | $0\frac{1}{2}$ | P. M. General N.W. Provinces, 1850. Selections N.W.P. |
| Meerut to Amballa…. ……… | Do. | Do. Do. Kucha road. No charge for cost or wear of carts………… | 3 | $1\frac{1}{2}$ | |
| Calcutta to Mirzapore ……… | Piece Goods. | By Cart along Trunk Road ………… | 3 | 9 | Rustomjee, Esq., quoted by Mr. R. M. Stephenson. |
| | | **RIVERS AND CANALS.** | | | |
| Calcutta to Mirzapore … … | Piece Goods. | By River boat ……………………… | 0 | 7 | Rustomjee, Esq., quoted by Mr. R. M. Stephenson. |
| Mirzapore to Calcutta ……… | Cotton. | Do. ……………………… | 0 | $5\frac{1}{3}$ | |
| Trichinopoly to Tranquebar… | Granite. | Do. ……………… …… | 0 | $7\frac{5}{7}$ | P. W. Commission, Madras. |
| Cochrane Canal ……………… | Firewood. | By Canal Boat……………………… | 0 | 3 | |
| Trichinopoly to Tranquebar… | General. | By River boats……………………… | 0 | 6 | Major Lawford, quoted by Col. Cotton |
| Rajahmundry Channels……… | Do. | In River boats, short trips, 20 and 10 miles……………………… .. | 0 | 3 | Colonel Cotton's Book, page 112. |
| Ghazeepore and Chupra to Calcutta……………… | Sugar and Saltpetre. | Calculated according to distance by the river, insured …………… | 0 | 5 | From invoices furnished by the late Bamboo Matting Lall Seal. |
| Do. Do. ……… | Do. | By counting boats, not insured …… | 0 | $2\frac{1}{4}$ | |
| Monghye to Calcutta ………… | Grain. | Do. do. not insured.. ……………… | 0 | 2 | |
| Erie Canal ……………… | General. | In Boats towed by horses ……… …… | 0 | $7\frac{1}{4}$ | ackay, quoted by Colonel Cotton. |
| St. Lawrence Canal ………… | Do. | In Steam-boats ………… ………… | 0 | 4 | Mitto, Ditto. |
| Scindh ……… ……………… | Miscellaneous. | By Government steamers on the Indus up stream ……… ……… | 0 | $11\frac{1}{2}$ | P. W. Commissioners, Madras. |
| Ditto ……………………… …. | Do. | Do. do. down stream……………… | 0 | 4 | |
| Calcutta to Allahabad …… | Goods exceeding 25 lbs per cubic foot. | By I. G. S. N. Company's steamer, calculated on direct distance, viz., 500 miles …… ……. ……. | 2 | 7 | Advertisements in the Bengal Directory. |
| Allahabad to Calcutta ……… | General. | Do. Do. Do……………… | 0 | 8 | |
| Do. Do. ……… | Cotton half screened. | By G. S. N. steamer, do. do. ……… | 0 | 8 | |
| | | **RAILWAYS.** | | | |
| German States……………… | Not classed. | By Railway ………………………… | 4 | 7 | Lardner's Railway Economy, page 488. |
| Ditto ……………………… | 1st class. | Ditto ……………………………… | 2 | $3\frac{3}{4}$ | |
| | 2nd class. | Ditto ……………………………… | 1 | $8\frac{1}{2}$ | |
| | 3rd class. | Ditto ……………………………… . | 1 | 7 | |
| France ………………………… | Average. | Ditto ……………………………… | 1 | 0 | Ditto, page 451. |
| Belgium ……………………… | Do. | Ditto ……………………………… | 1 | 4 | Ditto, page 425. |
| Moscow to St. Petersburgh | Grain and Flour. | By the Government Railway … …. | 0 | 6 | A memorandum in my note book; authority omitted. |
| | Flax and Hemp. | Ditto, Ditto ……………… | 0 | 8 | |
| | Other Articles. | Ditto, Ditto ……………… | 1 | 4 | |
| New England and New York. | General. | Average of Goods carried by 23 principal Railways in 1847 …… | 1 | $2\frac{1}{2}$ | By Economy, page 407. |
| East Indian Railway ……… | 1st class. | Rates provisionally sanctioned by government ……………………… | 0 | 9 | |
| | 2nd class. | | 1 | 6 | |
| | 3rd class. | | 2 | 0 | |

*ABSTRACT of the Annual Amount of Tolls collected on the Nuddah Rivers, from 1st May, 1837, to 30th April 1854, being a period of Seventeen Years.*

| Years. | Amount of Tolls collected. | REMARKS. |
|---|---|---|
| | Rs. a. p. | |
| 1837-38 | 206,064 1 0 | A reduction of 25 per cent. on the rate of toll leviable on the Bhaghiruttee was made in 1837. |
| 1838-39 | 184,333 11 9 | River channels closed early in the dry season. |
| 1839-40 | 193,345 7 7 | |
| 1840-41 | 222,959 1 11 | The state of the river was very favourable. |
| 1841-42 | 229,506 7 7 | |
| 1842-43 | 246,994 6 11 | |
| 1843-44 | 233,069 13 0 | The reduction of rate made on the Bhaghiruttee in 1837, was extended to the Jelinghee and Matahangha in August, 1843. |
| 1844-45 | 216,634 0 6 | |
| 1845-46 | 222,186 6 0 | |
| 1846-47 | 208,640 10 3 | In 1846-47, the channels were much obstructed. |
| 1847-48 | 238,728 13 9 | In 1847-48, the state of the rivers were very favourable. |
| 1848-49 | 201,322 12 9 | In 1848 49, all three rivers were easily closed to navigation. |
| 1849-50 | 218,822 0 3 | In 1849-50, the Bhaghiruttee was most favourable for navigation. |
| 1850-51 | 210,850 1 9 | In 1850-51, the state of the Jelinghee was very favourable. |
| 1851-52 | 228,062 12 9 | In 1851-52, the Jelinghee continued favourable. |
| 1852-53 | 201,510 1 7 | In 1852-53, all three rivers closed early in January. |
| 1853-54 | 203,934 15 4 | In 1853-54, the Matahangha alone continued open for boats of small draught throughout the year. |

(Signed) J. LANG, Major,
Superintendent Navigation Rivers.

Calcutta, 10th July, 1854.

## Home Correspondence.

### THE WORKING CLASSES AND MECHANICS' INSTITUTIONS.

Sir,—It is a well-known fact, and one greatly to be deplored, that the class of persons for whom Mechanics' Institutions were first established, do not avail themselves of the facilities such Institutions afford of improving the taste, cultivating the mind, and of imparting a knowledge of those principles of science which should regulate the craftsman in his handiwork. A workman, in the absence of such information, labours mechanically only; his labour is a drudgery to him, for the simple reason that he performs it in ignorance. As it is admitted on all hands that the failure of Mechanics' Institutions of reaching the working classes is a fact to be deplored, it will only be my present effort to make a few remarks upon the probable causes of this failure, and to endeavour to point out what appears to me the best means of enlisting their sympathies.

In this I cannot hope to be a together successful, yet I shall be excused venturing to bring the subject under public notice if it only be the means of drawing the attention of those far more able than I am to discuss so important a question.

When Mechanics' Institutions were first established, it was thought by their promoters that the advantages held out would be acceptable to few except workmen, or those in a similar position. They were mistaken. Workmen *did then* join the newly-formed institutions in large numbers, but "classes not contemplated in the original scheme, and supposed to be removed by their circumstances from the need of such means of instruction, in still greater numbers availed themselves of them."* Time has proved that whilst the latter class of persons continue in their support of, and advantage from, these Institutions, the latter has gradually diminished in number. The question then is, *Why is this?* An answer to the question (transmitted to your Journal) from those interested in the subject, and who have had the opportunity of personal observation in different parts of the country, might lead to most useful results.

* See *Manual for Mechanics' Institutions*, chap. 3, published by the Society for the Diffusion of Useful Knowledge. London, 1839.

My impression is, that when a working man leaves his labour, he is either too tired to make any change in his dress, and, therefore, thinks himself unfit to frequent a reading-room made use of by persons in a different position to his own, or that, not being sufficiently educated to read *comfortably*, he finds it altogether irksome. To remedy these objections, the management of an Institution should consist of men who would show themselves friendly to the working classes by *mixing amongst them*, and striving to show that the mere *dress* of a working man is no disgrace to him, but that, on the contrary, *discreet conduct alone* is sufficient to make his presence agreeable to those who may be placed higher in the social scale. Then, with respect to those who read with difficulty, I might suggest the establishment of weekly lectures on the events and topics of the week. News is acceptable alike to the educated and the uneducated, and the latter might thus be judiciously led to feel a desire to read for themselves. A class for the study of reading would, in all probability, follow in due course, and the first step in the progress of education would then be pointed out to many a thirsty mind.

Trusting these few hurried lines may not be barren of good,

I remain, sir, faithfully yours,
SAMUEL LEE RYMER.

Croydon, 25th June, 1855.

## Proceedings of Institutions.

Portsea.—On the evening of the 13th inst., Mr. J. Spence, one of the vice-presidents, gave a "Reading from Burns's Works," at the Watt Institute. In reply to a vote of thanks, the lecturer stated that the best way of thanking him was by the members coming forward and giving a reading from some celebrated author every month.

Royston.—On Tuesday, 26th June, Dr. Trevethan Spicer (of London) delivered a very interesting lecture, at the Mechanics' Institute, on "The Curiosities of English History." Dr. Spicer took a very comprehensive and entertaining view of the subject—tradition—the various nations that have peopled our island—the English constitution—commerce—the law of evidence; these topics were all ably descanted on. He also instructively

reconsidered several historical characters, and concluded with a sketch of the past, present, and future of England. The lecture, which was delivered for the benefit of the Institute Building Fund, was listened to with deep attention throughout; and, at the conclusion, a vote of thanks to Dr. Spicer for his liberality was carried unanimously.

## MEETINGS FOR THE ENSUING WEEK.

MON. Society of Arts, 11. Conference of Representatives of Institutions in Union.
Royal Inst. 2. General Monthly Meeting.
Entomological, 8.
TUES. Society of Arts, 4½. One Hundred and First Anniversary Dinner at the Crystal Palace.
WED. Society of Arts, 7. Election of Officers.
SAT. Asiatic, 2.
Actuaries, 3. Anniversary.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

Par. No.

*Delivered on 14th June*, 1855.
291. Army, Commissariat, and Ordnance—Accounts.
295. Customs Duties (Colonies)—Return.
Eastern Papers (Negotiation at Vienna)—Part 14.
*Delivered on 15th June*, 1855.
284. Real Property, &c., Commissions—Return.
302. Schools (Scotland)—Return.
304. Sea of Azoff, &c.—Copies of certain Correspondence.
307. Army Civil Departments—Copy of an Order in Council.
168. Bill—South Shields Parochial Districts.
*Delivered on 16th and 18th June*, 1855.
273. Newfoundland—Copies of Correspondence.
312. Metropolis Roads—Return.
305. Wines and Spirits—Account.
306. Wines—Return.
170. Bill—Court of Exchequer (Ireland).
Public Records—16th Report of the Deputy Keeper.
*Delivered on 19th June*, 1855.
299. Copper, &c.—Account.
300. East India—Home Accounts.
311. Court of Chancery—Returns.
313. Oyster Fishery—Copies of Letters.
316. Education Grants (Scotland)—Return.
171. Bills—Roman Catholic Charities.
172. Bills—Cambridge University.
*Delivered on 20th of June*, 1855.
303. Canadia (Transport)—Copy of Report.
309. Foreign Shipping—Account.
315. Guano—Copy of Consular Despatches.
Poor Laws (Ireland)—8th Report of the Commissioners.
324. War with Russia (Loss of Officers and Men at Hango)—Copies of Letters.
Charitable Donations and Bequests (Ireland)—10th Report of the Commissioners.
Bleaching Works—Report of the Commisssoners.
Criminal Offenders (Scotland)—Tables.
*Delivered on 21st June*, 1855.
327. Assay Offices (York, &c.)—Return.
328. Liverpool Docks Bill, and Birkenhead and Liverpool Docks Bill—Special Report from the Committee.
318. Army before Sebastopol—5th Report from the Committee.
240. Lunacy—9th Report of the Commissioners.
173. Bills—Absconding Debtors (Ireland) (Amended).
174. Bills—Union Charges Act Continuance.
175. Bills—Rating of Mines (No. 2).
176. Bills—Youthful Offenders (No. 2).
177. Bills—Christ Church (Todmorden) Marriages Validity.
178. Bills—Administration of Oaths Abroad.
179. Bills—County Palatine of Lancaster Trials.
*Delivered on 22nd June*, 1855.
169. Bills—Coal Mines Inspection (Amended).
180. Bills—Justices of the Peace Qualification (Amended).
181. Bills—Woollen, &c., Manufactures (Scotland).
183. Bills—Ecclesiastical Courts (as amended by the Lords).
184. Bills—Huddersfield Burial Ground Act Amendment.
185. Bills—Ramsgate Harbour.
*Delivered on 23rd and 25th of June*, 1855.
321. Education—Return.
326. Vessels and Tonnage, &c.—Return.
330. Militia—Return.
331. Loan—Copy of the Contract.
335. Birkenhead and Liverpool Docks Bill—Copy of Communication from the Board of Trade.
323. Letters Patent—Patents for Inventions—Return.
272. East India Railways—Return (a Corrected Copy).
187. Bills—Haileybury College.
188. Bills—Merchant Shipping Act Amendment.
191. Bills—Indemnity.
193. Bills—Stock in Trade.
The River Tyne—Report of the Commissioners.
*Delivered on 26th June*, 1855.
329. Poor Law (Strath)—Copies of Communications.
338. Kneller Hall—Copy of Minute.
189. Bills—Metropolitan Buildings (as Amended by the Select Committee).
192. Army Prize Money.
British Fisheries—Report by the Commissioners.
*Delivered on 27th June*, 1855.
339. Stage Carriage Duties—List of Memorials.
182. Bills—Dublin Carriage Acts Amendment.
190. Bills—Piers and Harbours (Scotland).
197. Bills—Infants' Marriage (as Amended by the Lords).
Public General Acts—Cap. 27, 28, 29, 30, 31, 32, and 33. (Delivered 23rd June)

## PATENT LAW AMENDMENT ACT, 1852.

### APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, June 15th*, 1855.]

*Dated 27th April*, 1855.
962. E. Muller, and J. and X. Gilardoni, Paris—Hooked tile.
*Dated 23rd May*, 1855.
1158. L. Ochs, St. Josse ten Noode, near Brussels—Paper from leather. (A communication.)
*Dated 28th May*, 1855.
1212. Captain E. G. Swinton, Warrash House, near Titchfield—Grinding corn.
*Dated 4th June*, 1855.
1269. G. H. Ingall, Bartholomew-lane, Railway couplings.
1271. W. H. Graveley, 40, Upper East Smithfield—Cooking apparatus.
1273. E. Morewood and G. Rogers, Enfield—Coating sheets of wrought iron.
1275. W. E. Newton, 66, Chancery lane—Ships' augur. (A communication.)
*Dated 4th June*, 1855.
177. J. Gedge, 4, Wellington-street south, Strand—Currycombs. (A communication.)
1279. J. Gedge, 4, Wellington-street south, Strand—Distribution of motive power. (A communication.)
1281. T. Barrows, Massachusetts—Treatment of wool.
1283. T. Barrows, Massachusetts—Treatment of wool.
1285. J. Tenwick, 24, Orchard-hill, Lewisham-road—Water gauges.
*Dated 6th June*, 1855.
7291. P. Lolmède, Saux, France—Instrument for administration of medicinal substances.
1293. H. Leech, J. Robinson, and R. Burrows, Preston—Spinning machinery.
1295. H. Nunn, Mabledon-row, New-road—Invalid carriages.
1297. W. Baines, Hunter's-lane, near Birmingham—Railways.
*Dated 7th June*, 1855.
1299. J. Ramsbottom, Longsight, near Manchester—Safety valves and feeding apparatus.
1301. M. Heap, Blackburn—Grinding dye-woods or roots.
1303. A. Orange, Edinburgh—Representations of articles for sale.
1395. D. Fehrman, Liverpool—Lamps. (A communication)
1307. R. A. Tucker, Lenton, Using gas and smoke arising during combustion.
*Dated 8th June*, 1855.
1309, R. Caunce, Bolton-le-Moors—Sizing, dressing, and warping yarn.
1310. P. A. le Compte de Fontaine Moreau, 4, South-street, Finsbury—Iron shovels. (A communication.)
1311. F. Weaver, Handsworth—Grinding bones.
1312. I. Lippmann, Paris—Leather.
1313. G. F. Chantrell, Liverpool—Charcoal.
*Dated 9th June*, 1855.
1314. H. Sibille, Paris—Decorticat on and preserving of grain.
1315. J. S., E. J., and J. H. Nettlefold, Holborn—Locks. (A communication.)
1316. E. J. Lafond, and Count de Chatauvillard, Bellville, Paris—Lighting.
1317. H. Teague, Lincoln—Meters.
1319. T. Bright, Carmarthen—Prevention of waste in water or other fluid supplies.
1320. M. J. Cooke, Newcastle—Preserving food.
1321. J. Robinson, Poplar—Tables.
1322. J. Greenwood, Irwell Springs, Bacup—Purifying oils.
1323. S. Colt, Pall-mall—Firearms.
1324. S. Colt, Pall-mall, and W. T. Eley, Broad-street, Golden-square—Cartridges.
*Dated 11th June*, 1855.
1325. W. K. Hall, Mark-lane—Railway breaks.
1326. H. B. Barlow, Manchester—Cotton machinery. (A communication.)
1327. F. C. Bakewell, 6, Haverstock-terrace, Hampstead—Bench planes. (A communication)
1328. J. D. Kind, Birmingham—Lock spindles and handles.
1329. J. L. Casartelli, Manchester—Pressure and vacuum guages.
1330. E. V. Gardner, 24, Norfolk-street, Middlesex-hospital, and J. H. Walker, Cole-street, Dover—Separating vegetable substances from fabrics containing wool, and preparing wool for re-manufacture.
1331. W. Barrington, Limerick, and W. R. Le Fann, Dublin—Joining bridge rails.

1332. F. T. S. Bards, Royal Exchange—Card cases.
1333. J. H. Johnson, 47, Lincoln's-inn-fields—Metallic pens. (A communication.
1334. J. H. Johnson, 47, Lincoln's-inn-fields—Governors. (A communication.)
1335. I. Lippmann, Paris—Dyeing skins.

*Dated 12th June, 1855.*

1336. I. J. Liebisch, London—Rails for railways.
1337. W. Armitage, Manchester—Union bags and sail-cloth.
1338. N. Hackney, Hull—Earthenware, china, and porcelain.
1339. S. Coulson, Sheffield—Sulphate of baryta.
1340. W. B. Johnson, Manchester—Steam boilers and safety valves.
1341. T. Metcalfe, High-street, Camden-town—Collapsible hats and bonnets.
1342. C. Parker, Dundee—Weaving.
1343. H. W Ford, Gloucester—Agricultural machinery.
1344. J. C. Brant, 8, Surrey square, Old Kent-road—Permanent way.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed June 15th, 1855.*

2660. Charles Frederick Stansbury, 17, Cornhill—Improved life-car or buoy. (A communication.)
2664. Edwin Whele, Birmingham—Improvements in oil and other lamps.
2680. R. B. Huygens, Holland—Improvements in ordnance and firearms, and in the projectiles to be used therewith.
2681. John Paul, Manchester—Improvements in machinery or apparatus for colouring or staining the surfaces of paper, leather, woven fabrics, and similar materials.
2693. William Greener, Birmingham—Improvements in repeating military rifles, carbines, and pistols, and in cartridges to be used therewith.
30. Louis Dominique Girard, Paris—Improvements in applying steam fluids and gases for the purpose of obtaining motive power, parts of which are applicable for compressing and rarefying air and gases, and for raising liquids.
46. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improved mode of obtaining alcohol.
95. Gustav Warnecke, Frankfort on-the Maine—Improvements in preserving vegetables and fruits.
96. Joseph Claudot, Paris—Improved stucco.
124. James Webster, Collingham—Improvements in the application of motive power.
248. Benjamin Goodfellow, Hyde, Chester—Improvements in ordnance.
384. John Hyde Pidcock, Leighton Buzzard—Improved method of propelling and steering vessels, which is also applicable to the forcing and directing of liquids and fluids.
471. Benjamin Dickinson and John Platts, Clough House Mill, near Huddersfield—Improvements in machinery or apparatus used in finishing woollen and other textile fabrics.
679. Archibald Turner, Leicester—Improvements in the manufacture of elastic fabrics.
749. Frederick Joyce, Upper Thames-street—Improvements in the manufacture of percussion caps and other primers.
769. William Bennett Hays, 47, Cambridge-street, Pimlico—Improved breakwater.
888. Alfred Vincent Newton, 66, Chancery-lane—Improved machinery for manufacturing bolts and other like articles.

*Sealed June 19th, 1855.*

2710. Felix Marie Baudouin, Paris—Improved means of isolating, and testing the isolation of, the wires of electric telegraphs.
2735. Margaret Williams, Chelsea—Improvements in suspending swing looking or dressing glasses.
113. James Simkin, Bolton-le-Moors—Improvements in rifles and other fire-arms.
603. Thomas George Shaw, Old Broad-street—Improvements in apparatus to facilitate the "tilting" of casks, barrels, or other similar vessels of capacity.
637. William Mac Naught, Rochdale—Improvements in machinery or apparatus for spinning cotton and other fibrous substances.

*Sealed June 22nd, 1855.*

2705. Frederic Prince, Haverstock-hill—Improvements in the nipples of firearms.
2706. Edward Loysel, Rue de Grétry, Paris—Improved apparatus for cooking or preparing edible substances.
2722. Benjamin Bishop and Joseph Dyer, Birmingham—Improvements in the manufacture of hinges.
2752. James Pillans, 40, Brompton-crescent—Improvements in the preparation of Hematosin and fibrinous and serous matters.
2758. Francis Preston, Manchester—Improvements in bayonets, and in the machinery for manufacturing the same.
2760. Robert Sam North, Gorton, near Manchester—Improvements in switches and crossings for railways.
2764. Samuel Smith Shipley, Stoke Newington—Improvements in fittings suitable for dressing cases, and for other purposes of elegance and utility.
6. Bashley Britten, Anerley—A cheap and convenient method and apparatus for obtaining a copy of writings, drawings, or tracings in ink.
17. Samuel Aspinwall Goddard, Birmingham—Improved firearm, a portion of which is applicable to ordnance.
20. Charles Hustwick and William Bean, Kingston-upon-Hull—Improvements in buffers and springs for railway carriages and other purposes.
31. Robert Ashworth, and Samuel Stott, Rochdale—Improvements in machinery for preparing, spinning, and doubling fibrous substances.
40. George Hallen Cottam and Henry Richard Cottam, St. Pancras Iron Works, Old St. Pancras-road—Improvement in the manufacture of iron bedsteads.
42. William Grindley Craig, Gorton, near Manchester—Improvements in railway buffer cases and rams.
58. Ebenezer Bow, Glasgow—Improvements in the manufacture or production of "blackening" for foundry purposes.
84. Ezra Miles, Stoke Hammond, Bucks—Improved coupling joint or connection for tubing or other purposes.
87. Francis Preston, Manchester—Improvements in ordnance, and in projectiles for ordnance and small arms.
88. William Barningham, Salford—Improvements in connecting the rails of railways.
135. William Johnson, 47, Lincoln's-inn-fields—Improvements in the application, treatment, cleansing, and dyeing of fibrous substances and products.
316. George Hallen Cottam and Henry Richard Cottam, St. Pancras Iron Works, Old St. Pancras-road—Improvements in the construction of iron buildings.
343. Benjamin Gower, Stratford—Improvements in cannons and pieces of ordnance, and in shot and projectiles for cannons and pieces of ordnance.
464. William Hodges, Stafford—Improvements in boots and shoes.
569. John Kidder, Plaistow—Improvements in the construction of castors.
700. John Blair, Glasgow—Improvements in hats and other coverings for the head.
707. William Crozier, Sunderland—The better extinction of fire.
741. Peter Rothwell Jackson, Salford—Improvements in machinery for making patterns and for moulding therefrom.

*Sealed June 26th, 1855.*

2724. Frederick Samson Thomas, Hook's-villa, Fulham, and William Evans Tilley, 6, Kirby-street, Holborn—Improved process for plating or coating lead, iron, or other metals with tin, nickel, or alumina.
2727. George Carter, 42, Lombard-street, and Henry Cyrus Symons, 52, Castle-street, Southwark—Improvements in boilers and furnaces, and in the apparatus for supplying and regulating the fuel, air, water, and steam.
4. George Cram, and John Jackson Crane, Chester—Improved composition, applicable to the coating of ships' bottoms and other useful purposes.
12. John Keir Harvey and Daniel Pearce, London—A calender inkstand.
13. Félix-Gabriel-Celestin Dehaynin, Paris—Improvements in the purification of hydrogen gas.
14. Hippolyte Fontaine, Marseilles—Improvements in engravers' presses.
21. Alexander Southwood Stocker and Samuel Darling, 11, Poultry—Improvements in the manufacture of bottles, pots, jars, tubes, and other receptacles, part of which improvements are applicable to various other purposes for commercial and domestic use.
43. John Huggins, Birmingham—Improved machine for the manufacture of lint.
65. William Coles Fuller, Bucklersbury—Improvements in the construction and adaptation of india rubber springs.
72. Alexander Robertson, Upper Holloway—A new manufacture of packages for dry goods.
90. Richard Archibald Brooman, 166, Fleet-street—Certain means of de-vulcanizing india rubber and other similar gums, or of treating such gums after having been vulcanized.
401. William John Macquorn Rankine, and John Thomson, 59, Saint Vincent-street, Glasgow—Improvements in machinery for laying subaqueous electrical conductors for telegraphic communication.
735. George William Friend, 22, High Holborn—Improvements in umbrellas and parasols.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3731 | June 22. | A Mourning Hat | Wm. Mountcastle & Son | Manchester. |
| 3732 | " | Improved Valve Plug for the bottom of Ships' Boats and Boats in general | Captain John Olive | Liverpool. |
| 3733 | " 26. | The Luffer Chimney Top | John Martyn Fisher | Taunton. |

Journal of the Society of Arts.

*FRIDAY, JULY* 6, 1855.

## FOURTH ANNUAL CONFERENCE.

The Fourth Annual Conference between the Representatives of the Institutions in Union and the Council of the Society, was held on Monday, the 2nd instant, at the Society's House in the Adelphi. Viscount Ebrington, M.P., Chairman of Council, presided. The following members of Council were also present:—Rev. Dr. Booth, F.R.S., Mr. J. C. Macdonald, Mr. S. Redgrave, Mr. W. W. Saunders, F.R.S., and Mr. G. F. Wilson, F.R.S.

The following is a List of the Institutions represented at the Conference, and of the names of the respective Representatives:—

| | |
|---|---|
| Andover, Hants and Wilts Educational Society. | Hon and Rev. Samuel Best. |
| Ashford, Mechanics' Institute | Mr. Henry Whitfeld. |
| Battersea, Branch of Belmont (Vauxhall) Mutual Improvement Society | Mr. J. G. Picking. |
| Battle, Mechanics' Institution | Mr. H. Martin. |
| Bedford, Literary and Scientific Institution | Mr. John Usher. |
| Bexley Heath, Society for the Promotion of Useful Knowledge | Mr. Flaxman Spurrell. |
| Birmingham, Polytechnic Institution | Mr. W. H. M. Blews. |
| Bolton, Mechanics' Institution | Mr. T. Barnes, M.P. |
| Boston, Athenæum | Mr. T. Garfit and Mr. J. W. Bontoft. |
| Bramley, (near Leeds) Mechanics' Institute | Mr. T. J. Pearsall. |
| Carlisle, Church of England Religious and General Literary Association | Mr. Alderman Cowen. |
| Chichester, Literary Society and Mechanics' Institution | Mr. H. W. Freeland. |
| Crieff, Mechanics' Institution | Mr. W. Stirling, M.P. |
| Croydon, Literary and Scientific Institution | Mr. Thomas Farley. |
| Devonport, Mechanics' Institute | Mr. U. H. King and Mr. J. C. Radford. |
| Dover, Museum and Philosophical Institution | Rev. William Yate. |
| Guildford, Institute | Mr. E. W. Martin. |
| Hastings, Mechanics' Institution | Mr. John Banks. |
| Horsham, Literary and Scientific Institution | Rev. J. F. Hodgson, M.A. |
| Leeds, Mechanics' Institution and Literary Society | Mr. W. H. J. Traice. |
| ,, Yorkshire Union of Mechanics' Institutes | Mr. William Crowther and Mr. James Hole. |
| London, Clapham Literary and Scientific Institution | Mr. J. C. Buckmaster. |
| ,, Crosby Hall Evening Classes for Young Men | Rev. Charles Mackenzie, A.M. |
| ,, Jews' and General Literary and Scientific Institution | Mr. Morris S. Oppenheim. |
| ,, London and South-Western Literary and Scientific Institution | Mr. F. J. Macaulay. |
| ,, London Mechanics' Institution | Mr. S. Vallentine. |
| London, Pimlico Literary, Scientific, and Mechanics' Institution | Mr. J. M. Hucklebridge. |
| ,, Walworth Literary and Scientific Institution | Mr. J. S. Noldwritt. |
| Lynn, Conversazione and Society of Arts | Mr. Henry Edwards. |
| Middlesborough, Mechanics' Institute | Mr. T. J. Pearsall. |
| Morpeth, Mechanical and Scientific Institution | Mr. Matthew Soulsby. |
| Newcastle-on-Tyne, Northern Union of Literary and Mechanics' Institutes | Mr. Robert Ingham, M.P. |
| Newport (Salop), Mechanics' Institute and Literary Society | Mr. H. Heane. |
| North Devon, Lending Library | Viscount Ebrington, M.P. |
| Portsmouth and Portsea, Literary and Philosophical Society | Rev. H. Hawkes. |
| Reigate, Mechanics' Institution | Mr. T. Martin. |
| Romford, Literary and Mechanics' Institution | Rev. W. Taylor Jones. |
| Royston, Mechanics' Institute | Mr. W. J. Simon. |
| Salisbury, Literary and Scientific Institution | Mr. Walter F. Tiffin. |
| Sevenoaks, Literary and Scientific Institution | Mr. George Franks. |
| Sheffield, People's College | Mr. T. J. Pearsall. |
| Shelton, Pottery Mechanics' Institution | Mr. J. L. Ricardo, M.P. |
| Shotley-bridge, Mechanics' Institution | Mr. T. G. Blakey and Mr. John Nicholson. |
| Stockton-on-Tees, Mechanics' Institute of Literature and Science | Mr. T. J. Pearsall. |
| Wandsworth, Literary and Scientific Institution | Mr. A. Coleman. |
| Ware, Institute | Rev. J. W. Blakesley. |
| Winchester, Mechanics' Institute | Mr. Henry Huggins. |
| Wrexham, Literary Institute | Mr. Willoughby Raimondi. |

The Chairman called upon the Secretary to open the proceedings by reading his Annual Report to the Council.

Mr. Le Neve Foster then read the following Report:—

*To the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce.*

Gentlemen,—In laying before the Council my report of their proceedings in connection with the Union of Institutes, the Educational Exhibition stands first in order of time, having been opened immediately after the holding of the last Conference. This Exhibition, it will be remembered, was held in performance of a pledge given by the Council at an early period of the Union. How that pledge has been redeemed the representatives who attended in London last year had personal opportunity of judging. For the information of the Conference, I cannot do better than quote from the Council's report to the members of the Society:—

"It is unnecessary here to enter into all the details connected with its establishment and its objects; the members are familiar with them, from the chairman's address at the commencement of the Session, and from the reports in the Journal of the lectures and other proceedings

connected with it. The Council, however, would be wanting in their duty were they to pass over without observation that remarkable series of lectures which were delivered at St. Martin's Hall in connection with the Exhibition—a series remarkable not only for the number and varied character of the subjects embraced, but also for the attainments of the individuals by whom they were delivered. During the nine weeks that the Exhibition was open, there were no less than sixty-one lectures given. A list of these will be found in the Appendix to this Report.

"To these gentlemen the thanks of the Society are eminently due. It is to be regretted that no permanent and complete record of these lectures remains, but many were delivered without even written notes. Abstracts of nearly all were, however, published in the Journal; some few were published separately by their authors, and at the request of the Council, the MSS. of others were furnished to Messrs. Routledge, who undertook their publication in a cheap form, and the volume* of the Exhibition Lectures thus published forms an interesting and valuable contribution to our Educational literature.

"Reports on the different departments of the Exhibition were intended to have been made, but difficulties, of a nature unnecessary here to specifiy, prevented this portion of the plan being fully carried out, and only two were obtained, viz., one on the Fine Art Department, for which the Society are indebted to Sir C. L. Eastlake, P.R.A., and Mr. F. S. Cary, and the other, on the Musical Instrument Department, to the Rev. W. W. Cazalet. These were published in the Journal. In the Journal, too, will be found an original and interesting Paper 'On the School System of Norway,' contributed by Councillor Nissen; also an account of 'The New York Free Academy,' furnished by the Board of Education of that city, and Reports on the Exhibition from M. Milne Edwards, specially deputed by the Minister of Instruction in France to visit it, and by Dr. P. A. Siljeström, Commissioner for Sweden. The articles in the Journal, by 'A Member,' reviewing the books exhibited, must have been read with interest, displaying as they did an intimate and practical acquaintance with the subject. They may be taken as a careful, intelligent, and impartial report on that section of the Exhibition. It was early seen how desirable it was that such a collection should be permanent, and the Council lost no time in communicating with her Majesty's Government, urging the importance of forming a National Collection of this nature, and pointing out the facilities which the present opportunity afforded for commencing the work. The Council are happy to state that the Government has announced its determination to establish such a collection as a National Museum of Education, and the Council are anxiously looking for the accomplishment of this most desirable object. The Council have equal pleasure in announcing, that on the faith of such a Permanent Museum being established, a large number of the contributors to the display in St. Martin's Hall have most liberally responded to the request made by the Council, and have placed their contributions at the disposal of the Society as free gifts for the Permanent Museum. The Exhibition excited considerable interest, not only in this country, but among foreign nations. Very large and valuable contributions were received from abroad, and the Exhibition was visited by Commissioners from several Foreign governments and Educational bodies, specially charged with the duty of reporting upon its contents. Although in a pecuniary point of view the Exhibition did not pay its expenses, having, notwithstanding the liberal subscriptions received, involved the Society in a deficit of nearly £400, yet the Council are satisfied that it has not been held in vain, and that it has exerted a powerful and important influence upon, and given a permanent impulse to, the progress of an improved education."

* Lectures, in connection with the Educational Exhibition of the Society of Arts, Manufactures, and Commerce. London: G. Routledge and Co. Price 1s. 6d.

The Literary and Scientific Institutions bill, prepared by the Council, the provisions of which were discussed at the last Conference, has since passed into a law, and Mechanics' Institutes and Literary Societies hold now, for the first time, a recognized legal position. It is hoped that the effect of this law will be to give permanency to Institutions of this character, without which they could scarcely expect to become thoroughly efficient for the purposes for which they have been established. Already, in several instances, the provisions of the Act in relation to sites have been taken advantage of. The question of exemption from local rates is one which naturally follows. It has been discussed at former Conferences, and at the last was specially left in the hands of the Council, to deal with as might seem most desirable to settle the anomalies and difficulties with which the present Exemption Act abounds. I need not remind the Council how frequently this subject has been under their consideration. The result at which the Council have arrived, is, that any attempt, during the present session, to obtain inquiry into the subject would have been fruitless. The legislature has been occupied with other matters of deep and exciting import, which have rendered it hopeless to obtain that attention to the subject which would have enabled the Council to ensure its being satisfactorily dealt with. It must be borne in mind that the question is by no means simple; whenever it comes to be discussed the general principle of exemptions will be put upon its trial. An attempt to patch up the present system, it is believed, would meet with little favour from any party in Parliament. It is argued by many, admitting it to be the duty of a wise government to promote and assist such Institutions as these, that the system of exemption, which in effect causes the Institution rates to be paid by the occupiers of other property in the parish, is not that which should be adopted for the purpose, inasmuch as the provision can rarely be made effectual for the object intended; and in a very large number of instances the owner of the property, and not the Institution, receives the benefits. It is believed that the whole subject of rating generally is likely, at no very distant period, to come under the consideration of Parliament, and until then it is scarcely probable that an attempt to alter existing regulations would be attended to. The tendency of the Courts in their decisions on the present Act has been to narrow the privilege, and it may be fairly doubted if there be many Institutions in the kingdom, as the law is now interpreted, which are strictly entitled to the exemption. I may add, that it appears to be the opinion of members of Parliament and others, warm friends

of the Institutions, that however unsatisfactory the present state of the law may be, any attempt at the present time, either to obtain inquiry or legislation on this subject, is not likely to result beneficially for the Institutions.

During the year, collections of Photographs, Chromo-lithographs, Nature-prints, and other objects of interest, have been lent to Institutions. It may not be amiss here to remark, that in order to meet the wants and wishes of the Institutions, no less than 300 specimens of Photographs, and 100 Nature-prints, have been collected by the Council. The cost to the Society of framing and repairing these and the lithographs, during the two years that they have been in circulation, has been not less than £170, in addition to the sums spent by the Institutions themselves for the same purpose. During the two years these articles have been lent to upwards of Eighty Institutions, forming, in many instances, the nucleus of general exhibitions, the value and importance of which need not at the present time be dwelt upon. It is gratifying to remark, from the reports which have been sent in, that these Exhibitions have, in many cases, been attended with considerable pecuniary gain to the Institutions.

At the last Conference, the Council brought forward for consideration, a plan for examining the students of classes in Institutes, and granting certificates of competency, which received its unanimous support, and the Council were requested to enlarge the plan, so as to embrace the inhabitants of rural districts as well as those of towns where Mechanics' Institutions are more generally found. This was done, the services of examiners obtained, and the scheme was issued to the Institutions, the month of March being fixed as the time for the first examination. So few individuals, however, were returned by the Institutions as candidates for examination, that the Council thought it better to defer undertaking the duty till the following year, when, from the correspondence which has taken place with the Institutions, there seems every prospect of an increased number of candidates. The time fixed for the first examination did not appear to afford sufficient interval for preparation, and the members of the Institutions were not in a position then to take advantage of the scheme. It may not be inappropriate here to remark, that Her Majesty's Government have given their sanction to the importance of examinations, by the establishment, in the last few weeks, of a system for examining candidates for situations in the Civil Service.

The efforts of the Council during the last two years, assisted by the Royal Commissioners of the Exhibition of 1851, to form a collection of raw and manufactured animal produce as the first step towards the establishment of a "General Trade Museum," must not be passed over in silence. The Museum has not only its commercial value, but as an educational instrument the collection cannot fail to excite the deepest interest in the members of the Institutes. The collection is now temporarily established in the Society's Model Room.

It will be remembered that at the last Conference the Council called attention to the benefit likely to result from the artizans of this country visiting the Paris Exhibition during the present summer, and suggested the formation of local clubs for raising the necessary funds by means of weekly or monthly subscriptions, and called the attention of the Institutions to the assistance they might render to this object in their various localities. The Council undertook to collect and publish information as to railway and steamboat fares, passports, and lodging accommodation in Paris. In the Journal have already appeared the regulations under which passports may be obtained free of all cost to the artizan; and the particulars of arrangements for lodging, boarding in Paris, and for interpreter guides, &c. It was hoped that cheap trips could have been organized from London, but from the correspondence which has taken place with the French railway companies, it appears that they are not prepared to make any reduction in their ordinary fares, though the English companies expressed their willingness to do so. The ordinary fares from London to Paris, whether by steamboat or rail, at present remain the same as hitherto; but within the last few days facilities have been offered to parties from the northern districts, by means of special boats from Hull to Antwerp, the particulars of which will appear in the Journal.

The Council, in October, 1853, entered into arrangements with numerous publishers for the supply of books to the Institutions in Union at various rates of discount, and established a plan enabling the Institutions to take advantage of these discounts. After a trial of 19 months, it was considered the details could be simplified, and much delay got rid of, whilst a somewhat larger pecuniary benefit might be obtained for the Institutions. It was found by experience, that on the average, the actual discount obtained by the Institutions, after allowing for agency, barely exceeded 25 per cent. Accordingly, arrangements have been made for the supply of books at one uniform rate, of 27½ per cent. discount on all books, and 25 per cent. discount on periodicals, except such as are irregular, when the regular trade discount will be allowed. The orders, instead of being collected monthly, will be supplied from day to day, and a single instead of a duplicate list of books is required. This plan has only commenced during the present month. The cost of the books purchased through the Society

during the year was £825 13s., and the saving to the Institutions has been £193 8s. 6d., or about $25\frac{1}{2}$ per cent. discount on the published prices.

The Institutions will be glad to learn that the Society has during the past year succeeded in obtaining the production of good and cheap Microscopes. The importance of such instruments being brought within the means of the many, will be appreciated by the Institutions. On this head, I may again quote from the Council's report :—

"The important position which the Microscope now holds, not only in relation to pure but to applied science, and its great value in assisting to form those habits of observation which it is the object of all sound education to impart, induced the Council to believe that the promoting the production of a good instrument at a price which should render it more readily accessible to the many, was an object worthy of the Society; and, accordingly, under the advice and with the assistance of a Committee, composed of Mr. Busk, F.R.S.; Dr. Carpenter, F.R.S.; Mr. Jackson; Dr. Lankester, F.R.S.; Mr. Quekett; and Mr. W. W. Saunders, F.R.S., the following prizes were offered:—

"For a 'School' Microscope, to be sold to the public at a price not exceeding 10s. 6d.—*The Society's Medal.*

"For a Teacher's or Student's Microscope, to be sold to the public at a price not exceeding £3 3s.—*The Society's Medal.*

The Council undertook to purchase 100 of the smaller, and 50 of the larger instruments for which the medals should be awarded.

"The members will be glad to learn that for these prizes there have been numerous competitors. After a most careful examination of all the instruments by the Committee, they unanimously reported to the Council that the instruments sent in by Messrs. Field and Co., of Birmingham, fulfilled all the conditions required, and the Council, have, therefore, awarded to that firm the medals offered, on Messrs. Field and Co. entering into the necessary undertakings to comply with the requirements of the Prize List. The Council congratulate the members on this result. Those members who are desirous of securing any of these instruments, which will shortly be supplied to the Society by Messrs. Field, at a discount of 10 per cent., should at once send in their names to the Secretary."

At the meeting of the delegates of the Yorkshire Union of Mechanics Institutes, a resolution was passed requesting the Council of the Society, in its next prize list, to offer a prize for books adapted for classes in Mechanics' Institutes.

This suggestion will doubtless be acted upon if the Conference should approve it.

In accordance with the wishes expressed at the last Conference, a list of Lecturers, with their subjects, was prepared on the principle previously adopted, and the opinion of the next Conference should be taken how far it is desired that a similarly prepared list should be compiled and issued this year.

During the past year 36 Institutions have been taken into the Union, which now numbers 368.

Reports have been received from 110 Institutions only. From these it appears that the Institutions generally are in a sound condition and increasing in usefulness. It is pleasing to observe that a very large number of them have classes for instruction, which are reported to be well attended. There are, however, very few to which schools are attached.

I have the honour to be, Gentlemen,
Your obedient servant,
P. LE NEVE FOSTER, *Secretary.*

The Secretary then read the following list of subjects which had been suggested for discussion :—

I. Paris Visits.
II. Museums.
III. Lectures and Lecturers.
IV. Classes :—
1. Diagrams and Apparatus. 2. Class Books. 3. Examinations.
V. Library :—
1. Parliamentary Papers. 2. Catalogue of Books. 3. Books, Periodicals, &c., at reduced rates.
VI. Legal Position of Institutes :—
1. Trustees. 2. Borrowing Powers. 3. Rating.
VII. Public Recreation Grounds.

The Chairman said, although the list of subjects this year was not quite so long as on the last occasion, when a more numerous meeting than the present one was presided over by his excellent friend Mr. Harry Chester, whose absence on this occasion, and from the periodical meetings of the Council, they had so much to deplore, and was only too well accounted for by the severe domestic afflictions he had sustained during the past year—he said, although the list of subjects to be discussed was not so long, yet it was sufficiently long and interesting, and would require so much time for discussion, that it would be necessary for them to adhere to the same rules for the conduct of the discussion as were established at previous meetings, viz., that no gentleman should address the meeting upon one subject for more than five minutes' duration, and that every gentleman on rising should announce his name and the title of the Institution which he represented, and that every resolution and amendment should be handed to the Chair in writing. It would be unpardonable in the Chairman if he set the first example of a breach of the rules which he had laid down; therefore, he thought, after the very full report which had been read by Mr. Foster, it only remained for him to address a very few words to the meeting. As he had been honoured by being again called to the legislature, after a voluntary exclusion from it of more than two years, he would begin with saying a word or two upon those matters now before parliament, in which they, as the representatives of Institutions throughout the country, naturally felt a more immediate interest. Foremost amongst these was the Public Libraries and Museums Bill, introduced by Mr. Ewart, which, he was happy to say, had reached its last stage, and stood for the third reading in the House of Commons that night, and if not then passed would doubtless do so very shortly, and would, he thought, be likely to work very satisfactorily, and produce excellent results in the country. He did not anticipate any serious danger to that bill now, either in the House of Commons or in the House of Lords. While speaking of Museums, he might mention that the motion for opening the British Museum to the public on Sunday was not carried, much to his own individual regret; but there was, no doubt, much to be said on both sides of the question. He could fully confirm the words of the report with regard to the difficulty of getting the question of the exemption of Institutions from rating settled. The whole question of rating, he knew, was intended to be brought before Par-

liament, and a comprehensive measure was being prepared by his hon. friend the President of the Poor Law Board, and would probably be introduced at an early period. He did not think Parliament would deal with the question piecemeal, and as regarded the Institutions themselves, he did not think they would have been benefited had the question been started, even if the attention of Parliament could have been secured for it in the present Session. To quit parliamentary topics—with regard to the Trade Museum, to which this Society attached so much importance, he was happy to say that, in consequence of a communication from the Royal Commissioners for the Exhibition of 1851, a deputation of the Council had very recently attended that Commission, and he had much pleasure in announcing that there was good reason to hope some arrangements might be made in the course of two or three months for exhibiting, as a permanent and continuous Exhibition, in connection probably with the Royal Commission, that Museum of which only a small portion could be displayed down stairs, for want of sufficient space. At any rate, the Society of Arts were most anxious, and no doubt all present were equally anxious, that so interesting and instructive an exhibition should not be put away, but that it should be continued as an accessible exhibition for the benefit of the public. The only other point to which he thought it necessary to call their attention, inasmuch as the question of the visit to the Paris Exhibition had been so fully explained in the report, that it was needless for him to say another word upon it, was the interest which the last Conference very justly manifested in the question of Examination of Students in the Classes of Institutions. They had heard in the report just read that very few candidates had this year offered themselves for examination. Should there be anything like the same backwardness next year, they would have just reason to be disappointed at the results of their labours and efforts; but they had reason to hope for better things from the promises and assurances they had received from many quarters, that students were preparing themselves for examination next year, and had only abstained from coming forward this year in order that they might make a more satisfactory exhibition of their industry and ability next year. He was sorry to say that amongst the different Institutions those in connection with the rural districts had not been the foremost, and, but for the consolation and hope he had received, he should have great cause for disappointment in that respect. He might, perhaps, mention with regard to the class in which he, as a country gentleman, felt the greatest interest—the sons and relations of farmers—a class above the labourer and below the gentleman farmer—he had made an effort in his own county to give them a little stimulus. He had proposed to give a prize to the farmer's son or relative, between 18 and 25 years of age, who exhibited the greatest proficiency in the geography and history of the British empire, in the English language, and in practical mathematics; and he had made it a condition—which, as he offered the prize, he thought he had a perfect right to do—that they should each obtain from the ministers of their respective denominations a certificate of their general proficiency in scriptural knowledge. He had offered a prize of £20 for three successive years, and if that failed in eliciting some efforts on the part of farmers' sons in his own native county of Devonshire, he confessed he should be much disappointed. Looking down at the watch, he found he was setting a bad example, therefore, without detaining them further, he would call upon them to discuss the first question before them—the exceptional question—for they could not hope for it every year, viz., the Visit to the Universal Exhibition at Paris.

At the request of Mr. E. W. MARTIN (Guildford Institute), the Secretary again read the list of subjects for discussion, as given above.

PARIS VISITS.

The CHAIRMAN would be glad to hear from any gentleman present whether any organisation had been commenced, or was intended, in the various localities which they represented for visiting the Paris Exhibition.

Mr. T. J. PEARSALL (Stockton-on-Tees Mechanics' Institute of Literature and Science) said, the Committee of the Institution which he represented had, amongst other matters, communicated their ideas to the Secretary upon the subject now under discussion. From all that he had heard on the subject, they appeared to be quite unaware of the amount of accommodation which the railway and steam-boat companies were willing to afford to excursionists. It had been suggested that parties connected with the great ports of the northern and eastern coasts might send out excursion trips, but he found, from the *Leeds Mercury*, that boats were now plying from Harwich and Hull to Antwerp, and that first-class passengers could go from Leeds or Normanton to Antwerp, out and home, for 30s., and from Hull to Antwerp and back for 15s. That gave every opportunity for good accommodation, and third-class fare from Antwerp to Paris was about 16s. From all that he had heard upon the subject, it appeared to him well that the Society of Arts had not gone too far in promulgating plans for the visits of parties to Paris, and he believed the general feeling was, that it was advisable to defer the visit for the present, as the Exhibition in several departments was yet far from completed. The mechanical department, which would possess great interest to them, he had understood was by no means finished.

The CHAIRMAN said the subject had been under the anxious consideration of the Society's Committee. They had had many communications with railway authorities, but up to the present time they had not met with the response on the other side of the channel which they had hoped for, and which they still did not quite despair of. He agreed with Mr. Pearsall as to their good fortune in having deferred the visit, for he (the Chairman) had heard exactly the same thing, that up to the present time it would have been too soon to see the Exhibition in anything like its perfection. He might promise the gentlemen present, that any information which might be gathered, would be from time to time communicated in the Journal of the Society, for the benefit of the Institutions in the country, and enable them to regulate their future plans.

The Rev. WILLIAM YATE (Dover Museum and Philosophical Institution) was sorry to inform the meeting that, after several communications with officials of railway companies, he had not been able to obtain any reduction of fares in favour of excursionists *viâ* Dover to Paris, either by railway or by steam-boat. He had been anxious to escort a party of apprentices to the Paris Exhibition in the same way as he had done to the Great Exhibition in 1851. In the latter instance, he brought up 52 apprentices from Dover for a week, and the cost of their travelling to and fro, provisions, paying for admission to the Exhibition, and to other places which they were anxious to see, amounted to only 24s. 6d. each, whereas, he found they could not get to Paris and back alone for less than that sum; therefore he had been obliged to give it up, as the apprentices could not spare the sum that would be required for their visit.

The CHAIRMAN suggested, that if the Committee were furnished with the fact that large numbers would be prepared to go from various parts of the country, it might arm them with arguments to use with the reluctant railway companies, but that must of course be the subject of local inquiry.

Mr. W. STIRLING, M.P., (Crieff Mechanics' Institution) inquired whether any official information had been received as to the Paris Exhibition being a permanent one, or whether next year it would be closed, and its contents dispersed.

The SECRETARY said no information had been received from which it was to be inferred that the Exhibition

would be permanent. A portion of the building was no doubt intended to be permanent.

Mr. Redgrave remarked, that it was understood the Exhibition would be quinquennial. The building would be permanent, no doubt, for many uses. It was of stone, and was not likely to be pulled down.

The Secretary said there were extra portions of the building which were temporary for the present purposes.

The Chairman said he was informed by Mr. Macdonald that it was intended to close the Exhibition in October, the Imperial decree being to that effect.

### Museums.

The Chairman then proposed that they should proceed to the next question, viz., the establishment of Economic or Trade Museums. There had, he said, been several communications on the subject, and it was felt by the Council, who attached considerable importance to it, that any strong expression of feeling on the part of this Conference, representing Institutions in so many different parts of the country, would be sure to be attended with very considerable weight. He would state that the Museum below stairs was open to all members of Institutions present. They might see what it was in its present imperfect state, and they might infer from that what the exhibition might be made from the addition of materials, some of which were already at the disposal of the Society, if a larger space were available for it.

Mr. Redgrave thought it very important that the Conference should come to some resolution expressive of the desirableness of maintaining this Museum as a Public collection and Permanent Exhibition. There were already under the auspices of the government, interesting collections at Kew and at Jermyn-street, the former of botanical, and the latter of geological subjects, and this would form the animal portion. The Society of Arts had made this collection at the instance of the Royal Commissioners, and the object now was to make it of a permanent character and accessible to the public, and he thought if gentlemen present, representing so many varied interests, would pass some resolution upon the subject, it would strengthen the hands of the Council in going to the Royal Commissioners and pressing this question upon them. He would, therefore, take the liberty of suggesting the adoption of some uch resolution as the following:—

"That this meeting is greatly impressed with the advantages, both commercial and educational, which would arise from the permanent establishment and arrangement for exhibition of the interesting collection made by the agency of this Society as one portion—the animal portion—of a General Trade Museum."

The resolution was then proposed by Mr. W. Stirling, M.P.

Mr. Traice (Leeds Mechanics' Institution) suggested that they would be in a better position to discuss this subject if a brief statement were given them of the essential provisions of the existing Museum and Libraries' Act, and also of the Act which had been that day mentioned by the noble chairman, and which might be considered as virtually passed, or, at any rate, they might hope soon to see it law. All persons connected with these Institutions must have seen the inconvenience of discussing questions of this kind upon abstract grounds, without a chance of bringing it to a practical account. If through the medium of these Acts they could see a practical way of establishing museums in various localities, they might be prepared to discuss the subject.

The Chairman said, this would rather seem to come under the head of Libraries and Museums, with respect to which there was a Bill introduced intituled "A Bill for further promoting the establishment of Free Public Libraries and Museums in municipal towns, and towns under the Local Improvements Act, and to Parishes." What they were now discussing was a general national collection of the animal portion of the Trade Museum, the mineral portion being collected in Jermyn-street, and that representing the vegetable kingdom being at Kew, so that it would hardly be relevant just now to read that which applied only to the establishment of Museums in different parts of the country. If they first disposed of the General Trade Museum for the country at large, they might then pass on very properly to the other question.

Mr. Traice had very great pleasure in seconding the resolution, and he thought it commended itself to every one connected with trade, or with the applications of raw produce to manufacturing purposes. Some two months ago, when in London, he was shown, in the offices of this Society, by Mr. Pearsall, the specimens then in course of collection, with which he was not only interested, but from which he acquired practical information useful to him in trade, and one of the privileges of their attendance at this Conference would be that of seeing those matters somewhat better arranged, and upon a more extended scale. The greatest amount of ignorance prevailed in the present day with regard to raw materials in daily use—the places they came from—whether vegetable, animal, or mineral—the mode in which they come to us—the processes they have gone through—the sophistications they have suffered; these were all matters on which many were in utter darkness, and it was only through the medium of such a collection as this that they could gain the information they desired.

Mr. Buckmaster (Clapham) said there was already a Museum of Economic Geology in Jermyn-street, and he hoped there would also be a General Trade Museum. A union of the three collections was required.

Mr. Pearsall (Stockton-on-Tees Mechanics' Institute of Literature and Science) should like to see at once carried out, anything they could accomplish, even if it were an instalment only. They would then avoid the evil of delay. A question had arisen as to the propriety of having separate museums, but men might go to their graves if they waited until they could carry out the whole object at once. He hoped the members of the Institutes would not wait till these various museums were brought to some such place as the British Museum. If good was to be done to a certain extent at once, let them accept the opportunity.

The Chairman expressed his great satisfaction and delight at what had fallen from the previous speakers. No time should be lost in getting what they could. He looked forward to the completion of the Trade Museum—to bringing the collections from the animal and vegetable kingdoms especially, within some convenient building. It was obvious that flax, cotton, wool, and silk should be taken in connexion with each other.

The resolution suggested by Mr. Redgrave, and proposed and seconded by Mr. Stirling, M.P., and Mr. Traice, was then carried unanimously.

### Free Public Libraries and Museums.

The Chairman said he would now state the provisions of this Bill, which was before the Houses of Parliament, and would shortly, he trusted, become the law. It first repeals the last Public Libraries Act, but continued valid all operations commenced under that Act. It then confers on boroughs with a population of upwards of 5,000, the power, by a majority of two-thirds, at a public meeting of the burgesses, to adopt this Act, the expenses of the same to be paid out of the borough fund. Districts having an Improvement Board might similarly adopt the Act; and in parishes of more than 5,000, they might, by a requisition of ten ratepayers, have a public meeting; if two-thirds of the ratepayers adopted it, it was carried into effect by a Commission to be appointed by the vestry of not less than three nor more than nine, who might sue and be sued;—such Commission was to be elected from time to time, and to go out of office in rotation, the expenses to be paid out of the poor rates. The vestries of two or more parishes, having an aggregate population of the same numbers, might adopt the measure, so as to have a joint public library or museum, or

both, and they might appoint a body of Commissioners. who should determine the amount of rate to be levied in any one year, such rate not to exceed one penny in the pound. Some more details followed, and he trusted that this explanation would give the Conference an idea of what the main provisions of the Act were The Bill had gone through Committee, so that it would be rather late to effect any alteration in its provisions—but not too late.

Mr. Henry Edwards (Lynn Conversazione and Society of Arts) thought the proposed majority of two-thirds was too large. Could not that majority be altered; or was it hopeless to do so?

The Chairman did not know that it was hopeless. He must say he quite agreed in opinion with the last speaker.

Mr. H. W. Freeland (Chichester Literary Society and Mechanics' Institution) begged to ask the noble Chairman whether the document from which he had read was an Act, or only a Bill before Parliament?

The Chairman said this was a Bill which had been introduced by Mr. Ewart, to give facilities in reference to the object in question. The Bill had passed through the Committee, and had been reported in the House of Commons, and it stood on the paper for a third reading. It was not too late to attempt to make the alteration if it should be the opinion of the Conference that such alteration should be made.

Mr. Henry Edwards said, that being the case, he should move that "a majority" be inserted in the Bill, instead of a majority of two-thirds.

Mr. H. W. Freeland said he should have very great pleasure in seconding that motion.

Mr. Redgrave suggested that it would perhaps be better to communicate the opinion of the Conference to Mr. Ewart, who had charge of the Bill; because it was quite possible that this very provision might have been a matter of compromise entered into to enable him to carry his Bill.

The Chairman observed that this was only to be considered as the expression of the opinion of this meeting. The same principle ran throughout the Bill. He knew that his hon. friend Mr. Ewart had taken great pains with the Bill, and perhaps the expression of opinion on the part of the meeting might be accompanied with thanks to him for the trouble he had taken. Such a communication was at all times an encouragement to gentlemen when they found their efforts were appreciated by those whose opinions they naturally attached great weight to. He would therefore suggest to Messrs. Edwards and Freeland a resolution in the following terms:—

"That this Conference highly appreciates the services of William Ewart, Esq., M.P., in promoting legislation on behalf of Public Libraries and Museums, and for bringing in the Bill now before Parliament, of which the Conference generally approves; and this Conference desires to express its opinion that the principle of a simple majority ought to be adopted in the Bill, instead of a majority of two-thirds."

Mr. Edwards and Mr. Freeland having expressed their willingness to move and second the above resolution,

Mr. T. Garfit (Boston Athenæum) said he was inclined to think that this measure would be more likely to be received with favour in the country if its provisions were less stringent. He was inclined to think that in the present state of the country there was a strong feeling against any new rates being levied, and consequently that if they tried to carry out the principles of this Bill with a bare majority, such an attempt would be attended with considerable difficulties. If the vestry carried their object with a bare majority, they would have afterwards to encounter many very unpleasant things. He thought the Bill would be better in its present shape than with the alteration or amendment proposed.

The Chairman.—As there was a difference of opinion, he thought the resolution might with advantage be broken into two parts,—the one consisting of that portion of which the Conference generally approved, namely the conveyance of thanks to Mr. Ewart; and the other having reference to the question of the majority being simply a majority or a majority of two-thirds.

This suggestion was agreed to, and the first part of the resolution, as proposed by the Chairman, was carried unanimously.

The Chairman said the members of the Conference could now state their views as to the "majority."

Mr. James Hole (Yorkshire Union of Mechanics' Institutes) said he entirely coincided with what had been said by one of the previous speakers. He thought there would be a great difficulty in carrying a proposition of this sort among local bodies, who would hardly ever be found willing to tax themselves for any object, and least of all for the purposes of education. There were exceptions to this proposition, as in the great town of Manchester, but that he could account for; they had a free library, which was established without opposition, and there were many special circumstances attaching to that case; but generally it would be found that people in towns and elsewhere were averse to any rate being levied for the purposes of education.

Mr. Traice concurred in opinion with the gentleman who spoke from Boston (Mr. Garfit). He thought it would be well to get rid of the proposed regulation of a majority of two-thirds if they could do it with propriety, but he did not think they could do so, and his reason for saying so was this,—all experience went to prove that any measure which was in advance of the people in any locality, instead ot meeting with any co-operation was met with hostility. Every obstacle, every quibble was taken advantage of, and he thought the provision, though stringent, would be more likely to ensure the measure being carried out efficiently.

Mr. W. M. H. Blews (Birmingham Polytechnic Institution) thought a bare majority was sufficient to decide such cases.

The Rev. J. W. Blakesley (Ware Institute) said, as it appeared to him there was a considerable difference of opinion as to the quantum of majority, but there was no difference of opinion as to the promotion of education throughout the country; all they wished to do, he presumed, was to strengthen the hands of Mr. Ewart. It must be remembered that they would have to deal with men who were accustomed, as men of business, to carry on their functions by simple majorities, as in the case of vestrymen. With that simple majority they might win a pitched battle, but they might also encounter many hindrances in carrying a plan to its practical termination. The difficulty would always be great unless they carried public opinion with them.

Mr. Hole did not see why a simple majority should not carry this as well as other matters.

Mr. Edwards thought this question of the majority might be left to Mr. Ewart's discretion.

Mr. Freeland said his only object was to elicit the opinion of the Conference, and to strengthen Mr. Ewart's hands.

Mr. Stirling, M.P., said the resoultion did not state that it should be left in Mr. Ewart's hands, but it boldly stated the opinion of the meeting that a bare majority should be substituted for two-thirds. Might it not be better to say that the meeting would prefer a majortiy,—leaving the matter in Mr. Ewart's hands?

Mr. Garfit said that as he had given rise to this discussion, he begged to express his anxiety to support Mr. Ewart. He knew that the Act of 1850 had not been carried out to any great extent. If this Bill were to come into operation with the principle of a bare majority, it would be in opposition to that of many newly-constituted boards—such as burial boards, where when a different rate was proposed, the question was decided by a majority of two-thirds.

The Chairman then put the second part of the resolution, which was moved by Mr. H. Edwards (Lynn); and seconded by Mr. H. W. Freeland (Chichester):—

"That the Conference desires to express its opinion that the principle of a simple majority ought to be adopted in the Bill, instead of a majority of two-thirds."

To this an amendment was proposed:—

"That the Bill do stand as at present."

On a division being taken, the original resolution was lost,—the numbers being—

| | |
|---|---|
| For the amendment | 21 |
| Against it | 19 |
| Majority | 2 |

in favour of the clause as it stands.

LECTURES AND LECTURERS.

The CHAIRMAN—The next topic for consideration was that of Lectures and Lecturers. Gentlemen were all aware of what had been done as regarded the Lecture List. Did the Institutions wish to have the List of Lecturers printed as last year? It was an expense into which the Society would not enter without being assured that the List was useful, and was appreciated by the different Institutions.

Mr. TRAICE asked whether the Secretary could tell what was the cost to the Society of publishing this Lecture List?

The SECRETARY said the expense was about £70 or £80 each year. Last year the cost was upwards of £80, including postage and all expenses.

Mr. TRAICE said that so far as his own experience went this List was of considerable value; but it was well worth while to consider whether this was the best mode of expending the £80. He confessed he was surprised at finding the amount was so large; at the same time, while he was on his legs, assuming the List to be published, there were one or two points on which he required information. In some cases lecturers were delighted to come themselves to an Institution to lecture; one lecture would be well attended—another would not be so. It was difficult to make out a selected list—to prepare a list of the lectures to be given. It was desirable to have the names and addresses of lecturers who had lectured four or five times at various Institutions, and then by some confidential correspondence they could find out what were the characteristic qualifications of the lecturer. In any future list let this be attended to. They had on the List at present the names of professors at Colleges, whilst others were known only at one or two respectable but obscure Institutions, where there might be only 50 or 100 members. He wished simply to know who the lecturers were, and thought that Institutions should be requested to send a list of lecturers who had lectured during the past session. He thought that instead of making the List annual it should in future be published only once in three or four years.

The CHAIRMAN thought that a list from 400 Institutions of the persons who had given lectures would fill a large volume. It was for the Conference to decide the point.

Mr. A. COLEMAN, (Wandsworth Literary and Scientific Institution,) said with respect to the lecture list furnished to the Institution which he had the honour to represent last year, it had proved of the greatest value; but he thought the List might be reduced to one-half by giving the general character of the subjects lectured upon, without indicating the title of single lectures; a sufficient amount of information might be given to the Institutions from adopting this course. He thought it would involve the Council in great difficulty if they were to receive the lists, and from the lists they were to choose out certain lecturers. A great many persons gave lectures gratuitously who would not like to be regarded as lecturers except to the particular Institution.

The CHAIRMAN thought it right to say, on behalf of the Council, that, receiving as they did largely from the various Institutes, they would be ashamed of grudging them a part of their own money for anything that was valuable. The Council only wished to elicit whether the List was found to be useful, and whether the Institutions thought it worth the money expended.

Mr. PEARSALL felt, and he was sure all the representatives must feel diffidence in speaking of other Institutions, with which they were not connected, and expressing opinions as to the value of the list. He would suggest that the opinions of the Institutions on this point be collected by means of a circular or otherwise, by the Secretary of the Society. A truer guide to the wishes and feelings of the Institutes would thus be obtained.

Mr. HOLE said, he found that in Yorkshire generally they had very few paid lecturers; most of the lectures given were gratuitous. Now, as regarded the List, he would submit that the matter might be supplied at a less cost in a condensed shape. The matter on two pages might be put into one page, and thus a large amount of the cost which went in postage at present would be saved.

Dr. BOOTH said, perhaps the last speaker would suggest more fully how these lists could be condensed.

The SECRETARY said there was a difficulty in condensing this matter, as it was necessary to give the required information in a tabular form, and, therefore, they must have a large quantity of white paper left; whereas, if it were crammed, the whole matter would appear like a confused mass. But this subject had not been uncared for by the Council.

The CHAIRMAN said these were matters of pure detail. The main question was, whether the Institutions wished the lecture list continued on the same general principle, and whether the Council were to understand that the Conference suggested inquiry of the different Institutions as to the utility and value of the lecture list; and even this, perhaps, might now stand over for another year.

Mr. EDWARDS suggested that the Institutions making returns of lecturers and lectures, should not return the names of those lecturers who did not go beyond their own districts, as in the case of the Rev. Mr. Trench, Sir Robert Peel, and others.

Mr. TRAICE thought that a little careful editing would supersede a great deal of the difficulty which had been suggested. He thought the lecture list could be more compressed by giving the name in one type, the substance of the lecture in another, and the name of the Institution at which the lecture was given at the bottom.

Dr. BOOTH proposed that Mr. Traice should place himself in communication with the Secretary.

The CHAIRMAN took it as understood for this year, that the lecture list should be made out in such a way as the Council deemed expedient, and then great benefit would arise from these suggestions being made. He thought the names of all lecturers need not be published. The cases of lectures given in the village school-rooms, and of lectures to large audiences in towns, were quite different. This subject being disposed of, they would now proceed to the fourth question, of Classes;—the first part being Diagrams and Educational Apparatus.

Mr. E. W. MARTIN (Guildford Institute) begged to request that a little more time should be given to the Institutions for making their returns for the lecture list, there not being sufficient time between the receipt of the letter requiring them and the answer.

Mr. CAMERON (Midland Union) would be glad to know what utility there was in these lectures? Of what good had lectures been to Institutions generally? For his own part, he had never met with a thoroughly cultivated man who had received any benefit from lectures.

DIAGRAMS AND APPARATUS.

The CHAIRMAN recurred to the fact that they had now come to "Classes," the first section of which was Diagrams and Apparatus, next Class books, and lastly the more important point of Examinations.

Mr. EDWARDS said it would be a great benefit if a series of diagrams, &c., could be furnished by the Society and lent out to to different Institutions.

The Hon. and Rev. Samuel Best (Hants and Wilts Educational Society) said diagrams had been collected by the Associated Societies in his own part of the country; models had been purchased from France which were of some value. He could not agree with the remarks which had been made by Mr. Cameron on the subject of lectures. He knew that as to the value of one casual lecture, no great information might be carried away; but there was a general spirit of inquiry excited by the delivery of these lectures, and he had seen the practical benefit of them. They disseminated the desire for further information, and promoted the establishment of reading rooms throughout the agricultural districts. Lectures stirred up the spirit of inquiry, and that which led a man to improve his mental condition must be good in itself. He most heartily wished to see lectures established in these Institutions.

Mr. Cameron stated that during the last three or four weeks he had called upon several members of Parliament, and that their opinion was that the Mechanics' Institutions had failed, and that the lecture system was utterly useless.

The Chairman believed that both with regard to the use of Lending Libraries and to the formation of Classes, the cause of success in most cases might be traced to the interest excited by lectures.

Mr. Traice said he should like to know, out of the 658 members of the House of Commons, how many had attended lectures at Institutions, and just in that ratio should he value the opinions they expressed. He contended that as yet our elementary system of education was so imperfect, especially all voluntary elementary education, and so utterly inefficient in connection with the elements of scientific truths, that the only way in which young men got a glimpse at such information was through the medium of popular lectures. He spoke from his own personal experience, having, when a young man, been a member of the London Mechanics' Institution.

The Rev. H. Hawkes (Portsmouth and Portsea Literary and Philosophical Society) begged leave to say that in the Society which he had the happiness to represent, the greatest possible good effects had been produced from the improved supply of diagrams. They were rendered peculiarly valuable when lectures were being given. So far from agreeing in what had been said as to lectures, whilst he admitted that no great amount of information was obtained from a mere desultory lecture, he was equally assured that a systematic course of lectures was far from being undesirable. Now, when his Society required him to attend on this occasion, he asked his friends what they particularly wished him to bear in mind on their behalf; they mentioned emphatically the great want, at a moderate charge, of lecturers, not *ad captandum* lecturers, but such as were suited to the class rooms, and for cultivated minds. In the Mechanics' Institutions, and elsewhere, there was a want of good diagrams to bring to the eye distinctly the subjects treated of.

Mr. Ingham, M.P., stated, that the Northern Union of Mechanics' Institutes, which held its meetings in different parts of the district, did all in its power to encourage the collection of apparatus. Living as he did on the sea coast, they had great opportunities of obtaining valuable collections of apparatus at reasonable prices, of which they endeavoured to avail themselves. He thought that a great deal might be done by endeavouring to prevail upon lecturers to leave their apparatus behind them. When Professor Airey last year lectured at Newcastle, he with great readiness did so, as also did Professor Chevallier, who came over from Durham to lecture on the law of tides. There was another mode, too, of extending a knowledge of common things amongst the people. There were a number of Working Men's Institutes which they preferred attending, because they could do so without the necessity of changing their clothes, and the Literary and Mechanics' Institutions in connection with the Northern Union allowed members of those institutes to attend their lectures at the same cost as their own members.

Mr. Buckmaster thought it most important that any collection of apparatus should be of so simple a nature, that any person employing it should be readily acquainted with it. It was of no possible use to put into a man's hands apparatus which he did not understand; and he certainly would not like to undertake to make a collection of paintings, because he did not understand painting. He knew that many diagrams were perfectly useless to the teacher. He agreed with Mr. Traice that the education ought to be begun with the boy. Indeed, they were now attempting to do with the working men that which ought to be done at school. It was useless to give them apparatus unless it was so simple as to be easily comprehended, and he thought every instructor of science ought to be enabled to construct his own apparatus. He recollected being sent to a school in Staffordshire, established by the Earl of Harrowby, and being furnished with a lot of German apparatus and German books. Now, he did not understand German, and though the apparatus was very pretty and appeared very ingenious, it was of no use to him. The Department of Science, at Marlborough House, had made a collection of apparatus which was very valuable. What they really wanted was a collection of simple apparatus and diagrams, with books to explain them. It was very little use for this Society to get together a collection of apparatus without they had the means of drawing the attention of the conductors of Mechanics' and Literary Institutions to it. The proper course was to begin with the education of the boys, and through them influence the men, for no large amount of science could be learnt in Mechanics' Institutions. The foundation must be laid in the school, and if the boy did not learn they must make him, and then when he grew up he would have such a knowledge as might induce him to improve himself.

Mr. Coleman believed there were a great many very valuable collections of diagrams, but very few people knew where they were to be seen. He thought the Society of Arts might do great good by letting them know where the various educational diagrams and apparatus might be obtained. He believed that by the introduction of their boxes of colours, drawing instruments, and now by their microscopes, the Society of Arts had done great good, and he trusted they would extend their operations to the production of other useful apparatus. If proper apparatus were put into his hands, the mechanic would be enabled—they would all be enabled—to test the quality of goods they were buying. The microscope would tell them to a great extent whether any given article was pure, and the working man would never object to pay a good price for a commodity if he was sure that it was good. They were also in want of cheap chemical apparatus. He knew many persons who made considerable progress in chemical researches, but were stopped in consequence of the want of apparatus, which was very costly. He believed that the Council of the Society of Arts would do great good if they were to offer a prize for cheap apparatus suitable for lecturers.

Mr. Traice thought they were all agreed as to the great advantage of being possessed of diagrams and apparatus, as they would often enable gentlemen to lecture who could not otherwise do so. Franklin said, that no man had any pretension to be considered a philosopher, who could not bore a hole with a handsaw, or saw a plank with a gimlet. He believed that there were many men in the country who would be enabled to offer instruction to others if they had the aid of proper apparatus. He would therefore suggest that Faraday's "Chemical Manipulation" should be reprinted, improved and brought down to the present time, at a price which would render it generally accessible. He believed that the publication of that work would be more useful than any other measure they could propose on the subject. He believed that a great deal of good would be done by Societies if they would occasionally employ young men in connection with them to exercise their ingenuity by the construction of apparatus. That was the way that Dr. Birkbeck first

gave an interest to young men in his original institution. If greater attention was also given to the teaching of drawing in these Institutions, it would be highly beneficial, for if every educated man knew how to lay down a geometrical line, and a little perspective, he would only want a board and a piece of chalk, to enable him to illustrate his lecture by diagrams.

Mr. Soulsby, (Morpeth,) said, that Mr. Buckmaster had referred to giving corporal punishment in schools, and disparaged the value of Mechanics' Institutes. Now they must recollect that in these Institutes they had to deal with men whose elementary education had been neglected; and with regard to corporal punishment, they should recollect that there was a passage in Ecclesiasticus, to the effect that they should beat the ribs of their son with a stick. He did not know whether there were any fathers of families present, but he hoped if so, they would not think it necessary to carry out that injunction.

The Chairman trusted that Mr. Soulsby would confine himself to the question before them, as corporal punishment might lead them into a very wide, and he thought, irrelevant argument.

Mr. Buckmaster begged to observe, that the only remark he had made was this, that if a boy would not learn they must make him.

The Rev. Mr. Blakesley was exceedingly glad to observe the efforts that were being made to improve the value of these Institutions. He thought it would be most useful to endeavour to improve educational apparatus, and more especially that a globe should be prepared, showing the phenomena of nature in various districts. He believed that there was no branch of education so badly supplied with the necessary apparatus as geography. The map and globe makers used such bad paper in their construction, that it was impossible to do any thing with them. Mr. Hughes had lately published some maps, of which he highly approved, and he therefore used them in the instruction of his own children. What they wanted most was a globe of reasonable size, showing, if possible, the general features of physical geography, for the use of Mechanics' Institutes. He had himself attempted something of the kind by obtaining one of the globes of the Society for the Diffusion of Christian Knowledge, painting the whole of the land white and the sea black, and also making marks to denote volcanoes and other physical features of the earth. He believed that there was no subject which merited greater attention than physical geography, and there was none upon which so little information could be obtained. The present system was very like that of the legend of the two knights, in which the manufacture of the shield was so uncertain, that one maintained it to be gold, whilst the other contended it was silver. He despaired of any great progress being made in scientific education whilst the Institutions were so defective in appropriate apparatus. As to the opinion of M.P.'s, alluded to by Mr. Cameron, it would appear that they knew nothing on the subject, that they went knocking their heads against the wall first on one side and then on the other, and believed they were walking in the centre of the road. Any person who knew anything of these Institutions knew that they had proved most beneficial, and what they were now called upon to do was to assist them a step higher in the amount of benefit they could afford the public, and he believed that, no matter what might be said to the contrary, that what were called *dilletante* lecturers, did great good by directing the attention of the public to the most useful objects.

The Rev. Mr. Best said, they had heard a great deal about diagrams, and they were aware that some very excellent diagrams had been published by the Working Men's Educational Union. There were also many diagrams of a high class published by the Department of Science and Art at Marlborough House, as well as by Messrs. Griffin, Carpenter, and Westley, &c. He felt that if Institutions could not obtain these diagrams for themselves, they might unite in counties or districts to purchase them. They did so at Winchester, where they had a number of small Rural Societies connected by an Association. He did not think that this subject was so much one for the Society of Arts to deal with as for Local Unions, such as the one of which he had the honour to be a member. It appeared to him hard indeed if the Societies in different districts could not unite together to obtain diagrams for the use of their districts, by which means the whole of the Societies might have the use of them. He begged to move, as one step in the right direction—

"That this Conference begs to impress on the Council its anxious desire that the Educational Exhibition, now in the hands of the Government, should be exhibited to the public without further delay, in accordance with the pledge given to the Council by Her Majesty's Government."

Mr. Buckmaster seconded the motion, and said, that a few years ago he went into the country to teach a class of 60 arithmetic, and 23 of the number he had to put back to the ordinary rules of simple arithmetic.

This motion was passed unanimously.

Mr. Edwards thought there was something unsatisfactory in the various propositions, and he thought that there could be no better means for collecting diagrams and apparatus for the different Institutions than the Society of Arts, if they would undertake it, and he would therefore move the following resolution:—

"That the Council of the Society of Arts be requested to obtain a series of diagrams, illustrative of lecture subjects, to be lent to the Institutions in Union."

The Rev. Mr. Best believed that there would be this difficulty, that societies in Cornwall or Cumberland would not be able to obtain the diagrams excepting at great expense. He believed that such collections would be much better made through local unions.

Mr. Edwards still thought the Society of Arts best adapted for the purpose, if the collection could be made without involving any great expense. It must be recollected that the Society of Arts had undertaken the business of the Societies in Union on the express understanding that they were neither to gain nor lose by them. It therefore became a matter for consideration what charge would be involved in the arrangement.

The Rev. Dr. Booth observed that the question of profit and loss had never been a matter of consideration with the Council.

The Rev. Mr. Best did not think there would be any difficulty with regard to the financial means for obtaining the diagrams and models, without which many Institutions were comparatively useless.

Mr. Simon, of Royston, seconded the motion.

Mr. Hole stated that it would certainly be a good thing if any arrangements could be entered into for the Society of Arts becoming agents on behalf of small local unions. If the Society of Arts would undertake to do so, he believed there would be no difficulty in getting meetings in the various districts to form such unions.

The Chairman suggested that the Unions already existing might serve as the types of others.

Mr. Ingham, M.P., again referred to the Northern Union as a proof of what might be done by a number of such societies in obtaining lecturers, apparatus, &c.

Mr. Buckmaster said that with regard to the Society of Arts, it could only act for Societies in Union. If Mr. Best had been enabled to get diagrams from the Department of Science at Marlborough-house, he had been more fortunate than, he believed, were many others,—great difficulties being generally thrown in their way. If the Society of Arts would make the collection, it would be most beneficial, and he saw no reason why they should not do so. Their box of colours and drawing instruments had done a great deal of good, and he believed also that a collection of industrial diagrams would be most serviceable, if they could be cheaply circulated.

Mr. Simon (Royston) might observe that the Society with which he was connected was so situated that it could not well come into union with others. Besides, there was

no body which could be readily got at, in which they would have so much confidence as the Society of Arts.

Mr. Pearsall believed that to circulate apparatus from one place to another would be most expensive, in consequence of the want of connection between the different modes of conveyance. Again, it must involve the expense of somebody to travel about with it, and look after it, for he might observe that a good microscope, for instance, could not be entrusted into the hands of inexperienced parties. Indeed he would not trust his microscope in the hands of his own brother without he felt well convinced he knew how to manage it. It was not so much that diagrams were wanted, as a knowledge of where they were to be obtained. Mr. Griffin and others had published good educational apparatus, and a correct balance might be obtained at a cost of only 10s. or 11s.

Mr. Traice thought they were going too far, and that they had not sufficient information on the subject. He thought if the Society of Arts could obtain the necessary data as to where appaıatus might be obtained, and circulate it, that was all that would be required. He would move, as an amendment on the the motion of Mr. Edwards:—

"That the Council of the Society of Arts be requested to published in the Journal, from time to time, lists of diagrams, apparatus, &c., with the names of the publishers, and any necessary supplementary information; and, further, that the meeting most heartily commends the means taken by the Society to procure, at a cheaper rate, the instruments of most essential use in illustrating scientific instruction."

The Society had done great good by obtaining them a cheap box of colours and drawing instruments, and now the microscope; and if they could carry the same principle further, and provide them with a cheap balance, and perhaps a simple air-pump, still further good might be done.

Mr. Coleman seconded the amendment, believing that not only the expense of obtaining the collection required, but of carriage from place to place, would be too great, as compared with the benefit to be derived. If they were to publish a list from time to time in the *Journal of the Society of Arts*, stating where cheap educational apparatus was to be obtained, that was all that would be required.

Dr. Booth observed, that if they obtained the Permanent Educational Museum, which her Majesty's Government had undertaken to establish, that would in a great measure carry out what was wanted.

Mr. Freeland agreed with the proposition of Mr. Traice, believing that the expense of obtaining a complete collection of educational models would be too great. He held in his hand a circular of the Hants and Wilts Educational Society, showing what had been done in the locality — and if the Society of Arts would send a similar circular amongst the Societes in Union showing where educational apparatus was to be obtained, it was all that could be required.

Mr. Noldwritt (Walworth) thought that at all events the discussion had done some good—as would also the publication of such a list as that now proposed. He confessed that when he entered the room he did not know that such a balance as that alluded to could be obtained at Messrs. Griffin's. He though that if they laid before the public a list of places where educational apparatus, suitable for lectures and classes, could be obtained, that was all that would be required. If, however, that failed of meeting a now acknowledged want, they could hereafter adopt other means to supply it.

Mr. Pearsall also supported the amendment, on the same grounds as those urged by previous speakers.

Mr. Edwards still pressed his motion, as though they might be strong enough in the North and in the metropolis, to form Local Unions, they were not in that part of the country to which he belonged—and he felt that there no body could be found which would enjoy so much confidence as the Society of Arts.

The question was then put, and the amendment was carried.

### Local Sub-Unions.

Mr. Hole moved—

"That, considering the success of the Yorkshire and other Unions, the Council of the Society of Arts be requested to consider the possibility of organising local Sub-Unions, in places where no local Union exists."

He thought such Sub-Unions most important, and believed that in many instances the Society of Arts might be enabled to form such Sub-Unions, though they could not be carried out by the localities themselves. Such Sub-Unions would be of great use, and materially assist the general Union with the Society of Arts.

Mr. Coleman seconded the motion. He had tried to establish a Union between the Societies within 20 miles round London. He invited deputies to meet him from all the Societies, but only those from two or three Societies met, and even then his Society was forced to give up the idea, as those parties did not attend subsequent meetings. He would support this resolution, under the belief that the Society of Arts might be enabled to carry out these Unions, though his own Society had failed.

The Chairman would observe, that he had attended, at Salisbury, one of the periodical meetings of the Hants and Wilts Union, of which the Rev. Mr. Best was so active and useful a member, and had been much interested with the proceedings. He was a great advocate of local Unions, believing that they must materially tend to the benefit of the general Union in connection with the Society of Arts.

Mr. Traice submitted, that the words, "by correspondence or personal communication," should be added to the resolution.

The resolution was carried as originally proposed.

### Class Books.

The Chairman said the next question was that of class books, on which the Committee of Council had received some suggestions—books suited for evening classes of Mechanics' Institutions. It was suggested that the Society should offer a prize for such books. The books of that character already published were intended for children, but it had been considered that class books for teaching the elements of education to adults should be written upon a different principle, and in different language from that which would be adapted to teach children the same thing.

Mr. Hole said, the proposition having come from the Yorkshire Union, he would state that it was owing to the general want of knowledge of the books published for this purpose—where they could get them cheapest and best. It was thought that the Society of Arts had peculiar facilities on both these points.

Mr. Cameron called attention to the class books published by the Irish School Society.

Mr. Traice remarked, that supposing the Society of Arts decided to offer a prize for the production of works in connection with this subject, it occurred to him that the premium of the Society's Medal would not be a sufficient incentive for the production of a series of class books such as was required. The reward would not be sufficient to elicit a manual on each subject. He begged to suggest that the Society should offer a prize for the best manual on educational expedients, or rather for a critical essay upon educational works. Such an essay, he thought, would be very valuable, but as to offering a prize for the production of a series of works, he thought it was out of the question.

Mr. Buckmaster would make the same remark with regard to class books as he had done with regard to educational apparatus. If the Society of Arts could get a collection of books suitable for Mechanics' Institutions they would not be bound to take them, but they could

recommend them. So many of those books were published that it was difficult to make a selection from them. Another thing was, that through the medium of the Society of Arts, Mechanics' Institutes ought to be supplied with those books on the same terms as they were supplied to schools. As it was at present, Mechanics' Institutes could not get the Irish Society's School books on the same terms as they were supplied to schools.

Dr. Booth said it was not easy to come to a decision on this subject, inasmuch as commercial interests were involved in it. The Council, however, would consider the question in all its breadth. He thought the Council would hardly like to pledge themselves to recommend any particular list of class books, as it would be sure to engender a great deal of commercial hostility.

Mr. Traice—Then we are to understand that the Council will take the subject into their consideration.

### Examinations.

The Chairman then introduced the next subject, that of Examinations, upon which, he said, they had heard a great deal last year.

The Hon. and Rev. Samuel Best said, having given a notice to the Secretary on this subject, he trusted the meeting would bear with him for a few minutes. It appeared to him that the question of examinations during the past year had been treated rather mildly in the report, but they must look at it in its practical bearings. In his opinion, they would never get people to come up for examination without some practical result as an inducement. If they intended these examinations to be carried out they must attach a money value to them; and until the Declaration which was annexed to the original proposition was carried out in all its fulness, they would never get people to come forward to undergo a voluntary examination. The gist of the matter rested in this—if that declaration were signed by the great firms and by the railway companies, or by Government, it would at once attach a money value to a successful examination, and under such circumstances, he had no hesitation in saying, they would get plenty of people to come forward to be examined. The question resolved itself into this—if they could get this declaration carried out, they would, in his opinion, succeed in their object, but not otherwise It appeared to him that there could be no opportunity more favourable than the present for putting forward that declaration in the proper quarters, and if influential parties in different localities could be induced to sign that declaration, so that it could be sent in to the Council here, they would, by that means, promote the object they had in view. He conceived it to be impossible for the Council of the Society of Arts in London, to be able, through the length and breadth of the land, to consult all the great commercial bodies on this subject. But if a resolution were passed by the Conference, and backed by the example of the Society of Arts, applying to the great commercial firms and companies in London, he thought it would give effect to the recommendation. He, therefore, begged to propose

"That the Institutes, under the direction and with the aid of the Society, be requested to procure influential signatures to the declaration."

Dr. Booth begged to second the resolution. He knew that their noble Chairman took great pains in endeavouring to obtain signatures to the declaration, but he was sorry to say without effect. Whether or not they would be more successful in this, now that the times were somewhat changed, it was not for him to say; at all events, he thought it was worth the trial.

Mr. Buckmaster said, last year he prophecied that there would not be a dozen candidates for examination, although other members of the Conference were more sanguine upon the matter. Previous to the last Conference a letter from him was published in the Journal, in which he expressed his opinion that they would never get any large number of persons to be examined, unless they held out a further inducement than the mere diploma of the Society of Arts. He thought it was a most important subject, and that it was more difficult to deal with than some imagined. He was glad to hear from his lordship that he had offered a prize of £20. He (Mr. Buckmaster) might be induced to try for such a prize, but he would not try for nothing. At the same time, examinations were good things in themselves, as they were proof of something done. Every man must do something to get through an examination, and if he failed, he had added to his store of knowledge, which, perhaps, he would not have done had it not been for a desire to pass the examination. With regard to the signature of large firms to the declaration, unless they were willing to give men more money in the event of their passing the examination, or doing something for the advantage of the men, he did not think it would succeed.

In reply to an inquiry from Mr. Coleman, the Secretary stated that the machinery for examination remained the same as last year.

The Hon. and Rev. Samuel Best remarked that education, in his opinion, ought to be as general as possible, as the best preparation for a special education. In support of that, he would refer them to the evidence given by Mr. Escher before the Poor Law Board, which was the most important evidence on that subject he had ever seen, and he should be glad if the Society could publish it, and disseminate it through the country, because it would impress them with the value of education in general principles, to be afterwards specially applied. He thought that should be made the basis of the examinations, and that we ought not to deal too much with specialities.

Mr. Cameron—What do you mean by a general education?

Mr. Best—That a person should be able to write a good letter; that he should have a thorough knowledge of geography, grammar, history, arithmetic, and other matters that might be pointed out. The special education, which he thought they had a little too much trusted to, should come after that general education.

Mr. Traice said the real difficulty of the case was this, —and it was no use to conceal it—if they gave prizes, it would be to give to the grown man rewards commensurate only with the attainments of boys of 12 years old. The ignorance which they found amongst young men entering classes was frequently such that they had to deal with them as they would with a child of 10 or 12 years old —a child whose education had been neglected. It was useless to expect to stimulate such persons by rewards of such a nature. At the same time, he did not think it was a thing to be lost sight of, and he thought in some Institutions it might be brought into operation. But what might be carried out to advantage was—it was done at Huddersfield—that a record should be taken of the level of attainment which each pupil had reached when he entered the class; that such a record should be made from time to time, and thus a sort of stock book would be kept of the advancement of each individual pupil. He thought this might be done as a preliminary step. But he scarcely hoped to see the application of prizes to young men who, however ignorant they might be, were still sensible of their humiliating position, inasmuch as after 12 months work in their class they were only upon a level with their children or younger brothers and sisters in the national school.

Dr. Booth here read the terms of the declaration as follows:—

"We the undersigned, having in view the very interesting and instructive character of the Educational Exhibition now opened at St. Martin's Hall, in Long Acre, by the Society for the Encouragement of Arts, Manufactures and Commerce, commend the same to the attention of all persons professionally or otherwise concerned in Education; whether general or special, whether of young persons or of adults, whether of the rich or of the poor.

"The Exhibition illustrates the actual condition of education, not only in the United Kingdom and in some of the Colonies,

but also in France, Belgium, Holland, Norway, Sweden, Denmark, Germany, Switzerland, Spain and the United States, and is highly suggestive of improvements in the modes and means of public and private instruction.

"We are desirous that all persons engaged in education, and especially the teachers of normal and elementary schools, should be enabled to profit by the advantages which this Educational Exhibition is calculated to confer upon those who carefully study it; and we invite the civil authorities, ministers of religion, patrons and managers of schools, and all persons of authority and influence, to promote the making of arrangements which may enable scholars, tutors, governesses, schoolmistresses and others engaged in education, to resort to London, and to visit the Educational Exhibition before the 31st of August next, when it must necessarily close."

Mr. Hole thought such a document, signed by railway companies and banking firms, and extensively circulated throughout the Institutions, would give a great stimulus to classes in Mechanics' Institutes; but he did not anticipate any very great results until something more was done in the classes themselves. In many cases the instruction was limited to the library—most of the books being novels—or to the reading-room, with a large proportion of penny literature and penny talent—then there were the musical entertainments, and the miscellaneous lectures, which, however valuable in themselves, would not give the attainments necessary to pass an examination in that general education which was advocated by Mr. Best. If the Society could give adequate assistance to the classes—if they could get that assistance which the School of Practical Science pretended to afford; if, instead of the miscellaneous lectures, they could secure, at an economical charge, the delivery of a course of 15 or 20 lectures—then, he believed, these examinations would be realities, and not till then.

Mr. Coleman trusted the Council would not be discouraged by the remarks just made. An arrangement of this kind could not be developed in a year. He felt convinced that if the subject were more frequently brought before the notice of the various Institutions, they would see the advantage of these examinations, and time would show a monetary advantage to those persons who had obtained a diploma from the Society of Arts. In endeavouring to establish classes, he had been met with the remark, "What is the good to us when we have obtained the information which you propose to teach? What benefit is it to us to have a knowledge of chemistry, or geology, or mathematics?" But if the individuals had the diploma of the Society of Arts, to show to the world that they were proficient in the subjects they had studied, he believed it would be a stimulus to the classes of Mechanics' Institutes. The Institution with which he was connected, was about to establish excellent classes during the next winter, and they had almost all been established in the hope, on the part of the members of the classes, of obtaining certificates of merit from the Society of Arts; and he had no hesitation in saying, that if that idea were to be abandoned, those classes would not be carried out. In the neighbourhood with which he was connected, they had advantages over many others, in having a school in which instruction in the sciences was generally given; and, he thought, if members of Institutions in other localities exerted themselves to establish such schools throughout the country, a far more healthy feeling would be exhibited in the Institutions themselves. He believed the examinations proposed by the Society of Arts would ultimately succeed: but they could not expect the thing to be carried out in a day, or a month, or a year. He believed the examinations would ultimately become of monetary value, as it must be an advantage to a workman, in the price he obtains for his labour, if he enters the workshop with the certificate of the Society of Arts, that he is qualified above many around him for the duties and engagements which he undertakes. It was by that means examinations would become valuable. He believed many persons would be willing to study with the object merely of obtaining a diploma of that kind.

Dr. Booth said this was a subject in which he had taken a great interest, and he would, therefore, say a few words upon it. He was the person who proposed the declaration, which, he might say, had completely fallen to the ground. The noble chairman made great efforts at the time to obtain the signatures of railway companies, and other public bodies, to that declaration, but, in almost every instance, he believed they declined, or at any rate they did not respond to it in the way that was hoped, and in that way the matter might be said to have fallen through. Although they had not been able to succeed with that system of examination at present, there was no reason why other bodies, possessing greater advantages, and coming before the public with higher authority, should not carry out to a successful issue what we had inaugurated; and he was glad to see that the government had made some small beginnings in this way. He might mention that at Woolwich the exigencies of the war made a greater demand upon the schools there than they could readily supply, and the authorities were obliged to draw upon the schools of the country for fresh pupils. What was the result? The young men so selected were found, as he had been informed, very much in advance of those who had received their entire instruction there. It was not that the men were better, as a class, than those found at Woolwich, but a selection was made in the former case, which was not done in the latter. He thought they might bid the measure God speed; and if it met with the approval of the meeting he would move the following resolution:—

"That this Conference views with great approbation the inauguration by the Government and the East India Company of a system of public examinations, whether absolute or competitive, preliminary to public employment, as a step in the right direction, on the ground as well of its stimulating the general education of the country as of its tendency to provide a well-instructed and intelligent class from which vacancies in public offices may be supplied."

He saw no reason why the public schools of the country should not send up young men to compete for the Government appointments, and as a point within their own reach, he saw no reason why Mechanics' Institutes should not claim from the Government the privilege of sending up one or two of their best men to compete for the rewards. That would be doing what they as a Society could not effect, and that would attach a money value to those honours, which would strike the hearts of those who received their education in connection with Mechanics' Institutes.

The Hon. and Rev. Samuel Best said he preferred the resolution of Dr. Booth to his own.

The Chairman thought one was not at all incompatible with the other, and he would put both to the meeting.

Mr. Buckmaster mentioned, with regard to the Department of Science in Jermyn-street, that upon an advertisement appearing in the *Times* that a course of six lectures were to be delivered by Professor Willis, in two hours after the advertisement appeared there were 600 applications for tickets from working men, the charge for the course of lectures being 6d. or 1d. per lecture.

The Chairman remarked, that the question of the education of the middle classes, and the more enlightened of the labouring classes, had brought him into the Society of Arts. He was anxious to see what could be done through the medium of this Society towards filling up a great want in this country, and he was in hopes that last year something might have been done in that direction, and he took the trouble to write to several influential persons of his acquaintance, but they did not respond to it in the manner he had expected, and, therefore, the declaration had remained a dead letter up to the present time. He went far in agreeing with the opinions expressed, that something in the shape of reward or honours were necessary to induce people to study for an examination. In the prize he had offered, gentlemen well qualified for the task had consented to act as his examiners, and in offering

that prize, he felt that there was some credit in gaining it, and that it was one not altogether unworthy of striving for. He felt that some such inducement was necessary to stimulate the parties to come up for examination. It would be desirable that this Conference should renew its expression of their wish that the declaration should be signed, and be sent round for that purpose, not only by this Society, but by those who were the chief promoters ot education in their respective neighbourhoods. He thought that they might do something in getting signatures to this declaration; he trusted many influential signatures might be thus obtained.

Mr. Best's resolution was then put and carried unanimously.

The Chairman said that Dr. Booth would then move his resolution, which he understood would be seconded by Mr. Traice. He begged to say a few words upon it, as it had reference to the subject of public examinations. This was a question in which he took a great interest, and it would be in the recollection of some of the gentlemen present, that he had written on the subject of examination of persons candidates for official situations. Though he did not think that the competitive system always elicited the best candidate—for no human system was perfect—yet, when they compared the chances of success under the competitive and under the present systems, he thought no reasonable man could entertain a doubt on the subject. At any rate, whatever objection there might be to examining a man—because he who passed the best examination was not always the best man—yet they knew that he must have taken pains to work hard, and to deny himself many pleasures; and if there were no other good in that system, it at least stimulated a man to take pains with himself. He did not over-value book learning; yet when they knew how situations and promotions were distributed, he looked upon this as an immense advance upon what hitherto had degraded our constituencies. He might add that for one instance of aristocratic jobbing, he knew hundreds of electioneering jobbing of the worst kind. The former were sure to be noticed, the latter generally escaped observation.

The Rev. Dr. Booth, F.R.S., then proposed, and Mr. J. W. Traice seconded, the resolution, which was carried unanimously.

### Parliamentary Papers.

The Chairman said the next question for discussion was that of the Distribution of Parliamentary Papers and Blue Books to Literary and Mechanics' Institutions. He might mention that more than once he had thought of moving in the matter since his return to Parliament, but, on reflection, he thought it desirable to wait for the opinion of the Conference before he mentioned it in Parliament, in order that he might have an opportunity of learning what were the wishes of the Institutions on the subject.

Mr. Buckmaster had assumed that the question had last year been settled as to the selection of parliamentary papers, and that that was all that could be done.

Mr. Hole took it for granted that the resolution of last year would still be in operation.

The Chairman said the Conference did not then come to a clear conclusion in the matter. If they wished the Council to indicate to them what sort of papers they could be supplied with when the Council thought they were likely to be interesting in different localities, the Council might consider the best means of carrying out the wishes of the Conference.

Mr. Hole begged to suggest as a resolution, that the Council be requested to prepare lists of Parliamentary papers, &c., for the benefit of the Institutions in union, and that the Council use its power in carrying out this object.

The Rev. Mr. Jones (Romford) said this appeared last ear to be a question of difficulty. A Committee of the ouse of Commons, he had heard, had come to a conclusion as to the distribution of these masses of papers. Mr. W. J. Fox, M.P., thought it would be useful to make selections, or a catalogue of such papers as might be useful. He apprehended a catalogue might be sent round, and then let the Institutions make their own choice.

The Chairman here remarked that the papers of a session weighed about a ton.

Mr. W. H. Freeland begged to say that the Institution he was connected with had a list made out by their Committee of useful papers and books.

The Chairman said the papers which were most likely to be useful were those which Members of Parliament liked for their own library, and he thought that if Institutions looked to Members of Parliament alone for these, they would not always get what they required. His impression was that they could not come to a definite resolution on the matter. Suppose Parliament were inclined to grant what was asked, the Council might perhaps suggest those papers which would be most useful in particular localities; some might be very valuable in manufacturing districts, and useless in mining, or agricultural, or shipping districts. He thought if the Conference desired some steps to be taken in the matter, it should be left to the discretion of the Council, and it was not impossible that the Council might be made useful. If this was the understanding, they would now pass on to the next point for consideration.

Mr. Traice said, the Society would render an important service by making it their business to publish, at the end of the year, a compendium, which would be a basis on which to proceed. He thought, however, it would be more prudent to leave the matter in the hands of the Council. He hoped the time would come when the Government would deem it their business to establish some board which would give, not as *Punch* termed it, the quintessence of Parliament, but the essential matter, which had been so long concealed within ponderous books.

The Secretary begged to remark that two years ago a very eminent publishing firm proposed to undertake that duty with a well qualified staff, and to publish this matter at a reasonable rate, once a month or quarterly. A prospectus was sent to every member of both Houses of Parliament, but not one single answer was ever received, and the whole thing fell to the ground. The firm, he begged to state, was a first-rate and highly respectable one.

It was agreed that the subject should be left in the hands of the Council.

### Catalogue of Books.

The Chairman said the next matter for discussion was as to making a catalogue of books fitted for the Libraries of Institutes.

The Secretary stated that it had been suggested that the Council should make and publish a catalogue of such books as were likely to be useful in the Libraries of Institutions.

Mr. Edwards could speak to the value of such a catalogue in forming a library, which was generally a mere *hap-hazard* affair to accomplish.

Mr. Hole begged to remark that the Yorkshire Union of the Mechanics' Institutes had requested Mr. Traice to prepare a practical manual for Mechanics' Institutions, which was now nearly completed, and several sheets of the work had gone through the press. A large number of books fitted for Mechanics' Institutes were named in it, and from his connexion with various Mechanics' Institutions, and from his general experience, he had selected an excellen catalogue. What he would suggest, and which he had stated to Mr. Foster, was, that Mr. Traice should forward the sheets of his manual as they appeared, and submit the proofs to this Society, and that it should bear the *imprimatur* of the Society, and thus let the work go out as a catalogue for the use of Mechanics' Institutions.

Dr. Booth believed that the Council would be very glad to avail themselves of such an offer. He was quite sure that no person they could employ for the purpose

would do it more zealously than Mr. Traice; indeed, the Council would rather father his work.

Mr. Traice said, that as no attempt had been made in this direction, great advantages he hoped would result from such an effort. At any rate, when published, any defects would be seen, and could be remedied in future editions.

Dr. Booth presumed it was understood that there was one branch which this work would not enter upon, and that was theology?

Mr. Traice replied that neither theology nor politics were absolutely excluded. The Yorkshire Union had requested him two years ago to look over a little catalogue which they published eight or ten years since. Finding it to be very imperfect, nothing was left for him but to take the catalogue of the London Mechanics' Institute—the original catalogue—in which standard theological works were included.

The Chairman said he took it for granted as clear, that theological or political matters would form no part of the undertaking, and that it would be understood the Society would not give its *imprimatur* to books containing these subjects. Indeed from the very constitution of the Society of Arts it was unable to pronounce any opinion on such topics. At the same time that would be a defective library which excluded the most interesting questions affecting men's welfare in this world and that which is to come. He felt, however, assured that the meaning and intent of the Society would not be misconstrued, and he, therefore, thought that without danger they might take and act upon the suggestion made.

Mr. Martin (Guildford) said he presumed it would still be open to local committees to select or not?

The Chairman—These catalogues would only be guides, after all.

Mr. Jones—They were not intended to be as guides to opinion.

### Trustees.

The Chairman—The next question for discussion was the Legal Position of Institutes—first, as regarded trustees; next, their borrowing powers; and lastly, their rating.

The Rev. Mr. Best said, that in consequence of an application of his, this matter had been put upon the paper of business. He thought the subject was one of great importance. He had known several instances of Institutions failing, and of the property being dispersed, in his part of the country, whereas, this might be avoided by putting it in the hands of trustees, for the express use of the Institute as long as it existed. If the Institution were dissolved, it would then remain under their hands for public purposes. Therefore, these powers would be given with a view to perpetuate the benefits of the Institution; and when the Institution was once established, the property could not be dispersed. The resolution he had to propose was:—

"That it be recommended to the Institutes to vest their property and library in trustees, for the use of the Institute; and, in the event of its dissolution, in trust for such public purposes as at the time of the establishment of the Institute shall be resolved on."

He had mentioned the importance of this subject, and the necessity of some short form being drawn up by the legal authorities in London, for the protection of the property of Institutes, and he was directed at the last meeting of the Committee to mention the subject. He, therefore, forwarded the suggestion to Mr. Foster for consideration that day; and he thought it sufficiently recommended itself to the members now present, and he would leave the question in their hands.

Mr. Hole said he would readily second the resolution. He had known several cases, where property, which had been subscribed for by hundreds, was, from the failure of the Institute, divided among three or four individuals. If some short rule could be drawn up it would be very useful.

The Chairman put the resolution—which was declared to be carried unanimously; and the meeting were about to proceed to the consideration of the borrowing powers and rating, when

Mr. Traice said he did not subscribe to the resolution proposed by Mr. Best. He did not understand it at first, as explained by that gentleman. He did not think it was complying with the Act 16 and 17 Victoria, in empowering trustees, in anticipation of a dissolution of an Institution, to apply its property to certain purposes. He maintained that there was no necessity for the resolution.

The Rev. Mr. Best's idea was that it would prevent the dispersion of property when once accumulated. The act did not apply to reading societies and such like institutions as they existed in small villages.

Mr. Hole, to show the effect of the act, proceeded to read the 30th clause as follows:—

"If upon the dissolution of any Institution there shall remain, after the satisfaction of all its debts and liabilities, any property whatsoever, the same shall not be paid to or distributed among the Members of the said Institution or any of them, but shall be given to some other Institution, to be determined by the Members at the time of the dissolution, or in default thereof by the Judge of the County Court aforesaid; provided, however, that this clause shall not apply to any Institution which shall have been founded or established by the contributions of Shareholders in the nature of a joint-stock company."

The Rev. Mr. Best would suppose the case of a valuable library being brought together, and the society was in debt, what was to prevent its being sold, if some such safeguard as that he proposed was not in existence in order to meet those debts?

Mr. Hole must withdraw his intention of seconding the motion, because he could not support it on the ground of protecting it from creditors. He had misunderstood the purport of Mr. Best's resolution. He thought that in every case the property of a party must be looked upon as an asset to meet any legal claims against it.

Mr. Traice thought they ought to confine the resolution to a declaration relative to the appointment of trustees.

The Rev. Mr. Best might observe that there was an Institution in Andover, established about 14 years since, with a library, which was vested in trustees. That society failed—there being a provision that every subscriber of 1s. per quarter was entitled to partake of the advantages of the library. He had lived to see that society restored to strength, and the library preserved; but, had the power to sell existed, it would long since have been dispersed.

Mr. Noldwritt thought the provisions of the Act most valuable, but he was sure the majority of Institutions would soon fail if it was once to be understood that their property was not liable for the payment of their debts.

Mr. Traice suggested that the mover should withdraw the latter clause of his resolution, and that they should request the Council of the Society of Arts to frame some simple form for vesting the personal property of Institutions in trustees.

The Chairman, if he understood the matter rightly, believed that the object was to keep intact the property of Institutions unable to go on.

The Rev. Mr. Best said that was precisely his object.

Mr. Cameron thought they might protect the books from sale.

Mr. Edwards would observe that in case of a society being dissolved, the law made the assets public property after payment of the debts.

Mr. Martin thought it would be a bad example to endeavour to free property from liability to debt. He did not think such a course could be looked upon as altogether honest.

Mr. Freeland did not believe that the law would allow them thus to protect their property against their creditors.

The Rev. Mr. Jones did not think there could be any ob-

jection to the appointment of trustees, as he thought property would be much more secure in their hands than under the control of a large Committee of Management. Such an arrangement would be better for many purposes; and, therefore, he would support any recommendation for the appointment of trustees, though he could not approve of that portion for protecting the property of a society against the creditors.

The Rev. Mr. BEST disavowed any wish to act dishonestly in bringing forward his motion. Indeed, he thought it was rather dishonest to dispose of property in which they had only a transitory interest, for the payment of debts—the more especially, as probably many of the books in the libraries would be presentations for a particular object. They had been collecting treasures for years in the British Museum. Did they think it would be honest to dispose off these treasures to pay the National debt?

Mr. HOLE—Certainly not. But they would be justified in doing so, to pay debts incurred on behalf of the Museum.

Mr. USHER suggested that they should follow the example of the Bedford Society—and always keep a good balance in hand.

The resolution, not being seconded, fell to the ground.

Mr. TRAICE said the Act of Parliament provided for a form of trust deed, as regarded the real property, such as the building belonging to a Society—and he thought that the Council might be requested to draw up a form with regard to what might be called the personal property of a Society.

The Rev. Mr. BEST observed that the majority of the speakers had alluded to regularly constituted Mechanics' Institutions, whereas, he had been alluding to village libraries (the majority of the books in which were gifts) to which the Act of Parliament did not apply.

The CHAIRMAN said, that the Council would no doubt take the subject into consideration. The next subject before them was Borrowing Powers, which, he thought, they might pass over—and he believed Mr. Hole now wished to bring before them the subject of rating these Institutions.

RATING OF INSTITUTES.

Mr. HOLE certainly felt somewhat disappointed to find that the subject of rating had been apparently shelved by the Council of the Society of Arts. The reason why he did not bring forward a motion on the subject last year was, that he was told it might interfere with the success of the Bill then about to pass into law, and he and his friends, therefore, remained silent. There was no reason, however, why they should do so now. If he was told there were objections to any class of exemptions from rates, he might readily admit that it was so, but whilst exemptions were allowed, there were no Institutions better entitled to them than Literary Societies. They exempted charitable societies, religious congregations and schools, from the payment of rates, why, therefore, should they not exempt Literary Societies? If they released a charitable society, established to assist a man in want, from rating, why should they not exempt a society started for the purpose of teaching him to rely upon himself and do without relief. He thought there was no better way of affording assistance to these Societies than by relieving them from rates. The amount might be small, but it was frequently a great deal to Institutions which had to struggle hard to maintain an existence. The three literary institutions in Leeds would have to pay about £100 a year in rates if they were enforced, and it was too much to leave them at the mercy of a rate collector or any one ratepayer, who, perhaps, might be disappointed in some measure with regard to the Institution. He had heard the noble chairman say that the Right Hon. M. Talbot Baines, M.P., President of the Poor Law Board, was about to bring in a Bill, in which the whole question of rating was to be raised. That Bill, at all events, could not be brought in before next session, and if they were to leave the subject untouched until the whole question of rating came under consideration, they were likely to be cheated out of their exemption privilege altogether. He did not think there ought to be any difficulty in the matter, for it now only existed on a mere lawyer's quibble. The Act of Parliament said that all Institutions should be exempted from rating which were exclusively used for the purposes of literature, science, and art. Now, newspapers had been decided not to come under the head of literature. He looked upon that as a mere quibble, and that newspapers were a most important portion of literature, and were destined ere long to become more important than ever. If the word "mainly" were inserted for "exclusively," every difficulty would be got over, and all they required be obtained. He believed that if the Council exerted themselves, and the various Societies saw the members of their different towns and boroughs, that they would have so much strength that there would be no difficulty in passing the Bill next session. He begged to move

"That this Conference earnestly requests the Council of the Society of Arts to take steps that the exemption from local rating, intended to be given to Mechanics' Institutions by the 6th and 7th Vict. cap. 36, and also the removal of the assessed taxes, be secured to them, either by an amendment of the present law, or the introduction of a new measure."

Mr. VALLENTINE (London Mechanics' Institution) seconded the motion. He had the honour to represent an Institution which was not in so happy a position as that at Bedford, but, on the contrary, was encumbered with a large debt. The amount of taxes materially affected them, as they represented an amount which they were annually losing. If they were relieved from the weight of the rates, they might be enabled to struggle on; but if not, he feared they must close their doors. The loss of one Institution amongst so many might not be much, but he was sure that there was no one who would not regret that the first-established Institution of the kind in London should fail. These Institutions were established to make men both morally and mentally better, and what Institution, therefore, could have a better claim to this exemption. He believed it was the intention of the Act of Parliament to give it them, but it was loosely worded, and therefore tax-collectors and lawyers had put a variety of interpretations upon it, and deprived them of their rights.

Dr. BOOTH agreed with both the last speakers as to the justice of their observations, but he was afraid that the Council had not the power to do anything, even were it expedient to raise the question. He agreed that they had the right to the exemption, but he was not quite sure that the Society of Arts could well go to the House of Commons on the subject. He believed that it was the opinion of their noble Chairman, and other well-informed persons on the subject, that if they went to the House of Commons, a committee might be appointed, and there was a great probability of all exemptions being swept away. It was for them to consider whether it would be desirable to run that risk.

Mr. COLEMAN thought that they ought to go to Parliament at all events to clear up the difficulty in which they were in. He believed it was the intention of the legislature that they should have the exemption, and they ought not therefore to be deprived of it, as it made only an infinitessimally small addition to the rates of other property.

Dr. BOOTH wished it to be clearly understood that if they did go to Parliament the result might be that they might lose the exemption altogether. Would they like to take that chance, it being well understood that the Council were not to be responsible for the result.

Mr. HOLE could scarcely believe that Dr. Booth was sincere in his expressions of a desire to get rid of the rating. He believed if the Society of Arts exerted itself zealously and energetically there would be no difficulty in settling the question. They did not want a Committee of the House of Commons. All they had got to do was to direct Mr. Lumley to prepare a declaratory act, and then for the various societies to call on their representa-

tives in Parliament to support it, and he felt assured that the Legislature would not undo their Act of 1843 for the promotion and benefit of these Institutions.

Mr. Noldwritt thought that if the Council of the Society took up the matter energetically, and the various Institutions called on the Members for their respective districts to support it, there would be no difficulty in passing a bill confirming their exemption. As a beginning he would call upon the Noble Lord in the Chair to redeem a pledge which he had given to him last year. Whilst speaking to his Lordship upon the subject, the Noble Lord probably might recollect that he said, "leave the matter alone at present, and I will undertake to bring it before the Legislature myself." He now called upon his Lordship to redeem that pledge.

The Chairman begged to say a word or two upon this subject. He was not in Parliament at the time referred to by the gentleman who had just sat down, and had no immediate prospect then of obtaining a seat, so he felt sure the last speaker must have misunderstood what he said last year; but he was acquainted with the subject of rating. He thought if they had pressed the matter last year, they would have impeded the passing of the act. He thought it would have been difficult to have got a bill passed this year, because the whole question of rating, and of exemption from rating, was expected to be dealt with on some more uniform and systematic plan than at present. It was, however, new to him to learn that the general wish of the Institutions in Union was rather to lose the privilege which many of them enjoyed, than to have the matter kept in doubt any longer. His impression was, that the question of exemption from rating was a difficult one, and he believed that any movement in the matter at the present time would lead to the sweeping away of a great proportion of the exemptions at present enjoyed by various Institutions, and foremost amongst them would be the Mechanics' Institutes themselves. With regard to pledges, he begged to say that he never gave them; that he had, ever since his first start in public life, always entered parliament as an independent member, and he told the electors of Marylebone that he would enter it on no other conditions, and he knew there were other members of the legislature who felt the same as he did on that point. He had all along shown that he had wished well, not only to Mechanics' Institutes in towns, but to equivalents for them in the remotest country village; but it was perfectly clear that nothing could be done in the matter of rating this year. He very much doubted whether parliament would entertain the question as an isolated question if it were brought forward, and whether the bill would not be rejected merely upon the ground that it was not proper to deal with isolated cases; and at the same time he felt an increasing doubt as to the justice and expediency of exemptions generally.

Mr. Hole—Would not the Chancellor of the Exchequer receive a deputation?

The Chairman said, it was a matter of local taxation. He would remind them that the relieving of any one kind of property from taxation was merely imposing an additional burden upon the rest, and the question was how to draw the line. The judges had held that the Cambridge Philosophical Society was liable to be rated because they had a news room attached to their Institution, and there were very few Institutions which were not liable if the matter were taken up against them. Then again, there was the Athenæum Club, which possessed one of the finest libraries in London, and consisted of members more or less engaged in literature, science, and art, that was now liable also to be rated. If the word "mainly" were put in, the Athenæum Club would fairly come under the meaning of the Act, and claim exemption. Was it right that where an Institution had replaced some property which was liable to rating, such an exemption should be given? It was a more difficult matter to deal with than some present appeared to imagine.

Dr. Booth inferred, from the tone of the meeting, that the resolution of Mr. Hole would be carried, but he would call attention to this point, that if the Council were to take up this subject, they must ask for the co-operation of one or two representatives at this conference, to act with the committee which the Council might hereafter appoint, because he felt sure that the Council would hesitate to take the responsibility of the movement entirely upon themselves.

Mr. Blews supported the resolution.

Mr. Traice subscribed to the opinion that it was better to be without the exemption than remain in the present state of uncertainty. At the same time he thought it would be sufficient if the Society took the opinion of this conference, that it was desirable that at an early period some measure should be brought before the attention of Parliament. Much of the unpleasantness that had arisen on this matter, had been owing to the Institutions being at the mercy of parish officials, dreesed in a little brief authority, but he believed if the matter were put to the vote of the rate-payers, in almost every case the Institutions would be exempted from rating. He thought it would be sufficient to record the opinion of this conference, that they were desirous the question should be settled in as short a time as possible.

Dr. Booth remarked, that after the expression of feeling on the part of the Conference, the Council could hardly refuse their consideration to the subject; but he repeated, that they would decline the entire responsibility of the movement recommended for getting rid of the existing anomaly.

The Rev. Mr. Jones (Romford) expressed a strong wish that something should be done to settle the question of rating.

The Chairman then put the resolution, which was carried unanimously.

It was moved by Mr. Martin, seconded by Mr. Edwards, and resolved :—

"That the following gentlemen be added to a Committee, to be elected by the Council, for the purpose of considering the best means of carrying out the foregoing resolution :—Mr. Vallentine, Mr. Traice, Mr. Hole, Mr. Noldwritt, and Dr. Prior Purvis."

The Chairman said they had now reached the last of the subjects for discussion, viz. Public recreation grounds. He would read to them the resolution that was passed at the last conference, which was as follows:—

"That, in the opinion of this Conference, with a view to the bodily, mental, and moral improvement of the community, no less than to its enjoyment, it is essential that due provision be made of adequate spaces for healthful and innocent recreation in the neighbourhood of our towns and villages; and that the members of the several Institutions be requested to exert themselves in their several localities, to promote the establishment of healthful and innocent recreation for the inhabitants."

It was moved by Mr. Coleman, seconded by Mr. Freeland, that the Conference desires to repeat the expression of its opinion of last year, which was carried.

The Chairman having declared the proceedings at an end,

Mr. Traice said, as he had taxed his Lordship's attention as much as any one present, he had perhaps the greatest right to thank his Lordship for the kindness, courtesy, and ability with which he had conducted the proceedings of the day.

This was seconded by Mr. Freeland, and carried by acclamation.

The Noble Chairman returned thanks for the high compliment which had been paid him, and the proceedings terminated after a sitting of nearly five hours.

## ONE HUNDRED AND FIRST ANNIVERSARY DINNER.

The One Hundred and First Anniversary Dinner of the Society took place on Tuesday, the 3rd of July, at the Crystal Palace, Sydenham. About 350 gentlemen were present on the occasion. The chair was occupied by His Grace the Duke of Argyll, F.R.S., who was supported on his right and left by Earl Granville, Lieut.-General Sir Charles Pasley, K.C.B., Col. Sykes, F.R.S., Messrs. W. Brown, M.P., A. Hastie, M.P., J. Johnstone, M.P., J. Kershaw, M.P., Eliott Lockhart, M.P., J. Malcolmson, M.P., G. Moffatt, M.P., B. Oliveira, M.P., J. Pilkington, M.P., Dr. Chambers, Dr. Cumming, Dr. Lee, L.L.D., F.R.S., Dr. Nairne, Dr. Waddilove, Dr. Watson, Captain T. B. Collinson, R.E., Captain Leopold Paget, R.A., &c., &c.

As Vice-chairmen, at the ends of the cross table, were Professor Owen, F.R.S., representing Science, and Mr. J. M. Rendel, F.R.S., representing Mechanics and Engineering. Professor Owen was supported by, among others, Messrs. J. G. Appold, F.R.S., J. W. Gilbart, F.R.S., J. Glaisher, F.R.S., C. Wren Hoskyns, W. H. Pepys, F.R.S., Dr. Roget, F.R.S., and Mr. T. Webster, F.R.S. Mr. Rendel was supported by, among others, Messrs. J. Whitworth, J. Glynn, F.R.S., C. Atherton, J. Braithwaite, J. V. Gooch, I. H. Trevithick, A. Henderson, H. Hensman, B. Fothergill, J. Samuel, W. Bridges Adams, R. Davison, D. K. Clark, A. C. Hobbs, J. Freeman, and D. Shears.

At four parallel tables, leading from the cross table, were seated the Members of the Society, the Representatives of the Institutions in Union, and their friends. The Council occupied the right-hand table, and were presided over by their Chairman, Viscount Ebrington, M.P. At this table were the Rev. Dr. Booth, F.R.S., Col. Eardley-Wilmot, R.A., Messrs. P. Graham, W. F. Harrison, J. C. Macdonald, Matthew Marshall, W. W. Saunders, F.R.S., G. F. Wilson, F.R.S., of the Council, and among others, Lieut.-Col. Andrews, Rev. Muirhead Mitchell, Rev. J. P. Norris, Messrs. J. Anderton, H. G. Bohn, Hyde Clarke, Leone Levi.

At the Arts table, which was the next to that occupied by the Council, were, among others, Messrs. Owen Jones, A. Claudet, W. E. Kilburn, Waterhouse Hawkins, H. Bradbury, E. Clowes, J. Coe, with Mr. W. Tite, M.P., F.R.S., as Vice-Chairman.

At the Manufactures table, which was next in succession, were, among others, Messrs. J. M. Blashfield, J. Bull, J. Corbett, R. T. Fauntleroy, A. Lapworth, J. R. Lavanchy, W. B. Simpson, J. Jobson Smith, J. Vavasseur, V. Wanostrocht, G. F. White, with Mr. F. Crossley, M.P., as Vice-Chairman.

At the Commerce table, which was that on the extreme left, were, among others, Messrs. R. W. Crawford, F. Bennoch, J. Dillon, W. Hawes, J. D. Allcroft, J. E. Carlile, E. Davis, Donald Larnach, F. Lycett, J. W. Sherriff, with Mr. J. G. Frith as Vice-Chairman.

The Representatives of the Institutions in Union occupied the centre of the room, and included among others, the Rev. T. Bacon, Rev. J. Glendinning, Rev. W. Yate, Messrs. T. G. Blakie, J. W. Bontoft, W. Cockerell, A. Coleman, H. Edwards, T. Farley, H. W. Freeland, T. Garfit, H. Heane, J. Hunt, U. C. King, F. J. Macaulay, H. Martin, G. Nicholson, J. S. Noldwritt, W. K. Norway, T. J. Pearsall, Wyndham S. Portal, J. C. Radford, S. Lee Rymer, W. J. Simon, M. Soulsby, J. Usher, H. Whitfeld, with the Hon. and Rev. Samuel Best, M.A., as Vice-Chairman.

*** The Secretary regrets that it is impossible to present a full and faithful report of the proceedings at the Dinner, owing to that part of the Building in which the Dinner took place being ill adapted for speaking in. Those Members who were present can bear testimony to the difficulty of hearing the different speakers.

After Dinner, the Hon. and Rev. S. BEST having said grace,

The CHAIRMAN said he rose with great pleasure to propose that which he was convinced in an assembly of Englishmen would always be the first toast, "The Health of Her Majesty the Queen." It was not only from her high position, but from the patronage her Majesty had ever afforded to arts and manufactures, that this Society had reason to acknowledge the obligations they were under to her Majesty. He therefore begged them to drink to the health of the Queen.

This toast having been duly responded to,

The CHAIRMAN again rose, and said the next toast he had to propose was one intimately connected with that which they had just drunk, it being "The Health of His Royal Highness Prince Albert." His Royal Highness had shown himself ever anxious for the advancement of science, and he might say that he believed it was through the great zeal and attention which his Royal Highness had shown in the promotion of the arts and commerce, that the Society of Arts had taken a new start, and now occupied the proud position it held in the country.

The CHAIRMAN then gave "His Royal Highness the Prince of Wales and the rest of the Royal Family," expressing a hope that they would emulate their Royal parents in the interest they took in the promotion of art and the commercial influence of the country.

These toasts, like the preceding, were duly acknowledged.

At this point of the proceedings the Secretary read the list of Premiums awarded during the past session, which will be found given at length at page 589.

The NOBLE CHAIRMAN again rose and said, I now rise, gentlemen, for the purpose of proposing that which is the toast of the evening. I mean, "Prosperity to the Society for the Encouragement of Arts, Manufactures, and Commerce." As you all know, we have now more than entered upon the second century of the existence of this society. A hundred years is, generally speaking, no very long period in the life of a nation, and there have been centuries during our own history which have left us very much in the condition in which they found us; and in the histories of all countries—even of those which are most progressive—there are centuries of which this may be truly said. But

certainly this cannot be said of the century which has now commenced in regard to the progress of England; nor can it be justly said that the great progress which we have made as a nation has been alone in any one department of excellence, or promoted by any one class of men. We have had great statesmen, great soldiers, great sailors, and great lawyers; and during the course of that century, we have added to our dominions many of the most extensive possessions which now belong to the Crown of England. Why, a century ago, at the period when this Society was founded, we had not acquired that noble colony in the West, which now owns its allegiance to the Crown of Victoria; and I would remind you that a century ago, the young civil servant of a great commercial company was then but engaged in laying the foundation of that marvellous empire which now belongs to us in the East. Notwithstanding, gentlemen, all these great works, and all these great possessions, if I were asked to mention a circumstance which would impress upon our minds more than any other the amazing progress which has taken place in this country during the last century, I would remind you that a hundred years ago Watt and Arkwright had not begun their labours—those works which have changed the whole face of society—those labours which, I rejoice to think, are being now largely prosecuted by the Nasmyths, the Whitworths, and the Paxtons of the present day; and, gentlemen, I would say there are some who have been afraid that the progress of this country in arts and manufactures, tending to concentrate the attention of the people, as it undoubtedly does, upon the possession and the getting of wealth, would tend to dull our spirit as a nation, and make us more reluctant to perform our duties in the world. I think, however, that the experience of the last eighteen months must have silenced all such doubts. Never has there been a more truly national spirit exhibited—never has there been shown a greater willingness to submit to great burdens for the sake of great national duties, and I would say further, nowhere has that spirit been more nationally evinced, than in the great seats of our commerce and manufactures. And, gentlemen, I cannot allude to this subject without expressing the earnest hope, which I am sure is felt by every gentleman present at this table, that the events which have brought us into close alliance with our great neighbour, which is of great importance, not for war only, but for the purposes of peace, and that when this contest shall have ended, I was going to say, when it shall have been forgotten, but forgotten it never can be; but when this contest shall have passed away, those two nations will continue to emulate each other in all the arts of industry and of peace. I am sure of this, that the close connection which ought to be kept up between these two great countries, will be of immense benefit to the arts and manufactures of both. The armies have acknowledged that there are peculiar parts belonging to each, which they have felt in the hour of battle, and in the arts and sciences we must confess the peculiar excellence of each, from which we may derive mutual advantage. Undoubtedly, gentlemen, that particular in which I believe we excel almost every other nation, is that which is peculiarly connected with the operations of this Society, I mean the command over the natural powers and over the mechanical inventions which have been given to England by the progress of her arts and manufactures. Now, gentlemen, I know that this Society directs itself mainly, not to the abstract sciences, but to the sciences as they are applied to the practical arts; but I hope, gentlemen, you will allow me, who have the honour of being President elect of the British Association for the Advancement of Science in the ensuing year, to say one word in this meeting with regard to the encouragement of science simply as such. In one of the ablest lectures on the Results of the Great Exhibition of 1851, which were given in the hall of our Society at the instance of our Royal President,—I mean the lecture given by Professor Whewell, he observed, with great ingenuity and truth that the arts have generally preceded the sciences, that just as men have constructed language, before grammars have been written, so there have been artificers in wood, in metal, and in stone, before the chemical qualities of these various substances had been found out, and science constructed upon the arts. This is undoubtedly true, but we must all recollect of late years, such has been the rapid advance of abstract sciences, that science has gone ahead of the practical arts. There is not a single month, there is not a single day, in which the abstract discoveries of the chemist, of the mechanic, and of the mathematician, are not called into practical operation for the purposes of the arts and the commerce of the country. Professor Whewell admits this in regard to chemistry and several of the other sciences, but the more you look into this matter, the more you will find that the practical arts and commerce of the country are drawing upon the resources of abstract science. All I can say with regard to this subject is, that I think we, as a commercial country, ought to appreciate abstract science and encourage the inventions of those connected with it. Upon this occasion, beneath the roof of the Crystal Palace, I feel that I have a perfect right to divest myself of all official character, and to consider myself as unconnected with the Government of the country, and in this character I am certainly prepared to say, that I do not think that the Government of this country, meaning thereby not any particular ministry, but the governments generally of this country, have not been sufficiently liberal towards matters of science. But then I would remind you that the Government of this country is but a reflex of public opinion, and if you put forth the opinion, which I believe is a sound one—if you, the great mechanical classes, demand the sciences to be more liberally promoted by the government, depend upon it your wishes will ultimately be attended to by the government. I am extremely anxious to say a few words more upon a subject which I think is interesting above all others. I do sincerely rejoice to see that the attention of this Society is not confined exclusively to the accumulation of material wealth, but that of late the labours of the Society, and the exertions of the members, have been directed almost as much to the intellectual culture of those great classes which our manufacturing industry has raised up amongst us. I thought at the time, and I think still, that one of the most valuable results of the Great Exhibition—at least one of those immediate advantages on which I place the highest value, was the habit which for some period it taught the artizans and mechanics of saving their own resources, for the purpose of being able to come up to see the Exhibition of the Industry of all Nations. There is an effect being produced by the natural laws operating in society, which we ought not to lose sight of, and which ought to be brought to the attention of the artizans and mechanics of the country. I allude to the effect produced by the great law of the division of labour. Every advance in the arts of the country is accompanied by some sub-division—some further illustration of the principle of the division of labour. Let us look at the effect which this law produces upon the happiness of the mechanic. In the early stages of the arts and sciences, a skilful artizan was a person of great individual importance in the country; at the present time, owing to the division of labour, there is hardly a single product of which any man can say with truth, "I made this." He may have made some small part of it—his labour may have been bestowed upon some minute portion, but the mind which planned the whole, and the labour which put it together, were not his, but the labour of various others. At first sight this might seem to be an evil. I believe, like all the other great natural laws operating in society, it has a beneficent purpose, and, if we use it aright, will have a beneficent result. The consequence of division of labour is this—it gives more time to the mechanic, and a higher remuneration for his labour; for, after all, it is the welfare and cultivation of the mind which alone gives dignity

to the labour of the hand. I believe, therefore, that the great principle of the division of labour is tending to give more remuneration to the mechanic, and to enable him to reserve more time for the intellectual culture of himself and his brethren. I rejoice, therefore, that this Society is directing its attention to the industrial education of the great artisan and mechanic classes. I believe you will find them at all ages—young and old—anxious to take advantage of the exertions made on their behalf, and of the opportunities afforded by societies like this for the improvement of their minds. I trust, therefore, although undoubtedly there are many difficulties in the way of a complete system of industrial education for the whole of this country, that the Council of this Society will continue to direct its attention to this important subject; that they will continue to encourage commerce between various nations, and the intercommunication of different ideas which is sure to react upon our own commerce and manufactures; and, above all, that they will attend to that moral and intellectual culture of the manufacturing classes, without which all our wealth and industry will carry with them the seeds of their own decay. The Noble Chairman then gave the toast, "Prosperity to the Society for the Encouragement of Arts, Manufactures, and Commerce," coupling with it the names of Mr. W. Tite, M.P. for Arts, Mr. F. Crossley, M.P. for Manufactures, and Mr. J. Griffith Frith for Commerce.

The toast was drunk with three times three.

Mr. TITE, M.P., rose to return thanks for the last toast, as the representative of Art. In doing so, he felt that he had more than an ordinary difficult task to perform, inasmuch as he had not heard one word of the able, and, from the way in which it had been received, he doubted not, eloquent address of the chairman. As an artist, he felt grateful to this Society for what it had done in promoting and extending a knowledge of Art, and the great improvements which had taken place, not only in that department of art to which, as an architect, he belonged, but in every other department of science amongst the people. He considered that nothing could be more beneficial, or tend more to the prosperity of the country, than a Society which had for its object the making known every improvement in manufactures and commerce, and thereby enabling those engaged in their prosecution to adapt those improvements to their various manufactures, and uphold the credit and honour of the country.

Mr. CROSSLEY M.P., returned thanks, as the representative of Manufactures. As a manufacturer himself, he could bear testimony to the great good which had been effected through the Exhibition of 1851, established at the suggestion of the illustrious President of the Society of Arts. That Society might truly be said to be the parent of that Exhibition, and it was most gratifying to perceive the beneficial results which had flowed from it. He might mention that, prior to 1851, his house had been unsuccessfully competing with America in carpets, but through the Exhibition they discovered that the excellence of American carpets arose from their being manufactured by machinery, and his firm having spent a very large sum in procuring machinery, they were now enabled to manufacture for 2½d. a yard that which formerly cost them in labour 14d., whilst their workmen earned better wages, worked fewer hours, and a corresponding reduction in price was made to the consumer.

Mr. FRITH felt that he had, on the part of Commerce, but little to say, after the able addresses of those who had preceded him. However perfect might be the manufactures of a country, they would be of little use but for commerce in diffusing them throughout the world, and no body of men could have done more for the promotion of the great objects with which they were connected than the Society of Arts.

Mr. J. M. RENDEL, F.R.S., had great pleasure in rising to propose a toast which had been entrusted to him, more especially as he felt that he and others connected with industrial pursuits, had derived great advantages from the exertions and researches of those connected with the abstract sciences. He was but a worker in the field, but he felt gratified at having the opportunity of attending there that evening, and of bearing his testimony to the advantages which had been derived through the exertions of the learned Societies. He believed that there was scarcely an improvement in science or art, during the last half-century, the promotion of which might not in a great measure be traced to those Societies. He had listened with great pleasure to the address of their noble chairman that evening, and he had become more than ever convinced of the advantages to be derived from a connection with those bodies. Looking with great anticipation to most important results from the further exertions of these Institutions, he begged to give them "The Learned Societies and Professor Owen."

Professor OWEN, after alluding to the difficulty of addressing audibly so large an audience in the lofty and splendid edifice in which they were assembled, said that he rose, in obedience to the arrangements of the Festival, oppressed by a sense of the inadequacy of his merits, or his power to do justice to the toast which had been so ably proposed by his esteemed friend, and by a conviction of the impossibility of duly acknowledging the flattering manner in which his name had been received and associated with the Scientific Societies of the Metropolis. The Royal Society of London was one of the oldest—after the Lyncean Academy of Rome, he believed the first association of individuals for promoting, by combined efforts, the discovery of natural truths. In the year 1645, at a time when England was falling into the distraction of religious and political struggles, a few men, under the genial inspiration of philosophy, agreed to meet together weekly to enjoy, and mutually aid in, her calm pursuit. At the Restoration, this association was recognised and chartered as the Royal Society of London for the Promotion of Natural Knowledge. Of its influence in the discovery and diffusion of that knowledge, time warns me to limit my instances to the sympathy and co-operation of the Royal Society with the transcendant labours of the immortal Newton. By the biography of that wonderful man, lately published by Sir David Brewster, many of us have perhaps learnt, for the first time, how much science is indebted to the Royal Society for eliciting, and for effecting the publication of Newton's discoveries, and for her jealous but just concern for the scientific reputation of her greatest President. The Association which I have now the honour to address was the next in order of time in this metropolis. But of the nature, scope, and beneficent influences and operations of the Society of Arts, a sketch as true as it was vivid, eloquent, and edifying has just been given by our noble and accomplished and liberal-minded Chairman. The stimulus which the writings of Buffon and Linnæus had imparted, towards the close of the last century, to the study of living Nature, led to the Association, in 1788, of the most eminent botanists and zoologists of that period in London, for the express advancement of Natural History. To the publications and meetings of the Linnæan Society is due the rapid diffusion, in this country, of the exact methods of observing and defining the characteristics of plants and animals, which the immortal Swede had instituted. The more recondite researches into the physiology and natural system of Plants, which have given lustre to the name of Robert Brown, will always be intimately associated in the history of the Science, with the House, the Museum, and Transactions of the Linnæan Society. That Society fostered the study of the whole range of organic nature; the first Paper in its "Transactions" is on the "Extraneous Fossils of Switzerland." At the beginning of the present century, the minds interested in the history of the changes of the earth and its inhabitants were mostly ranged in two antagonistic parties, and were chiefly occupied by polemical contests for the supremacy of Neptunian or Vulcanian hypotheses. But there were a few minds

of higher order, who felt that geology must be advanced, like other natural sciences, by observation and experiment, not by disputations and speculations. This small inductive school, which included a Wollaston and a Greenough, founded, in 1807, the Geological Society of London; and truly it may be averred, that in no equal period of time has the world been enriched by a more vast and unexpected treasure of natural truths, than has accrued in regard to the ancient history of our earth and its extinct inhabitants, mainly through the efforts and by the example of the Geological Society, since the comparatively recent period of its foundation. And here I am led to refer to the praiseworthy mode which the directors of the unrivalled edifice in which we have been permitted to assemble have adopted, in order to impress upon the minds of every class some of the most striking results of Palæontological Science, in the representations, for example, of geological strata, and by the restorations of associated extinct animals; in which appropriation of a part of the grounds of the Crystal Palace, a long cherished scheme and aspiration of mine for public instruction, have found their fulfilment, chiefly through the aid and artistic skill of the accomplished superintendent of that department, Mr. Waterhouse Hawkins. Time will not allow me to dwell on the great gain to the sacred cause of science by this principle of the division of labour, as it has been further exemplified by the Zoological, Chemical, Physiological, Geographical, Statistical, Medico-chirurgical, and Microscopical Societies of this metropolis. But I cannot omit referring to an English characteristic, common to them all, viz.,—that they are self-supporting that they are independent Associations of private individuals for the public weal—for the promotion of peace—for the progress of civilization throughout the world. The founders of our Royal Society began by subscribing each a shilling a week. When a young scientific recruit has now the honour of being enlisted into its ranks, and would buy up his annual subscription, he must pay down £60. About ten years ago, a liberal Administration lent a timely assistance to the aims of the Royal Society, by the munificent annual grant of £1000. This grant has been of essential service in promoting scientific investigation; by enabling the less wealthy inquirer to undertake experiments otherwise too costly; by expediting the publication of useful Constants, Star Catalogues, and the like works, which can only be published at a pecuniary loss; by enabling the naturalist and anatomist—as more than once in my own case—to procure the aid of good artists in the delineation of anatomical structures, rare fossils, and other new or nondescript natural objects. I trust that England may never be so low reduced in her righteous struggles as to make it necessary to withdraw this grant. And now, finally, in reference to the topic touched upon by the noble chairman, viz., the social position, national relations, recognition and rewards of scientific merit in this country. What these were of old—how they were once viewed—we see in the provisions made in mediæval times for the due dignity and independance of such master-minds as might achieve the higher posts at our Universities, such positions, for example, as the Deanery of Christchurch, Oxford, the Mastership of Trinity College, Cambridge, which the wisdom of our ancestors established for those men who won renown in the sciences, which alone were recognised in the time of the foundation of those and the like independent and dignified offices. The human intellect has since extended its conquests over a wider range and different fields; more congenial, perhaps, to its true aims and powers than the scholastical, logical, and theological studies which represented science before Galileo and Bacon. Has England continued to cherish and foster in the same spirit the new and fruitful Natural Sciences, as she honoured herself and manifested her wisdom by doing, in relation to the older forms of human knowledge? What, for instance, at the present period of her unexampled wealth, due mainly to the application of the abstract discoveries of science—what is the national relation of her Faraday? What is my own? Are we labouring, lecturing, in national institutions, in fixed positions, absolutely exempt from the annoyance of individual interference or caprice, in the peace-giving certitude of the continuance of hardly-earned emoluments, with the cheering conviction of a suitable retiring provision when the wearied brain begins to fail in its wonted and expected efforts? As working men in our line, with bread to earn by the work we do, England owns us not; she ignores us in the sense in which she recognised and provided for her mediæval teachers. We are merel the servants of particular chartered bodies. As a comparative anatomist, indeed, I deem myself fortunate among my fellow-workers in the place I hold, but it needs only that a majority of the Council of the College of Surgeons should so will and vote it, and after nigh 30 years' service I must begin the world afresh. My masters are irresponsible, or only remotely responsible, to public opinion. Hitherto England has devised no other or better position for the man whom she may delight to honour by calling "her Cuvier," than the curatorship of a museum belonging to one section of the medical profession. In my own case, indeed, the Council of the Surgeon's College have done me the honour to reelect me annually, for some years past, to a professorship not previously held by the curator of their museum. But this position has none of that fixedness and independence which my brother professors of the same science on the Continent enjoy. When the First Consul of France revised the appointments and position of the professors in the national establishment of the Garden of Plants at Paris, the salary which he attached to the chair of comparative anatomy, with which the secretaryship of the sciences was then associated, the appointment, I say, was on such a scale, that the finance minister remonstrated. "Cuvier," replied Napoleon, "has a position in science; it is for the honour of France that he should be able to maintain that position towards the foreign *savans* who may visit Paris." Great is the pleasure with which I can state, that the short-comings of our national arrangements for analagous cases have been well understood by the most illustrious personages and individuals of the State, who have generously endeavoured to remedy and compensate for them. The noble lord at the head of foreign affairs, in the most handsome terms, gave my son a clerkship in his office. Sir Robert Peel in assigning to me, a short time before his lamented death, a pension of £200 a year, well appreciated the acceptability of such a provision in the exemption from anxiety flowing therefrom. I shall never cease to gratefully cherish the memory of the wise and benevolent statesman, whe created for me the satisfaction of feeling that, whatever might possibly cause a termination of my present appointments, I do not thereby fall into utter destitution. Her most gracious Majesty, measuring my humble merits by the standard of her own greatness of mind, was pleased to offer me, as a residence, the mansion of the late King of Hanover, at Kew. On my respectfully representing to her illustrious consort, your gifted and philosophic president, the disproportion of my means to the fruition of that royal gift, he was pleased to suggest the assignment to my use of a beautiful cottage, in which the most healthful and delightful hours of my life have been spent, and which daily renews a grateful sense of the happiness and privilege we enjoy in the benign reign of Victoria.

The Rev. Dr. Booth, F.R.S., had been requested to propose "Prosperity to the 368 Mechanics' and Literary Institutions in Union with the Society of Arts." Four years ago they had had their first meeting, under the presidency of Mr. Harry Chester, whose absence that day, in consequence of domestic affliction, he deeply deplored. He must say that he had been greatly gratified by observing how much those societies were doing in advancing the morality and social position of the industrious classes. Of the value of these Institutions as great moral instructors, he believed too much could not be said; but he

would not occupy their time longer than to propose "Prosperity to the 368 Institutions in connection with the Society of Arts," coupling with it the name of the Hon. and Rev. Samuel Best.

The Hon. and Rev. S. Best responded to the toast, which he presumed he had been called upon to do from the circumstance of his having taken a deep interest in the success of various Literary and Mechanics' Institutions. He adverted to the great benefits which had resulted from the union of these Societies with the Society of Arts, to the spread of useful education and knowledge, and to the great moral influence which Mechanics' Institutions and Literary Associations exercised, not only on the present generation, but would equally bear on generations to come. In conclusion, he begged to return thanks for the Societies with which he was personally connected, and also on behalf of the other Institutions in union with the Society of Arts.

Earl Granville said that he had been requested by the Council of the Society of Arts to propose a toast, and he did so with great pleasure, though he felt some difficulty upon the subject, lest the arrangements of the Adelphi might come under the censure of Drury-lane, for having placed so much in the hands of members of the Upper House. He had been detained in that house, and had therefore arrived late, but he must say that he was gratified on his arrival to find that that evening they had got a grand show of the right men in the right places. In saying this he had to acknowledge the advantage of being connected with the Society of Arts, for his noble friend was perfectly aware that it was much more difficult to put the right men in the right places than the wrong men in the wrong places. He regretted that he had not been in time to hear what had taken place that evening, as he might be led to repeat something that had been already said. In endeavouring to persuade his noble friend the chairman to preside at that dinner, he had explained to him that, unlike other dinners, it would be quickly served, and the speeches would be few and short. As regarded the first part of what he had stated being true, he had had a sufficient proof, for the dinner was over before he arrived, and the second part he should endeavour to prove by the brevity of his own address. If the Society of Arts proposed to itself less ambitious objects than other learned or scientific societies, he was quite sure there was none which had done more for the advantage of the artizan, and for promoting the progress of the commerce of the country. They were apt, at the present moment, to think more of war than of peace, and it appeared to him that their Society was something like those excellent troops the Zouaves. They were apt to go into action without reference to how they were to get out again; but, in fact, they could turn their hands to everything—they were full of resources. He had read that when the Zouaves found themselves between a cross fire, they laid themselves down, and allowed the Russian regiments to fire into one another, and then when their enemies were pretty well destroyed, they got up again and made a step in advance. So the Society of Arts had kept clear from the disputes of all sections and denominations of religionists and educationalists. They had allowed them to dispute by themselves, and then, taking advantage of their position, had taken a step in advance, and none had been more important than that of bringing the Mechanics' Institutions into union with them. He believed that if Montesquieu were now alive, he would refer to the Society of Arts as a proof of the advantages resulting from good government and perfect organization. The Society had done much to assist the Government of the country in the work of education, and he hoped that within a few months they would have erected a building for a General Trade Museum, for exhibiting those various collections of the materials used in manufactures and arts, which the Society of Arts had been so instrumental in bringing together. He ventured to say that the Committee of Council of Education were desirous of doing all in their power to promote the formation of such a Museum, which might naturally be said to arise out of the Great Exhibition of 1851. This Society had much to do with that Exhibition, which had, he believed, given a remarkable impetus to individual enterprise, as well as to the commerce of the world. If there was one man more than another connected with that Exhibition, whose health they were bound to drink, it was Sir Joseph Paxton. They all knew what Sir Joseph had done towards providing them with a suitable building for that Exhibition, and which had led to the formation of the splendid edifice under the roof of which they were then assembled. They had heard that Aristides was not always just, neither were the works of Sir Joseph always perfect, and he was rather happy to fine one flaw in his character, but he hoped next year that he would carry his principles of administrative reform so far as to give them a room in which they could hear themselves and one another without the risk of injuring their lungs by too great exertion. The noble lord concluded by giving the health of "The Directors of the Crystal Palace Company, coupling with it that of Sir Joseph Paxton, M.P."

Sir Joseph Paxton, M.P., on the part of the Crystal Palace Company and himself, begged to return them his sincere thanks for the honour just conferred upon them. Such an honour could not be otherwise than most gratifying, and in acknowledging it he hoped they would excuse him if he took that opportunity, in accordance with his usual habit, of endeavouring to do a little business. They had that night heard that there were 368 Institutions in connection with the Society of Arts. He could not but feel that those Institutions benefited greatly by that connection, neither could he forget that to that Society they were in a great measure indebted for the formation of the Crystal Palace. It was the first time in the history of the world that private enterprise had brought under one roof so much that was beautiful in art and useful in commerce as was to be found in that building which was devoted to the carrying out of those objects which it was the mission of the Society of Arts to promote. The noble lord had told them that the government was about to provide a great temporary building as a General Trade Museum. Now he, on the part of the Crystal Palace Company, begged leave to offer them all the room required for the purpose. If they would bring their collection there, where it could be seen by millions, he would undertake that they should be habited in a proper and comfortable manner, free of charge, and a large expense might be thereby saved to the country. He trusted, that when the subject came to be considered by the government, the noble lord would do him the honour to remember the offer he now made, that the Crystal Palace Company would find any amount of room required for the Exhibition. He had listened with pleasure to the eloquent address of his friend Professor Owen, and he perfectly agreed with him, that too little was done in this country for scientific men and for scientific Societies. He was told that the annual grant of £1,000 to the Royal Society was about to be withdrawn; but he hoped it was not so, and he trusted that they would have the aid of the noble chairman, and of the noble lord who had last spoken, in supporting and promoting the interests of those Societies. He believed that £60,000 or £70,000 was annually drawn by government from inventors who wished to bring their inventions before the public, and he thought that money might very properly be applied in promoting their interests through these Societies. He pleaded guilty to the charge that the room in which they were then assembled was not fitted for sound, but this was the first time it had been used for such a purpose. It had only been temporarily arranged for that day, but if the Society of Arts did them the honour of holding their meeting of next year in that building, he would venture to say, that not only would the speakers be enabled to hear themselves but be heard by every gentleman present.

Lord Viscount EBRINGTON, M.P., in proposing the health of the Chairman, said that he had had intrusted to him a toast which he was sure would be received with gratification by the company assembled. He had listened with great delight to the eloquent address of the noble duke who had that day presided over them, an address which was, indeed, characteristic of the enlightened feelings of his Grace. He had heard with satisfaction the remarks of the noble Chairman on the subjects of the Financial Reform and the Administrative Reform movements. He would merely observe that in one case, the Administrative Reform agitation had been based on the ruins of the Financial Reform. The Financial Reform Association confined itself to cutting down salaries, but the Administrative Reform Association took larger views, and recognised the wastefulness of parsimony, and the propriety of giving the public labourer his proper wages. With reference to the noble duke, it was gratifying to the Society of Arts that at this, their 101st Anniversary, they should be presided over by a nobleman who was distinguished alike for his talents and for his amiable qualities in private life. He had the honour to propose the health of their Chairman, with many thanks for his kindness in presiding over them that day.

The Noble CHAIRMAN felt much gratified by the kindness with which the toast had been received. It was true, as had been said by his noble friend, that he required some little persuasion from his persuasive lips to undertake the duties of chairman that day, and in intimating that reluctance he had, he thought, proved himself a better administrative reformer than his noble friend. He thought it required some boldness to liken this Society to the Zouaves, for his noble friend on his right (Earl Granville), came running in just as the Zouaves did at Inkermann, whilst they were proceeding under a hot sun and certainly in an apartment most unfavourable for being heard, and he thought they would all agree that, although they were the right men, they certainly were not in the right place. His noble friend next him had amused them amazingly, and when he (the Duke of Argyll) was requested to take the chair, he said he knew very little about the Society of Arts; he was a member of Societies which directed their attention to the more abstract branches of science, to which Professor Owen had alluded in a speech which he should have been glad for all present to have heard, although if what he (the Duke of Argyll) had said were fully reported in the newspapers, he was afraid he should get into a scrape with some of his colleagues. He certainly did put off his official character, but he must do his noble friend (Earl Granville) the justice to say that, he believed if he had been present he would have concurred fully in all that he had said. The principle on which he had acted in the Committee on Education had been of the most liberal character, and he trusted that, setting aside all abstract theories, which tended to divide men from men, instead of leading them to unite in common action for a common good; they would continue to advocate to the utmost of their power the industrial education of the working classes of the country.

The company then separated.

## GENERAL MEETING.

WEDNESDAY, JULY 4TH, 1855.

The General Meeting for the election of officers for the ensuing year was held on Wednesday, the 4th inst., W. W. Saunders, Esq., F.R.S., Deputy-Chairman of Council and Treasurer, in the chair, when the following noblemen and gentlemen were declared to be duly elected to fill the several offices. The names in *Italics* were not in last year's list:—

### COUNCIL.

PRESIDENT.

H.R.H. PRINCE ALBERT, F.R.S., &c., &c.

VICE-PRESIDENTS.

Harry Chester.
Henry Cole, C.B.
C. Wentworth Dilke
*Viscount Ebrington, M.P.*
William Ewart, M.P.
The Earl Granville, F.R.S.
Lord Robert Grosvenor, M.P.
The Earl of Harrowby, F.R.S.
The Dean of Hereford.
Henry Thomas Hope.
George Moffatt, M.P.
The Duke of Newcastle.
*Sir Joseph Paxton, M.P.*
*Sir Robert Peel, Bart., M.P.*
Dr. Lyon Playfair, C.B., F.R.S.
John Scott Russell, F.R.S.
*Robert Stephenson, M.P., F.R.S.*
William Tooke, F.R.S.
*Thomas Twining, Jun.*
The Lord Bishop of Winchester.

OTHER MEMBERS OF COUNCIL.

*Rev. Dr. Booth, F.R.S., Treasurer.*
Thomas De La Rue.
Lieut.-Col. F. Eardley-Wilmot, R.A.
*Joseph Glynn, F.R.S.*
Peter Graham.
*William Hawes.*
*Matthew Marshall, Treasurer.*
John Cameron Macdonald.
*John Joseph Mechi.*
Sir John Ramsden, Bart., M.P.
*Samuel Redgrave.*
*William Wilson Saunders, F.R.S.*
George Fergusson Wilson, F.R.S.
Thomas Winkworth.

AUDITORS.

William Frederick Harrison | *Samuel Morton Hubert.*

SECRETARY.

Peter Le Neve Foster, M.A.

COLLECTOR AND FINANCIAL OFFICER.

Samuel Thomas Davenport.

The following Candidates were balloted for, and were declared to be duly elected Ordinary Members:—

Bacon, Rev. Thomas
Baker, William
Barlow, Robert Sharp
Barry, John Tottenham
Browne, Henry
Castleman, Charles
Chambers, David Noble
Copland, James, M.D., F.R.S.
Davis, Alfred
Dobson, Benjamin
Greaves, Charles
Hambley, Joseph
Holmes, Alfred William
Lark, James
Lewellin, Henry
Longbottom, John
Macnaught, Archibald
Mann, James Hargreave
Martin, Rear-Admiral William Fanshawe
Prevost, George
Rice, William
Rose, James Anderson
Rymer, Samuel Lee
Salmon, John
Tamplin, Richard
Walmsley, Geo. Augustus
Watkin, Edward
Watkins, Zacharia
Whittington, Rev. Richard
Wicks, John

## PREMIUMS AWARDED.—SESSION 1854-55 *.

The Council have awarded the following Premiums for PAPERS read at the Weekly Evenings Meetings:—

To Charles Atherton, Chief Engineer of H.M. Dockyard, Woolwich, for his Paper "On the

* Reports from some of the Committees have been unavoidably delayed. Should any additional premiums be awarded by the Council, they will be announced in a future number of the Journal.

Capability for Mercantile Transport Service of Steam-ships."—The Silver Medal.

To Colonel Arthur Cotton, late Chief Engineer, Madras, for his Paper "On Public Works for India, especially with reference to Irrigation and Communications," and for his persevering and continued advocacy for their extension.—The Silver Medal.

To John Bennet Lawes, F.R.S., for his Paper "On the Sewage of London."—The Silver Medal.

To John Forbes Royle, M.D., F.R.S., for his Paper of last Session "On Indian Fibres fit for Textile Fabrics, or for Rope and Paper-making."—The Silver Medal.

To Charles Sanderson, for his Paper "On the Manufacture of Steel as carried on in this and other Countries," being an Essay sent in competition for a Premium offered in the Society's Prize List.—The Silver Medal.

To Peter Lund Simmonds, for his Paper "On some Undeveloped and Unappreciated Articles of Raw Produce from different parts of the World."—The Silver Medal.

The Council have also awarded the following Premiums for Articles exhibited in the Seventh Annual Exhibition of Inventions, or submitted for the consideration of the Society's Committees :—

To Felix Abate, of Naples, for "Nature Printing from Wooden Blocks and Rollers."—The Silver Medal.

To Field and Co., of Birmingham, "For the production of Microscopes, to be sold to the public at the respective prices of 10s. 6d. and £3 3s.," sent in competition for the Special Premium offered by the Council.—The Silver Medal.

To Andrew Peddie How, for his "Engine-Room Telegraph."—The Bronze Medal.

To Herbert Mackworth, M. Inst. C.E., Government Inspector of Mines, for his "Instrument called 'METRA,' intended for the use of Mining and other Engineers, for Geologists, Scientific Travellers, &c."—The Bronze Medal.

To Messrs. W. Muir and Co., Manchester, for their "Improved Grindstones."—The Bronze Medal.

To Francis Herbert Wenham, "For an Improved LETTER LOCK, which prevents the combinations being ascertained by any other means than by working out the entire system of changes," sent in competition for the Premium offered in the Society's Prize List.—The Bronze Medal.

P. LE NEVE FOSTER, Secretary.

## MEETINGS FOR THE ENSUING WEEK.

TUES. Zoological, 9.
WED. Literary Fund, 3.
SAT. Royal Botanic, 3¾.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, June 29th*, 1855.]

*Dated 13th March*, 1855.

558. A. E. L. Bellford, 32, Essex-street, Strand—Musical wind instruments. (A communication.)

*Dated 20th March*, 1855.

627. H. T. Williams, Guilford street—Easel.

*Dated 25th April*, 1855.

935. F. J. Anger, 16, Stamford-street—Metallic alloy. (A communication.)

*Dated 1st May*, 1855.

974. G. W. Knocker, Dover—Motive power.

*Dated 9th May*, 1855.

1046. S. C. Lister, Bradford—Preparation of fibres for spinning.

*Dated 16th May*, 1855.

1101. W. Latham, Liverpool—Fabrics for saddle covers.

*Dated 26th May*, 1855.

1195. W. S. Young, Leith—Prevention of smoke.

*Dated 2nd June*, 1855.

1265. H. Galante, Paris—Surgical injection bottle.

*Dated 4th June*, 1855.

1267. M. Staite, Liscard—Black paint.

*Dated 5th June*, 1855.

1267. F. Puls, Soho-square—Electro-coating iron.

*Dated 6th June*, 1855.

1289. J. Gedge, 4, Wellington-street South—Flat tiles. (A communication.)

*Dated 13th June*, 1855.

1345. F. C. Bakewell, 6, Haverstock-terrace, Hampstead—Supplying furnaces with hot air. (A communication.)
1346. F. C. Bakewell, 6, Haverstock-terrace, Hampstead—Rotating-breech fire-arms. (A communication.)
1347. J. Avery, 32, Essex-street, Strand—Oscillating steam engines. (A communication.)
1348. W. J. Blackman, Kensington—Cough syrup.
1349. E. R. and F. Turner, Ipswich—Grinding grain.
1350. W. Moxon and J. Clayton, Rochdale—Looms.
1351. H. H. Henson, Parliament-street—Portable buildings.
1352. J. Betteley, Liverpool—Iron knees for ship-building.
1353. J. Betteley, Liverpool—Ships' anchors.
1354. G. Cottam, Winsley-street, Oxford-street—Hayracks and harness brackets.
1355. G. A. Biddell, Ipswich—Grinding machinery.
1356. E. Lodge, Mirfield, and G. Marshall, Huddersfield—Animal and vegetable naphtha, ammonia, and charcoal.

*Dated 14th June*, 1855.

1357. G. Sinclair, Regent-street—Signalling between railway guards and drivers.
1359. J. Enouy, 31, Denbigh street, Pimlico—Revolving fire-arms.
1360. A. Robertson, Islington—Packages.
1361. F. Leloup, Paris—Separating cotton from wool, silk, &c. (A communication.)
1362. S. C. Lister, Manningham—Treating silk waste.
1363. J. T. Chance, Birmingham—Glass fattening furnaces. (A communication.)

*Dated 15th June*, 1855.

1364. W. Hewitt, Bristol—Propelling vessels.
1365. W. Clay, Liverpool—Bar iron.
1366. W. Clay, Liverpool—Peculiar application of bar iron.
1367. H. Bridgewater, Alfred-place, Bedford-square—Spike.
1368. W. Lee, Duke-street, Westminster—Water closets.
1369. H. Mathis, Paris—Preserving wood. (A communication.)
1370. J. H. Sadler, Hunslet, Leeds—Looms.
1371. G. F. Morrell, Fleet-street—Ink bottles.

*Dated 16th June*, 1855.

1372. D. Pallier, Broad-street, Lambeth—Soap.
1373. W. Jones, Birkenhead—Punching machinery.
1374. J. Webster, Birmingham—Balance.
1375. L. F. Vaudelin, Upper Charlotte-street, Fitzroy-square—Railway breaks.

*Dated 18th June*, 1855.

1377. J. Sellars, Monsall-house, near Manchester—Starch.
1378. J. Carlhian and J. Corbiere, 27, Castle-street, Holborn—Moderator lamps.
1379. L. H. Réal, Paris—Elastic seatings for beds, &c.
1380. R. Peaker, Methley, and T. Bentley, Wakefield—Grinding machinery.
1381. W. H. Wilding, New-road—Furnaces.
1382. H. Bessemer, Queen-street-place, New Cannon-street—Screw propellers.
1383. W. Little, Strand—Printing machinery.
1384. H. Bessemer, Queen-street-place, New Cannon-street—Cast steel and mixtures of steel and cast iron.
1385. T. Blanchard, Paris—Bending timber.
1386. H. Bessemer, Queen-street-place, New Cannon-street—Ordnance.
1387. H. Francis, 456, West Strand—Cutting out garments.
1388. H. Bessemer, Queen-street-place, New Cannon-street—Rolls or cylinders.
1389. E. Myers, Rotherham—Raising liquids.
1390. H. Bessemer, Queen-street-place, New Cannon-street—Railway wheels.
1391. E. Myers and J. W. Potter, Rotherham—Buffers, and draw and bearing springs.

Journal of the Society of Arts.

FRIDAY, JULY 13, 1855.

## EXAMINATION OF CLASSES IN INSTITUTES.

The following is the Declaration referred to by the Conference, and in respect of which the Resolution below was unanimously passed :—

DECLARATION.

"We, the undersigned, having considered the circular letter of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, dated March, 1854, and the plan therein set forth for examining and granting certificates to the students of classes for adult instruction in the Literary and Scientific Institutions, Mechanics' Institutes, Athenæums, and other similar bodies in union with the said Society, do hereby declare that we desire to promote the success of the said plan, and are prepared to regard as testimonials worthy of credit such certificates as may be awarded in conformity thereto."

RESOLUTION OF CONFERENCE.

"Resolved,—That the Institutes, under the direction and with the aid of the Society, be requested to procure influential signatures to the Declaration."

The circular letter or memorandum referred to in the Declaration, will be found at length in the Journal for November 3, 1854, and copies may be had for distribution on application to the Secretary, to whom it is requested that a list of any signatures obtained may be sent.

## THE TRADE MUSEUM OF ANIMAL PRODUCTS AND MANUFACTURES—SOCIETY OF ARTS, LONDON.

(From the *Scotsman.*)

When the glory and greatness of the first Crystal Palace were about to pass away, it was wisely resolved that an effort should be made to establish a permanent exhibition of useful products, which might perpetuate the utilitarian, if it could not preserve the æsthetical, attractions of the wondrous building. The Royal Commissioners of the Great Exhibition of 1851 accordingly acquired the possession of many of the objects of interest displayed in the Crystal Palace, and many of the exhibitors liberally contributed either the original specimens, or duplicates of these, as materials for the inauguration of the permanent collection. It was resolved to style this the Trade Museum (a title far from significant or well-chosen, as *Punch* has taken care to tell the name-givers and the public), and to make it a "collection in illustration of the productions, industrial resources, manufactures, and commerce of all countries."

Various circumstances have hitherto prevented this idea from being carried out as it was expected to have been; but the Society of Arts, of London, with the sanction and co-operation of the Royal Commissioners of the Great Exhibition, have this summer made a beginning, by opening an exhibition in the model-room of the society in question, of samples of animal produce and manufactures.

Animal products in their raw form, and in many of their stages of manufacture, are much less attractive objects than the raw materials of the vegetable and mineral kingdoms. In the latter, indeed, the raw material is not seldom more beautiful than the most elaborate objects which human skill can construct from it, whilst the products of this material are often beautiful also. But from the raw hide, for example, onwards through its cleansing, tanning, currying, blacking, cutting, and sewing, till it yields several pairs of thick-soled shoes, it is not very easy to awaken an unprofessional interest in leather; unless, perhaps, when, richly dyed and gilt and tooled, it appears as the morocco binding of some rare folio, dear to bibliomaniacs. The same may be said of bones, bristles, horse-hair, fats, and oils, not to speak of refuse matters; and it is only silk, fur, wax, and shells, which would gratefully attract the eyes of general visitors to the Animal Trade Museum.

The Society of Arts, however, and the Royal Commissioners, had a valid reason for selecting animal rather than vegetable or mineral products for their present exhibition. The Museum at Kew Gardens, collected under the auspices of Sir William Hooker, contains a splendid collection of economic botanical specimens; and the Museum of Practical Geology at Jermyn-street, Piccadilly, is equally rich in illustrations of the economic applications of geology and mineralogy. Kew and Jermyn-street thus form two-thirds of what a perfect Trade Museum should be; and the present temporary exhibition at the Society of Arts' Rooms, John-street, Adelphi, represents the nucleus of the third essential component of such a museum. It will very much depend upon the interest which the public manifests in the Adelphi Exhibition whether it is made permanent or not as part of a general Trade Museum. The admission is free; but the Exhibition will continue open for only a week or two longer, and it competes, at a formidable disadvantage, with the attractions of Kew and Jermyn-street, the splendours of Sydenham, and the Great Exhibition at Paris; nor are the warlike sympathies and political discontents of the day at all favourable to the interests of peaceful museums. But those interested in economics, who visit London, will find it worth their while to spend an hour in the Adelphi collection. It has been brought together with much labour and care, chiefly by Professor Solly, who has bestowed a large amount of attention on the subject of Trade Museums. Some two years have been spent in collecting the specimens shown, in addition to many more which there is not room to exhibit. They are arranged on a three-fold principle, carried out systematically by Mr. Solly, and to this effect: —1. A Trade Museum should contain samples of the productions, both raw and manufactured, of all parts of the world, such as leather, wool, silk, woods, gums, oils, dyestuffs, drugs, ores, and the like, so that a visitor could at once compare the silk or wool, for example, of France, Russia, Sweden, Italy, or England, with that of Canada, the United States, Persia, China, the East Indies, South Africa, or New South Wales. 2. There should be illustrations in such a Museum of all manufactures, from the collection or raising of the raw produce, through every stage or operation to which it is subjected, down to the most finished products. 3. The Museum should show progress, by exhibiting raw and manufactured articles of known age for the purpose of comparison with those of the present time, so as to illustrate the history of improvements, and save ingenious men from wasting their time in inventing as novel what has long ago been invented, and perhaps found insufficient, and thrown aside. The Museum is thus to some extent historical, but eschews being antiquarian.

One of the most complete sets of specimens thus arranged is the wool series. It begins with several entire fleeces, skulls, and portraits of important breeds. These are followed by wools in tufts, locks, and parcels; by illustrations of carding, combing, scouring, dyeing, weaving, &c.; by samples of alpaca and mohair fabrics, and of all the tissues into which wool enters as a component, the series ending with the applications of shoddy and "devil's dust" to the manufacture of pilot coats (!) and wall papers.

In the silk series, we commence in a similar way with the silk-worm's eggs, caterpillar, cocoon, and moth. Silk-moths of various species, and from different parts of

the world, succeed to these; and then the ordinary cocoons from all the countries where silk is produced, which in their turn are followed by samples of raw and manufactured, dyed, woven, and figured silks; the historical element being represented by specimens of fabrics worn in the days of our grandmothers, among which is one breadth of a gown once the property of the redoubted Sarah Duchess of Marlborough.

The Museum is necessarily utilitarian in its character and aspect, but its arrangers have been careful to relieve it, where they could, of too sombre an air. The bone series includes some splendid skulls, horns, and tusks, and many beautiful ivory carvings. Most ladies would linger with pleasure over the fur series, and compare with interest the ermine tippet worn by a Peeress at George III.'s coronation, with those which were the fashion when Queen Victoria was crowned. Under feathers, there is a brilliant show of fishing flies; under skins, occur some fine examples of bookbinding, and a curious series of illustrations displaying the various stages of the gold-beater's art. Even under refuse matters, a group of magnificent lemon-coloured crystals will be found, the basis of some of our most splendid pigments.

No intelligent person can fail to find an hour spent in the Animal Trade Museum a source of instruction and pleasure. It may also interest many, as showing one of the great classes of products which will be collected in the Industrial Museum of Scotland, which is still, but will not long be, in its cradle.

## Home Correspondence.

### UTILIZATION OF IRON SLAGS.*

Sir,—Permit me a few remarks on the patent process of Dr. Smith, of Philadelphia, referred to in Mr. Davison's letter;† it is a subject to which for three years I have given some attention. Early in 1852 I was consulted by Mr. Elliott, of Blisworth, on a patent taken by him in 1850 for the same purpose, specimens of the manufactured produce having been exhibited in the Hyde Park Exposition of 1851. On perusing the specification, I suggested some improvements, and Mr. Hindmarsh and Mr. Webster coinciding in my opinion, a second patent was secured, and this patent, dated prior to Dr. Smith's, comprises in the specification the annealing process and every other important claim, clearly subjecting any minor manipulations to a license from the prior patentee. But the field is most extensive, the objects most important, the time required to bring operations of such magnitude into general use is great, so that united efforts are most desirable, and I am confident the holders of Mr. Elliott's patents will be disposed to do everything in their power to promote and assist Dr. Smith's course of action. As the matter proceeds, there will, more than probably, be great scope for securing by patent further minor improvements of detail, but all these must remain subsidiary to the first general claim for converting the iron slags into a compact and durable material by the process of annealing. The value of annealing in the ordinary glass manufacture is well known, but it has a still higher importance to those who are well acquainted with the nature and behaviour of the slags or cinder of smelting furnaces. These require a still further degree of annealing, amounting, in some cases, to devitrification, to ensure an available and marketable product. The igneous solution of the earths by an alkali, cements common glass into a homogeneous compound, in which the great variation of expansive and contractile capacity belonging to the earths is comparatively amalgamated. Alumina shrinks under intense heat, and remains contracted when cooled, a property on which it is well known that Wedgewood founded his pyrometer. Silica, on the contrary, expands under heat and re-contracts on cooling. I have seen a cupola blast furnace built with highly-silicated bricks, extend itself upwards from four to six inches, or more than one-tenth of an inch per foot while under blast, and sink to its original level when cold. It is the action of these opposite qualities which gives such an *apparent* brittleness to the slags of the iron smelting furnace. The silica, which is their principal constituent, united with lime, which is less variable either way, rapidly contracts as the outer surface cools, and shells off from the hot and still expanded mass; fragment after fragment falls away, and if there be much lime interspersed in the bulk without fusion, the interior will fall to powder when cooling. But both the outer fragments and the internal mass, when once cold and contracted, are anything but a brittle substance; the hardness is great, the vitrid texture resists the action of water, and from these combined qualities such slags have long been in request, as excelling all species of rock, for the purposes of road making. The rationale of the effect of annealing in addition to slow cooling, is well known. Crystalisation or solidification, whether from liquid or igneous solutions, is more complete and solid the more slowly the process proceeds. Very large crystals are obtained by slow evaporation, and there is abundant evidence of a similar effect in producing a massive and solid structure by the slow and uniform cooling of vitreous fluids. Thin masses of slag, drawn out into twisted and other ornamental shapes, have always been a favourite decoration of the furnace-man's cottage. These thin masses, cooling throughout at once, do not loose their tenacity, and on the other hand, the last portions of slag which run out with the iron, resting in bulk on the surface of a body holding so much more specific heat, cool far more slowly than their own constitution would permit, and by this species of annealing develope a large and crystalline arrangement in their fracture. Mr. Elliott proposed, by processes of annealing duly applied, to convert the several million tons of iron slag produced yearly in this country into tiles, draining and sewage pipes, paving and other bricks, and architectural mouldings of every description. It is as long since as November, 1853, that I called public attention, by a letter in the *Mining Journal*, to the vast economical promise of such a manufacture. For all underground works, cemeteries, drains or sewers, such bricks and pipes would be invaluable, from the absence of porosity, and impossibility of decomposition. Under some fairly-grounded views, but in which I did not entirely coincide, the first operations of the company holding Mr. Elliott's patents were directed towards establishing, under his first patent, the manufacture of a certain proportion of these valuable articles, in combination with the ordinary brick manufacture. Reasons of convenience dictated these preliminary experiments before encountering the difficulty referred to in the discussion on Professor Wilson's paper,* of persuading iron masters, engrossed in expensive and extensive operations, to disturb their ordinary routine by any course of experiment. But it is obvious the safest, widest, and readiest field for commencement lies in the manipulation of their slags, already fused without cost, and thrown away to waste, at an expense in labour and land which would go far to cover the cost of labour in moulding. The ultimate success of the manufacture will depend on the cheapness with which effectual annealing can be realised, and on the amount of labour required to utilise the whole daily produce of the smelting furnaces, so that articles of not only partial use and high price may be brought into the market, but a large bulk of produce of general utility. In those ornamental fabrics to which Dr. Smith seems peculiarly to have addressed his attention, the cost of polishing will probably form an important item. The substance is much harder than ordinary glass, combined

* It will be seen by the date at the foot of this letter, that it was written before Dr. Smith's paper was read to the Society, and which will be found printed at page 335.

† *Vide* ante, page 307.

* *Vide* ante, page 247.

with a large bulk of alkali; it is harder than porphyry, serpentine, and other ornamental siliceous rocks containing water of crystallisation, and still harder than marble with its copious constituent of carbonic acid. The same cause which gives hardness for decorative uses, gives greater weight for common uses, increasing the charge of transport. The density is double that of ordinary brick or tile, but to compensate this inconvenience, the greater strength, when properly annealed, will permit of a thinner substance for roofing or draining; and for building the weight is diminished to any degree by indefinitely varied modes of piercing, which fall under the claim of Mr. Elliott's specifications. Numerous avocations have prevented me from taking any active part in superintending the working details of applying these patents, which, considering the wide and important prospects they indicate, I should have been most desirous to assist in; but for those who can devote their whole time and energies to push the matter to a conclusion, there promises a scope for the united and hearty action of not two only, but even of ten times two, patentees; and I trust that all interested will join in earnest in pressing forward a comprehensive result to their mutual advantage in so important a field.

I am, sir, your obedient servant,
DAVID MUSHET.

March 20th, 1855.

## INTERNATIONAL DECIMAL COINAGE, WEIGHTS AND MEASURES.

Sir,—It appears from the discussion recently held in your Society in reference to the approaching Congress at Paris, the object of which will be the consideration of an International Code of Mercantile Law, that the adoption of a general system of measures, weights, and coins, is considered as included among the great aims of that Congress. (See *Journal* for February 9th, p. 190, 192, 196.) Your Society, I believe, took an active part in the promotion of this object at an early period of its history, and I rejoice that the subject was resumed by its Council, when they resolved to present to the Lords Commissioners of Her Majesty's Treasury that admirable memorial which is published in your *Journal* for March 25th, 1853.

The Council of your Society having declared its opinion in favour of a uniform system of measures, weights, and coins for all nations, I beg to offer a few remarks with a view to the introduction of this subject at the Congress in Paris, to which I have alluded.

As in every separate country the adoption of any particular coinage, as well as of any particular set of weights and measures, is determined by the law of the land, so the adoption of any international metrological or monetary system must depend on laws, upon which the nations in union agree. Commercial law, therefore, seems to include laws on the subject of measures, weights, and coins among its special objects. It is true that in numerous instances an accordance in the employment of the same measures, weights, and coins by different nations has been attained even independently of law. It appears to have resulted from a common perception of the advantages to be derived from such agreement. But there can be no doubt, that without any stronger and more permanent bond, this agreement is always in danger of being broken, and there are, moreover, numerous circumstances and various arrangements, which might be determined by law so as to introduce great improvements. If any two countries, such, for instance, as France and Belgium, agree to a very great extent, even without being bound by treaty, or by any sanction beyond a prevailing sense of justice or of mutual advantage, additional securities and still greater exactness might be obtained by common regulations.

Suppose, then, we were to send delegates to Paris to confer upon the subject at a general Congress, what course should we adopt?

Mr. Decimus Maslen, one of the earliest and ablest advocates of what is called the Pound and Mil Scheme, in his "Decimal System of Money, Weights, &c., London, 1841," proposes a *concordat* among the nations of Europe for this purpose, but he assumes that the scheme, which he espouses, being based upon the pound sterling, is so indisputably superior to every other, that if different nations are invited to join in a particular plan, this and no other must be the method proposed. His conclusion is in the following words:—

"I should hope that there can be but one opinion as to its usefulness, its simplicity, its facility for each country, and its perfectness, and therefore, if foreign nations cannot see their own interest in adopting it, if their jealousy of England is such that it blinds them to the advantages of a universal and uniform monetary system, they must even jog on in the old rotten road, in which they have stumbled along for so many centuries from the dark ages of ignorance, prejudice, superstition, and error."

Thus does the sanguine advocate of a new system, or, in other words, of a coinage for the most part never tried, and existing only in imagination, regard it as certain to succeed universally because it is based on the English pound; thus does he assume, that nothing but prejudice and barbarism can oppose the acceptance of so great a boon. The Mandarins and bonzes of China would put forth exactly the same pretensions on behalf of their money, and perhaps with better reasons.

Others may commit an error the very opposite of Mr. Maslen's by proposing to go to the Congress with their minds like a sheet of white paper, quite unprejudiced, ready to inquire and be informed, and to receive any impression according to the light of truth. It should be remembered, that we go to meet delegates from other countries, with whom the subject is not new, and that if we go to Paris to learn our A, B, C, we can expect nothing better than a cool and polite indifference to our childish ignorance from those who have long been familiar with the question, both in its general aspects and in all its details. We must not suppose, that we are entering upon new ground. If with seeming candour and generosity we propose, that all other nations should unite with the English in investigating the best principles and methods of procedure with a view to their universal adoption, we shall be told, that we are only proposing what has been done long ago; that the French Government, before the great Revolution, took steps to engage the co-operation of other countries; that they were joined by some of those countries; that the system then agreed upon has, after overcoming a multitude of obstacles, been firmly established; that it has been hitherto as successful as could, under such adverse circumstances, have been anticipated; that it is highly approved and admired by those who have attended to it, and seen it in operation; and that there is now a very encouraging prospect of its further extension.

To me it appears manifest that in any continental congress upon this subject, the discussion must be to a great extent, and perhaps mainly, directed to the consideration of the *Système Métrique*. This is the only system of measures, weights, and coins, which is founded upon exact and philosophical principles; which, in consequence of being formed upon no local or partial basis, but designed for mankind at large, and offered to the acceptance of all nations, has a just claim to impartial attention; and which cannot be altogether and at once abandoned by those who have decided upon its adoption after the most careful inquiry, and who have found it in general well adapted to their requirements. No one can be a fit delegate, who is ignorant of this system, or decidedly hostile to it. He ought to be prepared to give his general assent to the merits of those by whose labours and investigations it has been brought to maturity, although nothing need prevent him from proposing improvements not at variance with its main principles.

Notwithstanding its general excellence, there are probably circumstances of detail in which the *Système Métrique* may be improved, more especially when regarded as a system for universal adoption. By way of an example, I may mention that the corresponding French and Belgian coins are said not to have contained at all times the same quantity of alloy. A convention of states might decree that all their coins of the same metal and denomination should contain the same proportion of alloy, be of the same size and weight, and differ only in their image and superscription. Another question of no less importance would be how to obviate the loss and embarrassment which frequently arise from changes in the value of the precious metals. Silver being the standard, and the franc the measure of value, gold would vary in price on the usual principles of demand and supply, and this circumstance would make it necessary to vary from time to time the quantity of gold in coins of the same denomination. This would be done in the most satisfactory and efficient way by a congress or meeting of delegates, held at stated times for this and similar purposes. Nothing can be conceived better adapted to the wants of the most advanced civilisation than an international decimal coinage, regulated by common consent, and accompanied by a corresponding international system of weights and measures. It would obviate the tendency to superfluity in some coins, and to deficiency in others; it would annihilate the delay and embarrassment incurred in changing the coins of one country into those of another; and it would extend to nations the same conveniences which have now been enjoyed for a long period of time by provinces.

In confirmation of these remarks I would refer to the letter of the Vienna correspondent of the *Daily News* in the number of that journal for February the 17th. The writer gives an account of the conference held at Vienna by representatives from the principal states of Germany, with a view to the adoption of a common coinage. Austria proposed a new coin of gold, and the other states one of silver, this metal being preferred as less liable to great fluctuations. The writer concludes his account by saying:—"It is generally believed that the only way is to make concessions on all sides, throw up all existing coins, and boldly introduce the most perfect system, theoretically and practically, known in the world, the French decimal system."

I notice a fact mentioned by Mr. Jacob Franklin, in his essay lately read before your Society (see *Jonrnal of the Society of Arts*, Feb. 16th, page 219), as tending to another most important assimilation. He observes that the German Zollverein has adopted a *zoll-centner* or *cwt.* equal to 100 half-kilogrammes. We might do the same by a very small reduction of—

Our ton = 1016 kilogrammes.
Our sack = 101·6 ditto.
Our cwt. = 50·8 ditto.

In all our great mercantile transactions, as well as in weighing all bulky articles for domestic use, such as stone, gravel, ores, iron, coals, potatoes, sugar, cotton, wool, tallow, timber, &c., and in all calculations connected with shipping and engineering, we should, by a slight adjustment, to wit, by striking off sixteen parts in a thousand, come into exact accordance with the whole of Western Continental Europe; for the French weights, as I have reason to believe, are employed in Holland and Denmark, as well as in all those countries which use the French monetary system, and the introduction of them has been decreed in Spain and Portugal.

I have thus endeavoured to explain the views and motives with which, as it appears to me, delegates from this country might attend the approaching congress. To show that we are willing to meet our neighbours upon common ground, instead of standing aloof from them, as we have hitherto done, would of itself have a salutary influence, and would tend to raise our national character. The diffusion of information respecting the progress and extent of the Système Métrique, the difficulties it has encountered, its allowed benefits and its alleged defects, would be very important. Indeed this appears to me of so much moment, that I would suggest the offering of prizes for the best historical memoirs on the origin and introduction of the system, since we are greatly in want of such information, and a well-compiled narrative, relating facts and recording arguments, would be exceedingly valuable. Whether we might obtain any immediate practical result or not, it is certain that fair discussion, friendly intercourse, and candid and impartial consideration of the subject, as one combining the interests of commerce with those of science and philanthropy, would do honour to the authors and members of the delegation, and conciliate respect and confidence towards the nation which sent it forth.

That your ancient and powerful Society may never renounce or forget its high office of calling science to the aid of commerce as well as of manufactures and the arts, is the sincere wish of, Sir,

Your most obedient servant,
JAMES YATES.

Lauderdale-house, Highgate, March 3, 1855.

P.S. June 26th. Notwithstanding the result of Mr. Brown's motion in the House of Commons, on the 12th instant, and the little support there given to Mr. J. B. Smith's amendment, the intention of holding a general congress this year in Paris for the consideration of international measures, weights, and coins, is by no means abandoned. The celebrated Michael Chevalier, perhaps the highest authority in Europe on this subject, in letters which I have recently received from him, expresses the warmest interest in the movement now commencing both here and in the United States of North America; and in particular he expresses his high admiration of the extensive views of Mr. J. B. Smith, observing that a reform confined to money would be insignificant, and that it ought to embrace weights and measures in order to cement the harmony and union of civilised nations, and he concludes, "Honour be to him [Mr. Smith] for his effort; success will one day be his reward." J. Y.

## LIFE BOATS.

13, Brompton-row, June 4th, 1855.

Sir,—It was with great regret I observed that the Society had not been able to find an opportunity for the reading and discussion of Mr. Henderson's excellent paper on Life-boats. It is a subject in which I take much interest, and I wish to offer a few observations upon it, if you should think them worth insertion in the Journal of the Society.

I would first advert to an alleged source of danger to life-boat crews, which I think is imaginary—that of the boat turning *end over end.* This has been, I think, on five occasions alleged by life-boat crews as the cause of the loss of their boats.

Now, it is obviously natural for boatmen to wish to assign for such an accident some cause beyond their own control, rather than to attribute it to their own want of nerve or of seamanship. This observation does not necessarily charge the men with falsehood. No one who ever has been upset in a boat in rough weather will be unaware of how entirely impossible it is for men who are knocking about, and bruising themselves against the boat, or swallowing salt water by bucketsful, to get any distinct idea of what exactly does happen, and it is quite natural for men to argue from the extraordinary nature of their sensations to an extraordinary cause, for then, especially when the ordinary solution of the difficulty might impute to them a want of skill or vigilance, of which they would be unwilling to accuse themselves.

I do not believe any boat will capsize end over end. Let any person who does, take a model down to Brighton or Ramsgate, and try whether he can get it capsized in that way. The way in which a boat, carefully steered, upsets in a sea-way is from a great wave striking her hard

enough to disconcert the crew; she then slews round to the next wave and goes over. I have seen this happen frequently.

On the other hand, I have been caught by a topping sea in a dingy, eleven feet long. I pulled straight at it, and, instead of turning end over end, I went through the crest of the wave, half-filling my boat, and getting knocked into the sternsheets. Of course I knew what the next wave would do; so instead of waiting for it, I dived right into it, and helped my boat ashore bottom up. Now, if anything could turn end over end, I think it is a dingy eleven feet long.

The circumstances attending the upset of the Appledore life-boat seem evidently to have been mis-stated by the crew. The Tynemouth case seems more doubtful, but I do not think it is clearly established, even in this case, that she went right over in the line of her keel. At any rate, however, this misfortune was principally owing to a bad arrangement for the water-ballast, and to the men not being properly secured.

In the whole discussion on life-boats, one question seems to have been almost entirely neglected, and that is the selection of different boats for different places and services. The boat that is to rescue a collier's crew among the sands of our eastern seaboard, and the one that is to land some score of emigrants at every trip upon the open shores of the channel, are two things as essentially different as the dog-cart that takes you to the meet, and a Hampton Court van. To expect a boat to be invented which shall perform all services, on all shores, and under all circumstances, is exactly as absurd as to expect to have a carriage which shall be fit to carry the family to church on Sundays, pigs to market on Saturdays, and farm produce to the homestead the other days of the week. This is nothing more than every boatman knows, but the public does not know it. The public never does know these things until they are forced upon its notice, and it is not by inventors that it is ever warned not to expect too much.

The Duke of Northumberland's Committee has done something to keep up this expectation of a paragon life-boat by its offer of one prize to the one boat which should come nearest perfection. I do not disparage his Grace's noble offer, or its invaluable results. It is true that it has not given us what could not exist, but it has done two things past all price. In the first place, it has given us a good average of the best of the various inventions, so that we have an excellent boat for general purposes; and secondly, it has brought before the public an immense mass of useful ideas, which may be turned to account wherever any special service is required.

Capt. Washington and his coadjutors have so much more experience than myself, that I have some diffidence in suggesting whether they may not have given too much value to the *self-righting* quality. This quality can only be gained by the sacrifice to some extent of several other virtues. It demands high air-cases, which catch the wind,—a heavy keel, which increases the draught, and makes the boat labour, and even then it cannot right itself if its crew are lashed to their seats. It would be very useful to have a return, unencumbered with other matter, of the results of life-boat upsets, showing the proportion of crew and passengers of the life-boat saved. (1) Where the boat did actually right itself, (2) where it did not. It is so difficult to return to a boat, when once tumbled out of it so roughly, that I doubt whether the two proportions would be very materially different.

With reference to life-boats partaking of the character of the raft, or catamaran, I venture to bring under notice an invention of Mr. H. Augustus Severn, of the Royal Australian Mint, which seems to combine most, if not all, the advantages of Richardson's, with a power of turning to windward, which Richardson's does not possess.

It is, in fact, a whale boat divided longitudinally, flat sides put to each half, and the two halves set eight or ten feet off by means of three strong beams, with diagonal bracing. An iron or copper band passes along the top of each beam, round the outside of each half-boat, through a slot in the keel, and up the flat side to the beam again, where it is strongly secured by a slot and key, or by nuts. If it is desired, blocks may be put between the beam and the band, so as to make it a compound girder. A platform of strong rope netting, or metal lattice, is stretched between the halves, and a mast is stepped on one of the beams. Air cases and water-ballast tanks are placed at the sides, above which the rowers sit.

In a model this boat seemed everything that could be desired, as far as its sailing and seaworthy qualities were concerned. It would sail to windward through waves higher than its length, and nothing seemed to capsize it. The model has been severely tested, and a full-sized boat is now building at Sydney by the inventor.

It is evident, that in this boat the metal-centre is thrown so high, that it matters little how high it is ballasted. It is consequently well adapted for carrying large loads of cargo or passengers, and would serve well for landing or embarking horses, artillery, or cattle.

I am, sir,
Your's truly,
CHARLES W. MERRIFIELD.

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## THE PANOPTICON PRINCIPLE OF BUILDING FACTORIES.

Sir,—The Society of Arts have already honoured the memory of the late Sir Samuel Bentham by the insertion in its *Journal* of details of several of his improvements; and I would now solicit attention to another of them, the value of which has only of late been appreciated, and that only in the instance of one of its several applications. I allude to *Panopticons*, that is, buildings which from their mode of construction, afford a point of central observation, from which all that is going on within their walls may be inspected. Jeremy Bentham (Sir Samuel's brother), in a letter to their father, ascribes the origin of this invention to Samuel's observation at Paris, that in a public educational establishment there, an inspector perambulated the sleeping apartment of the pupils during the whole night, to observe through a glass window, whether any of the inmates of the separate chambers were stirring or misconducting themselves, but it was not till the year 1786 that Sir Samuel carried his ideas into effect. At that time, when in command of a battalion near Kricheff, he had the entire management of several of Prince Potemkin's extensive manufactories, but having literally no skilled or scientific assistant, he was compelled, as it were, to superintend the fabrics himself. To save time and trouble, he therefore devised a structure, from the centre of which he might witness all that was going on. Military operations soon called him to the South of Russia; this first Panopticon was abandoned, but in the year 1806, when on a mission from this country to Russia, and having orders to exert himself to gratify the Emperor Alexander's wishes, a Panopticon for a School of Arts was erected, under Sir Samuel's direction, at Ochta. This structure is particularly mentioned, because, having been in it myself, I can vouch that from its centre all that was going on within the building was visible, and that, although the central part was 140 feet in diameter, to which centre five rays were added, each of them 105 feet long.

In this country the Panopticon principle has hitherto been only adopted for prisons, and it is only of late years that its efficacy has been generally acknowledged. Yet it would seem that it is no less desirable for the purpose it was originally designed for, namely, a *manufactory*.

Without recurring to the effect of the "Master's Eye," it must be admitted that supervision of the several subordinates employed is no less conducive to the prosperity of a manufactory than is the overlooking of the operatives, and this effect can only be insured in a Panopticon, for it is only from a central point of observation that the many chambers of a manufactory can be at once inspected.

This in a panopticon is feasible by either its proprietor, his partner, his chief manager, or by any other person appointed to perform the important business of general inspector. In the model of a building of this nature, which Sir Samuel made for his brother Jeremy in the year 1794, the floors were so constructed, that from one point of view two separate stories were equally in sight, but such an arrangement of course requires much mathematical calculation. In that model, also, a central chamber was shown, wherein a considerable number of persons might witness not only the several operations going on, but also the habitual treatment of the prisoners. This chamber was proposed to be open to the public by night as well as by day, and for inspection of the upper floors and dormitories an inspector's chair was provided, in which he could raise himself to any height. The provision of such a chamber might be desirable in many manufactories, since it has been found that the presence of strangers is apt to disturb the assiduous attention of the operatives.

A prominent advantage of this mode of structure is, that without injury to the façade, the building may be augmented according to need. Thus a central part only may be at first constructed, and rays added to it as wanted, or the rays themselves may be from time to time lengthened.

In these days of rapid progress, and the application of *reason* to so many things, it may not be a visionary hope that the existing form of buildings will be no longer adhered to, but that in lieu, subserviency to use may be no less considered than established practice.

I am, sir, yours truly,

M. S. BENTHAM.

Holly Mount, Hampstead, June 30th, 1855.

## MEN OF SCIENCE AND PATENTEES.

Sir,—At the Society's dinner at Sydenham, attended by men of all classes and pursuits—the philosopher—the man of science—two distinct phases of mind—the man of practice—the man of arts, and the man of buying and selling—Professor Owen descanted on the hardships endured by men of abstract science, producing nothing palpable wherewith to go into the great market of life, and yet the benefactors of the community, indirectly in giving rise to new arts, in which practical men find some prizes and many blanks. He himself received, he stated, £500 per annum from the College of Surgeons so long as he shall do nothing which they may consider heretical; and beyond this he has the gratuitous use of a cottage belonging to one of the royal palaces.

Sir Joseph Paxton, in commenting on this speech, alluded to the Patent Laws, and stated, pertinently enough, that out of the taxes contributed by patentees, in return for their protection in the uses of their own brains, ample funds could be given for the remuneration of the workers at abstract science.

There is great justice in this. The men of abstract science, the Daltons and Faradays, working indirectly for the public, work, and more directly for inventors, could be compensated without charity.

Much discussion on the Patent Law has appeared in your pages. The effect of the Amended Patent Law has been to make patents nominally cheaper, but really dearer, but the great evil, the costly, unnecessary, and uncertain legal process of adjudicating disputed patents is left untouched. How long shall patentees labour under this grievance?

Patents are granted on the ground that without them active-minded people will not take the trouble to invent and bring new and useful things out for the public benefit; and the patent must be for something *new*. Now, there is nothing really new under the sun; and, consequently, the patent can only have reference to something not in actual use, or not recorded. Intrinsically this question is of something not in actual use, for a neglected record is equivalent to being not known. It is held that landed property having no legal owner for a certain number of years lapses to the actual possessor; therefore, as the patent really is granted to induce people to put things to public use, it is probable that when we are a little more enlightened, we shall hold that things which have disappeared for forty years from public use shall be considered as new things, rediscoverable, and capable of being dug up and patented as though no record of them had ever existed; and the public would clearly benefit by having attention constantly directed to the fructification of the old as well as the production of the new.

This was the opinion constantly advocated, of my revered friend, the late John Farey, and I apprehend it will be difficult to disprove. It is worthy of agitation in your pages.

I am, sir, yours faithfully,

W. BRIDGES ADAMS.

July 3rd, 1855.

## THE PARIS UNIVERSAL EXHIBITION.

Sir,—As I am fully aware of the interest which the Society of Arts takes in the success of the Paris Universal Exhibition, I think it advisable to send you a few lines concerning the progress of this important undertaking; indeed, it is only fair play to let you know the truth upon the subject, as the English journals have hitherto done nothing but throw cold water upon the whole concern. My information will be derived from my own personal observation at the Palais de l'Industrie during the whole of last month, as well as from a constant intercourse with several members of the Imperial Commission.

At the opening of the Exhibition the general impression was one of disappointment. Natives and foreigners, all expected that things would have been more forward, and in a better condition to receive the offerings of civilized nations. That such was not the case, became but too apparent from the unfinished aspect of the building—from the numberless bales of valuable goods strewed here and there, and from the general air of ruin and desolation prevailing everywhere. And then, what a string of grievances against the arbitrary measures of the contracting company. To think of obliging a Frenchman to pay for the pleasure of viewing the wonders of industry and the delights of the fine arts. Why, sir, the idea alone was preposterous, and could end in nothing else but a total failure of the undertaking. Such was the hue and cry set up at first by our friends and allies, which, as a matter of course, was followed in by the firm and steady battalion of all "Our own Correspondents."

Well, two months have elapsed since the beginning of the Exhibition, and how far have these gloomy expectations been realised? There is no gainsaying figures. For the last three Sundays no less than ONE HUNDRED THOUSAND persons visited the Palace, and every day of last week they numbered between twenty and twenty-five thousand, Friday excepted, on which day the price of admission is five francs; in fact, people begin to say, the English as well as others, that the Exhibition will, in point of detail, prove superior to our own in 1851. So far from being a failure, the Paris Exhibition turns out to be a signal success. How are we to account for this, as well as for the untoward circumstances which marked its beginning?

In regard to the latter question, allow me to say, sir, that the French government had undertaken a thing utterly alien to the previous habits of the nation. You are well aware that Museums and Exhibitions of every description have always been thrown open freely and gratuitously to the people. On the present occasion, however, the government entered upon the undertaking according to the English system of private speculation, and a company contracted for the building; hence the necessity of requiring a fee for admittance, and hence so much grumbling, so many complaints.

The very circumstance of entering upon this new system gave rise to difficulties of which we can hardly form an idea in our own country. These difficulties have, however, been conquered, as well as others of a more serious nature—I allude to the want of energy and decision in the persons who were placed at the head of the organising commissions. It would be invidious to speak disobligingly of those who have been lately removed from office, I shall, therefore, confine myself to the fact that since Mons. Le Play, an eminent French engineer, has been entrusted with the executive power, he has already done wonders, and to his strong impulse, fully supported by Prince Napoleon, may be attributed the progress which has marked the last and the present month.

First of all, such exhibitors as had been hitherto daily putting off the display of their goods, though everything was ready to receive them, had notice of immediate eviction in case they did not proceed to business without delay. The consequence of this measure alone has wrought miracles during the last fortnight, more particularly among the French, who were conspicuous for their inconceivable neglect and disregard of time.

2. The completion of the building, and the creation of new structures in every direction, has been pushed on, day and night, with surprising rapidity, so that at present the whole Exhibition is really accessible to the public at large. In the immense *annexe* which runs along the river, the machinery is worked by steam, so that visitors may thus witness in practice the wonderful inventions of human ingenuity. I can assure you that this forms by no means the least attractive part of the Exhibition.

3. The new director has established a most useful branch of administration in an office where a certain number of gentlemen are constantly in attendance to give information and inquire into complaints. One of them is familiar with several European languages, and I know from personal experience that he has already been of some use to several of our countrymen, as well as to the Germans and Italians.

4. Measures have been taken to facilitate free egress and ingress to all exhibitors and their workmen or attendants. At any rate, when any ca ual difficulty occurs, they have but to apply to the *Bureau des Réclamations*, to see it immediately solved or soothed down. Indeed, in this respect, I must candidly admit that some of their pretensions are downright extravagant, and, if not curbed, would lead to the admittance of 42,000 gratuitous visitors every day, to say nothing of the frauds practised upon the Company.

The results of the new spirit infused into the administration by M. Le Play are fully apparent in the splendid appearance the Exhibition has now assumed. Indeed, it does him the greatest credit, no less than the affability with which he receives the foreign commissioners and agents at every hour of the day. Let him be ever so busy, his door is open to them, and if they do not choose to seek for support on difficult occasions, but prefer to grumble on, it must certainly be laid to their own door.

And now, sir, let me add that our countrymen would do well to come over at once, whilst the Exhibition is still in all its freshness and beauty. The admirable workmanship of the French artists in jewellery, bronzes, porcelain, &c., is not only worth seeing for an amateur, but might furnish excellent hints and practical lessons to our own artisans. The simple inspection of such masterpieces is frequently sufficient to spur and stimulate latent genius.

And, by the bye, I am glad to inform you that measures are about to be concerted with the French railway companies, which will enable the labouring of all countries to visit the Exhibition at a cheap rate. Prince Napoleon has, I believe, taken the affair in hand, and is resolved to effect this long-wished-for melioration. This, I trust, is a piece of good news for the Society of Arts, and for the numerous Institutes in Union with it. The laudable endeavours of the Council in this direction were checked last year by the obstacles which it had to encounter on this side of the Channel,—but I again repeat that these obstacles will be cleared away in a very short time. Thus, if the Council, or any particular members of the Society, are disposed to resume their former views on the subject, they will find their realisation far more easy than six months ago.

And now, to conclude, you may see that the Paris Universal Exhibition is anything but a failure. The French have certainly had their difficulties to contend with in the beginning, and would have acted wisely had they kept them to themselves, just as we did in 1851. After all, they have of late displayed great energy in making up for past deficiencies; just the same as our own nation, *magnis componere parva*, is now retrieving our faults and blunders in the Crimea. On that trying occasion, the French never uttered one single word of complaint against us; should we not do the same, at least, in an undertaking where neither human life nor a nation's honour are in jeopardy?

I remain, sir, yours truly,

C. F. AUDLEY.

Paris, July 8th, 1855.

## THE CUSTODY OF THE SOCIETY'S TRADE COLLECTION.

Sir,—Sir Joseph Paxton, judging from his speech of to-day, is very anxious to carry all our property to Sydenham. This may be very useful for the multiplication of Sydenham shillings, and thus doubling our subscriptions for entrance to examine our own wares, but it is not a useful proposition for the Society of Arts as a body. The Society is now upwards of 100 years old. It gave birth to the Great Exhibition, and the Great Exhibition gave birth to Sydenham. In the hey-day of exultation the child disowned its father; the hundreds of th usands of pounds which the Society enabled the Great Exhibition to earn, was wholly kept away from the Society, rendered poor by its many efforts for a successful rival, and in its last effort for education it went into debt, and was denied help from the mass of wealth it had helped to create.

I can understand that our collections would be useful to Sydenham, just as a new attraction is useful to Cremorne. But we have to look at home, and not trust our property out of our own keeping. Who is to guarantee the expense of moving. Who will guarantee its safety at Sydenham from wet and damp, and "land rats, and water rats." What, if waiting away from our own dry storage, it should happen to be placed beneath leaky glass, unrepaired during the long nights of winter, and without the means of warming and drying. This is a Society over 100 years old. The Crystal Palace is little over two. What are its funds, what are its means, what its guarantees of permanence, that we should merge our collections in it and thus deprive ourselves of the chance of creating a newer and larger habitation than we now possess. All we know is, that its shares are certainly not at a premium, that its directors have left it, and Sir Joseph Paxton is its be all and end all, who will no doubt keep it up as a very beautiful garden, hot-house, and green-house, but as certainly not as a museum, a thing not compatible with vegetation. If the courts could be sealed in glass like hermetic gardens, or were located in a dry climate in volcanic lava, their gorgeous beauty might be preserved for years, but in the atmosphere of a green-house they must finally become mere theatrical daubs, to which the scenic painter's mop will be applied from time to time, till people draw on their imaginations for the original realities. The Crystal Palace will have answered its purpose of leading people on to something better, but from the want of philosophical reflection as to the capabilities of matter, it can only be, as the boy's copy for writing by, a thing to be worn out

in the process; or it must be remodelled altogether, separated into distinct parts, and double glazed, dried, and warmed, the vegetable creation apart from the works of art. To look on that beautiful Alhambra, and to know that an insidious damp must gradually creep under it, and destroy its beauty, leaving it a mere caricature of its Moorish prototype, would be a painful sensation, and I trust that Mr. Owen Jones will case it in glass to save it. Trusting also that our property will never be placed in such a predicament, I remain, Sir,

F.S.A.

July 3rd, 1855.

## THE TRADE MUSEUM.

Sir,—I have been much gratified by a visit to that part of a Trade Museum which is now exhibiting at the rooms of the Society of Arts, and I trust that a collection so valuable and instructive will not only be enlarged and rendered permanently useful, but may also be extended to every chief town in the kingdom, so as to be available for instruction in our Mechanics' Institutes and our public or national schools. The effect which might be thus produced is really incalculable.

I will detail to you the result of such an experiment. I have been the manager of the Girls' Bishopgate-street School at York, where they enjoy the advantage of a most skilful and intelligent teacher. Having remarked the gratification which the object lessons invariably gave to the children, and the good effect which they produced upon the mind, I was led, upwards of three years ago, to commence forming a series of objects of manufacture —beginning with the raw material, and tracing every process, step by step, to its highest product. Through my own personal influence with many kind friends, this has now become an important collection, illustrating the manufacture of textile fabrics, both animal and vegetable, and containing specimens of gums, dyes, oils, spices, cereals, and many others.

The result of this real and practical teaching has been most beneficial, and is evidenced by the increased intelligence of the children, and the eagerness with which they pursue useful knowledge; in fact, the tone of the school is such, that education ceases to be a task, and is rendered pleasing and attractive.

The advantages which have accrued to this school, and the deep interest which I take in the education of the poor, induce me to bring the subject before you. I would propose that every public school should possess a series of objects illustrative of the progress of the chief manufactures in its district, so that our children may be specially educated for our different branches of commerce; and, judging from my own experience, I would affirm that there is no manufacturer of any importance in this country who would refuse to give such specimens as I have described for the use of the schools in his own locality; he will himself reap the fruits of his liberality in the greatly improved class of workmen which would thus be created, and the results to the commerce of this country would be such as no man can at present estimate.

I am, sir, very faithfully yours,

JOHN. W. NUTT.

6, Bank-chambers, London, 6th July, 1855.

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Sir,—Having enjoyed the opportunity of carefully studying, at repeated visits, the Trade Museum at present open in London, I venture to express, through your *Journal*, the hope that measures will be taken to render the Museum permanent, and to enlarge it, so as to embrace within its collections the other objects required to render such an institution complete.

The apartment of the Society of Arts rooms at present occupied by the Museum can only, of course, from its comparative smallness and darkness, imperfectly display the number and variety of objects collected to illustrate the animal department of a Trade Museum. But the admirable way in which they are arranged, and the courtesy of Professor Solly and his assistants, enable even a hasty visitor to appreciate the value of the collection already made, and the importance of preserving it as the nucleus of a much larger similar collection, fitted adequately to represent the extent to which trade and manufacture are dependent on the animal kingdom as a source of marketable products and pliant raw material.

For my own part, having studied the contents of the Museum with considerable minuteness and care, and having for some years past come much in contact with young men training for professions in which the application of physical science to the useful arts is a matter of paramount importance, I would value very highly the existence of such a collection as I saw at the Adelphi as a means of instruction for those students.

A complete Trade Museum, representing with tolerable fullness, the animal, vegetable, and mineral departments of an economic institute, would, of course, be still more valuable as a school of practical science. The sons of our manufacturers, tradesmen, farmers, country gentlemen, and others who proposed to follow the professions of their fathers, or to go abroad, and the officers of our army and navy, and of the East India Company's service, who can so largely contribute to open up the wealth of our Colonies, have hitherto had to pick up imperfectly in many quarters, and with much waste of time, labour, and money, information which a comparatively brief study of the contents of a well-arranged Trade Museum would much more completely and easily furnish. It would be a great satisfaction, accordingly, to all here interested in economic science, to be assured that the views which have led to the present exhibition of the nucleus of the animal department of a Trade Museum, will be carried out so as to secure the permanent establishment of such a museum in all its departments.

Allow me to add, that I was specially pleased to find that the historical element has not been neglected in the animal collection. Objects of merely antiquarian value would be out of place in such a museum, but illustrations of the progress of manufacture and invention, marking the great changes which have occurred in important processes, are essential to prevent ingenious men wasting their time in unprofitable re-inventions and re-discoveries.

Yours very truly,

GEORGE WILSON, M.D.,

Director of the Industrial Museum of Scotland.

Elm Cottage, Edinburgh, July 7th, 1855.

## WROUGHT-IRON ORDNANCE.

Sir,—It is an undoubted fact that cast-iron ordnance will wear out and become unserviceable after a certain number of shot have been discharged, owing to the irregular enlargement and scoring of the bore, and this effect will take place more or less rapidly, whatever may be the material of which the gun may be constructed.

The rapid discharge and skilful aim of modern gunners, unknown to our fathers, renders this destruction far more prominent in our time. As soon as the bore of a gun becomes so much deteriorated as to render the aim uncertain, it will be thrown aside as useless by the artilleryman of the present day, or his reputation as a marksman would be endangered; and more than all, be it observed, that though science has marched of late with giant stride, the material of both gun and shot has remained identically the same for centuries.

This destruction is accelerated by the unfortunate circumstance that the shot or shell acquires an extremely hard crust or "*chill*" by being cast in iron moulds, while the bore of the gun, drilled out of the solid, presents internally a surface of soft cast-iron. The introduction of wrought-iron guns, though possessing the great advantage of strength and lightness combined, will increase the rapidity of destruction, unless such wrought-iron guns

shall be lined with steel throughout the bore. But the most economical and ready mode of producing light ordnance equal to the wear and tear of modern warfare, will be found to be that recommended by me in my communication inserted in your *Journal*, No. 108, page 78.

So superior is steel to iron, that it has been found necessary to construct the working parts of locomotive engines of steel only, as soft iron is wholly inadequate to withstand such violent and rapid motion.

The passing of heavy shot through the bore of a gun is a parallel case.

A CIVIL ENGINEER.

Poole, July.

## MORTARS, CANNON, AND SIR HOWARD DOUGLAS.

Sir Howard Douglas, in his discussion in the *Times* of the question of horizontal and vertical fire, unquestionably has reason with him in preferring the latter, as more destructive, quoad the present means of resistance, *i.e.*, the ramparts of earth erected to resist horizontal fire are superior, with regard to their object, to the defences against vertical fire; but it would be a practicable thing, first of all, to build a whole town of what are called bomb-proofs in stone, and then to cover them with such a "Pelion on Ossa" of earth as to preclude the possibility of any weight piercing through them; that is to say, artificial caverns might be constructed as safe against vertical attack as a deep coal-mine, and as unpleasant to live in,—probably so unhealthy as to defeat the object of defence. "Better is it to hear the lark sing than the mouse cheep," and so far the water janitors in the free air would have the advantage of the cavern dwellers.

In the matter of mortars *versus* guns, Sir Howard Douglas seems to lose sight of the philosophy of the question. He takes it for granted that all the instruments for vertical fire, or rather for throwing shells into the air at an angle of 45 degrees, to drop vertically, must be mortars, because they always have been so; that long guns are fitted for horizontal fire, and short guns, or mortars, for vertical. Let us inquire into this.

Given the diameter of a bore and the weight of powder: it is obvious that there is a proportionate length of bore requisite to produce the maximum effect on the projectile with the expansion of the gases generated. If the bore be too short, the projectile will be thrown out with diminished force, and power will be wasted upon the external atmosphere: if too long, power will be wasted in frictional resistance to the projectile by the surplus length. The maximum result must be obtained by confining the generated gases just long enough, and not too long.

Apart from the economical consumption of power, the length of the bore gives also directing power. So well is this understood by Yankee riflemen and Eastern gunners, that the one country is known by the long rifle, and the other by long cannon, of which many samples have been brought to England.

If a long cannon be better than a carronade, *i.e.* a short cannon—for long shots horizontally, *i.e.*, for a flat parabolic curve, it must be better for what is called vertical fire, *i.e.* a very sharp parabolic curve.

It is quite true that a heavy gun, suffered to recoil, may damage a ship's side, but so might a heavy mortar. If the gun were placed in the position of the mortar, with a sufficiently broad bearing, distributed over a mass of heavy ballast low in the vessel, the effect would be the same as the mortar, proportioned to the force of the powder, and the inertia of the gun, by reason of its weight.

It follows, therefore, that the greater the range of the gun the greater may be the distance of the vessel from the fortress attacked, so as to be out of reach of attack by boats, an advantage of considerable importance, and the greater will be the height from which the shell will fall.

It is clear that the mischievous effect of the shell will be in proportion to the height from which it falls, up to a certain point, viz., the maximum of accelerating velocity, the positive weight, and the power of the explosve compound with which it is charged.

The projectile force of the powder in the gun will be in proportion to the resistance of inertia in the gun.

Cast iron is not a good material; it is highly elastic, and being also brittle it becomes crushed internally by the blows of the large mass of powder, just as the metal is crushed in a Bramah's press of great power; and, therefore, to attain the maximum effect we must come to wrought iron, the more especially that the larger the iron casting the more inferior is the metal.

How to construct a wrought iron gun of 26 inches bore, and 26 feet in length, to fix it in a corresponding bed plate at an angle of 45 degrees, and to arrange the mechanism needful to charge it, with little human labour; how to preserve its bore polished, and to replace its vents when worn, preserving the gun from injury as a woodman does his rifle; and how to keep it cool in use—is the problem set before us to solve. The weight is no detriment in a steam fleet, but an important element in neutralising recoil. It is not a very difficult problem, if rightly set about.

The increased size in the guns of war-ships has made them more difficult to handle; it takes 15 men to work and fight a great gun, to run it in and out, and remain exposed to the enemy's small arms while charging it. If recoil be prevented, and breech-loading adopted, horizontal fire may go on with closed ports, and three or four men to a gun will suffice. For vertical fire, the gun would be a fixture, and some fewer men would suffice. The steam power could place the vessel in position requisite for the range and aim. The steam power could also be used in conjunction with an air cylinder to repel boarders by a shower of shot.

The aim and object of war is to disable your enemy, while out of his range. It is obvious that horizontal fire must give a greater range than vertical fire with a weapon of a given power, and that the only way to increase the range of the vertical fire is by increasing the size of the projecter.

We do not well understand what Sir Howard Douglas means by saying:—"It may be doubted whether at any time fusees can withstand the shock of the charge which must be used in firing executive shells from a distance of 5,000 or 6,000 yards." Does he mean that our mortars are at their maximum? Surely the fuse can be attached to springs to reduce the concussion. But if it is "doubted" why not try it? Why not fire a cannon vertically up and down, to try conclusions, and measure the time of the descent of the shell.

Why do we call the Russian water-mines infernal machines? They seem very harmless so far, as are most mines. The American torpedo was the first of this class, but required fixing like a petard to the ship's bottom, a problem difficult of solution; much more so than that of the winged mines that will yet rive out the heart of Cronstadt, and wither into impotence the brute despots who call men serfs, and expend them with as little remorse as they do heads of cattle.

It is not by taking things for granted on byegone knowledge that the new and essential can be attained. It is by practical experiments based on philosophical induction, that this question of the maximum range and power of missiles must be worked out, so as to deposit the largest integral power of explosive compound within the enemy's fortress at each successive discharge. We may not attain the fabled result of the long thin Dover gun, called Queen Elizabeth's pocket pistol, but we are assuredly still very far from the possible. In our arsenal at Woolwich it would be possible to solve the problem, with much more useful results than the rifle experiments at Manchester, and surely a man like Sir Howard Douglas would be com-

petent to take the matter in hand, useing the byegone only as a fulcrum for the future.

COSMOS.

July 9th, 1855.

## SUGAR MANUFACTURE.

Sir,—I address you with a twofold object; firstly, to give a short account of improvements in sugar mills, manufacture, &c.; secondly, to try and receive through your columns information relative to the growth of sugar up the Nile. Sugar mill rollers were formerly made to revolve from 5 to 7 revolutions in a minute. Now it is found that three or four revolutions allow the cane-juice to drop away more clearly and fully, and that the megass, or refuse cane, is consequently so much more easily dried, and becomes better fuel. Such colonies as Trinidad and Demerara have long suffered from want of proper fuel. W. Burnley Hume, Esq., (second son of the deceased M.P.), informs me that cane, which was underground drained in 1845-6-7, is now giving a most unparalleled return of fine sugar. He is also an advocate for good high chimnies at sugar works, and railways for the colonies. No fairer field presents itself to intelligent sober engineers, than the colonies of Demarara and Trinidad for the erection of saw mills.

Can you kindly give me any information relative to the growth of sugar up the Valley of the Nile. I fear to trespass further on your valuable space.

Yours, &c.,
MACKENZIE DICK.

23, Newman-street, London, June, 1855.

P.S.—Having acted as one of two judges at the first ploughing match ever held in the fine island of Trinidad, in 1846, I feel an interest in the welfare of the colony, which is comparatively in a virgin state, abounding in fine timber and rich lands. Certainly, the Americans are more apt to run up light saw mills (water or steam) than the Britishers. Something in the shape of Dr. Arnott's ventilators would, I think, be of use in evaporating chambers, both at home and abroad—of course on a large scale.

## CATALOGUE OF BOOKS FOR MECHANICS' INSTITUTIONS.

Sir,—Be so good as to correct, in the next number of the *Journal*, a statement attributed to me in the Report of the Meeting of Representatives at the Conference last week.

I am made to state that, for the purpose of getting a list of books for institutions, I had gone to the catalogue of the London Mechanics' Institution. This is obviously a mistake, and will be best corrected by stating what I have done. The Yorkshire Union published some years ago a priced catalogue of a few hundred works, as an aid to Mechanics' Institutions in the selection of books. This has been out of print for some years, and more than a year since the committee requested me to revise it, with a view to its re-publication. I found, however, that a hasty process of curtailment and addition would be very unsatisfactory, and I therefore decided to go over the *London priced lists* of books published during the last thirty years. This, though done cursorily, has at least brought under review the great accessions made in recent years to the literature suitable for popular institutions, and I have selected pretty liberally, so that I apprehend the committees (of all but the largest institutions) may, for a few years to come, be enabled to form from this catalogue, collections of works in every class, and distinguished by ample variety of treatment. And as the published prices will be attached to the works, an exact estimate may be made of what can be effected with a given sum appropriated to the purchase of books.

As regards theological books, the catalogue of which mine may be considered a new and enlarged edition, contained a section of these of standard character, and I have retained this section and made such additions to it as appeared to me to be absolutely necessary to preserve its integrity.

I should add, that we propose to embody a new manual for Literary and Mechanics' Institutions with the catalogue, and a variety of practical information and suggestions relative to the selection and purchase of books.

I am, sir, yours truly,
W. H. J. TRAICE.

Leeds, July 11th, 1855.

## To Correspondents.

Mr. Alfred Coleman, of Wandsworth, writes, that in the report of the Conference of the 2nd inst., he is made to say, upon the subject of rating, "That they ought to go to Parliament, at all events, to clear up the difficulty in which they were in, &c." These, he adds, were the remarks of some other representative, his own opinion being that any such step would, at the present time, be very injudicious.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 28th June, 1855.*

Par. No.
65 (5). Trade and Navigation—Monthly Accounts.
314. Port Wine Adulteration (Jerupiga)—Correspondence, &c.
341. Education (Scotland) Bill—Correspondence.
186. Bills—Dwellings for Labouring Classes (Ireland) (Amended).
194. Bills—Leases and Sales of Settled Estates.
195. Bills—Duchy of Lancaster Lands.
196. Bills—Bills of Exchange and Promissory Notes (as Amended by the Select Committee and in Committee).
200. Bills—Endowed Schools (Ireland).
Factories—Reports of the Inspectors for the half-year ending 30th April, 1855.

*Delivered on 29th June, 1855.*

320. Constabulary, &c. (Ireland)—Returns.
322. Harbour of Refuge (Ireland)—Copy of Memorial.
334. Gold and Silver Watch Cases—Return.
340. Houses (Public Service)—Account.
342. Carriages, &c.—Return.
198. Bills—Charitable Trusts.
202. Bills—Copyhold, &c., Commission Continuance.
South Staffordshire Railway—Report upon collision of the 21st May, 1855.

*Delivered on 30th June and 2nd July, 1855.*

337. Highland Roads and Bridges—41st Report of the Commissioners.
325. East India Revenues—Return.
343. Agricultural Statistics—Report of the Highland Society.
355. Colonial Lights—Copy of Correspondence.
204. Bills—Burial of Poor Persons.
205. Bills—West Indies Relief Loan Arrangement.
209. Bills—Ecclesiastical Jurisdiction Continuance.
The River Tyne—Plans.

*Delivered on 3rd July, 1855.*

332. Coroner's Inquests (Ireland)—Abstract of Return.
344. Army in the East (Applications of Officers for the Loss of Horses, &c.)—Return.
347. Westminster New Bridge—Copy of Report.
348. Battersea Park and Chelsea Bridge—Copy of Report.
319. Metropolitan Buildings Bill—Proceedings of the Select Committee.
199. Bills—Medical Profession.
206. Bills—Excise Duties (Amended).

*Delivered on 4th July, 1855.*

357. Civil List Pensions—List.
201. Bills—Bleaching, &c., Works.
207. Bills—Lunatic Asylums and Regulations Acts Amendment.
210. Bills—Union of Contiguous Benefices.
212. Bills—Partnership Amendment (Amended).
213. Bills—Limited Liability (Amended).
National Education (Ireland)—21st Report of the Commissioners, Vol. 1.

*Delivered on 5th July, 1855.*

211. Bills—Education (Scotland) (Amended).
214. Bills—Cinque Ports (as Amended by the Lords).
215. Bills—Weights and Measures (as Amended by the Lords).
216—Bills—Gold Wedding Rings.
Great Western Railway—Caledonian Railway—Two Reports on Explosion of Boilers.
South Staffordshire Railway—Report upon an Accident of the 23rd December.

*Delivered on 6th July, 1855.*

351. Roman Catholic Prisoners—Return.
353. Militia (Number of Volunteers)—Return.
354. Militia (Number of Officers, Privates, &c.)—Return.
356. Army School Regulations (Madras)—Return.
359. Assay Offices (Exeter, &c.)—Copy of Minutes and Papers.

217. Bills—Militia Officers Qualification.
218. Bills—Mortmain (Amended).
219. Bills—Coal Mines Inspection (as Amended in Committee, and on Re-commitment.)
220. Bills—Dissenters Marriages (as Amended in Committee, and on Re-commitment).
222. Bills—Treasurers of Counties (Ireland).
223. Bills—Sale of Spirits (Ireland).
244. Bills—Commons Inclosure (No. 2).
Public General Acts—Cap. 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, and 44.

## PATENT LAW AMENDMENT ACT, 1852.

### APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, June 29th*, 1855.]

*Dated 18th June*, 1855.

1392. J. Jones, Sheffield—Motive power.
1393. J. H. Johnson, 47, Lincoln's-inn-fields—Furnaces. (A communication.)

*Dated 19th June*, 1855.

1394. C. A. Hartmann, Paris—Colours for fabrics.
1396. E. Dixon and T. Bailey, Wolverhampton—Tap.
1398. J. Macintosh, Great Ormond-street—Fusees.
1400. J. Letchford, Duncan-place, Hackney—Folding bedstead.
1402. J. H. Johnson, 47, Lincoln's-inn-fields—Storing grain. (A communication.)

*Dated 20th June*, 1855.

1404. D. B. Herts, 17, Cornhill—Life-preserving harness. (A communication.)
1406. R. B. Longridge, Manchester—Boilers and tubes.
1408. J. Gernon, 14, Buckingham street, Adelphi—Articles of clay. (A communication.)
1410. R. Walker and A. Mc Kenzie, Glasgow—Electric telegraphs.
1412. R. W. Savage, St. James's square—Swing doors.
1414. E. Cochand, Paris—Aerated liquids.
1416. W. E. Newton, 66, Chancery-lane—Finishing thread. (A communication.)

[*From Gazette July 6th*, 1855.]

*Dated 17th May*, 1855.

1119. W. Smith, 10, Salisbury-street, Adelphi—Machine for cleaning cotton. (A communication.)

*Dated 7th June*, 1855.

1298. P. A. Favre, Marseilles—Employment of residue arising from lixiviation of crude sodas.

*Dated 9th June*, 1855.

1318. C. F. Varley, 1, Charles-street, Somers-town—Electric telegraphs.

*Dated 16th June*, 1855.

1376. J. Lowe, East Greenwich—Propelling vessels.

*Dated 19th June*, 1855.

1395. J. F. Norton, Manchester—Measuring liquids. (A communication.)
1397. F. Burke, Montserrat, W. Indies—Paper material.
1399. D. Gover, King-street, Long-acre—Gun carriages.
1401. J. H. Johnson, 47, Lincoln's-inn-fields—Emptying cesspools. (A communication.)
1403. J. H. Johnson, 47, Lincoln's-inn-fields—Dish covers, &c. (A communication.)

*Dated 20th June*, 1855.

1409. J. Gernon, 14, Buckingham-street, Adelphi—Plaster of Paris and cement. (A communication.)
1413. U. Lane, Brighton—Pumps.
1415. L. Pol, Paris—Pianofortes.
1417. T. F. V. Fabien, Paris—Wheels. (A communication.)

*Dated 21st June*, 1855.

1418. J. L. Jullion, Tovil—Paper, card, and millboard.
1419. W. C. Wilkins, Long-acre—Lamps.
1420. P. F. Rioux, Paris, and L. de Pariente, Schaerbeck, next Brussels—Fixing metallic ornaments upon fabrics. (A communication.)
1421. M. Shelley, 12, Union-crescent, Kingsland-road—Cooking utensils.
1422. J. R. Birch, Liverpool—Boat plug.
1423. J. Benjamin, Leadenhall street—Gas. (A communication.)
1424. T. Bongereau, 46, Lime-street—Roasting coffee.
1425. R. Keevil, Lacock, Chippenham—Vessels used in manufacture of cheese.
1426. W. Basébé, 2, Mayfield-place, Kensington—Paper.
1427. C. E. Green, 13, Blandford-street, Portman-square—Huts, tents, and camp hospitals.
1428. L. Young, Bow-lane, Cheapside—Gas regulators.
1429. T. C. W. Pierce, Manchester—Machinery for finishing yarns.
1430. A. E. L. Bellford, 32, Essex-street, Strand—Steam engines. (A communication.)

*Dated 22nd June*, 1855.

1432. O. R. Chase, Boston, U.S.—Machine for making lozenges.
1434. S. White, Liverpool—Washing, cleansing, and drying grain.
1436. A. E. L. Bellford, 32, Essex-street, Strand—Breech-loading fire-arms and cartridges. (A communication.)
1438. J. G. N. Alleyne and H. Strafford, Alfreton—Railway brakes.

*Dated 23rd June*, 1855.

1440. S. T. M. Sorel, Paris—Applying adhesive matters on stuffs.
1442. F. W. Mowbray, Shapley, near Leeds—Looms.
1446. A. E. L. Bellford, 32, Essex-street, Strand—Bats for felting. (A communication.)

*Dated 25th June*, 1855.

1448. J. Young, Linton, Roxburghshire—Harrows.
1450. J. Page, Perth—Moulding metals.
1452. M. Poole, Avenue-road, Regent's-park—Sculpturing surfaces of marble and stone. (A communication.)

*Dated 26th June*, 1855.

1454. A. E. L. Bellford, 32, Essex-street, Strand—Rotary blowing machines. (A communication.)
1456. F. Leiss and C. Schneider, Hesse Darmstadt—Mica letters, figures, &c.
1458. M. Poole, Avenue-road, Regent's-park—Printing rollers. (A communication.)
1460. F. Vennin-Derégniaux, Lille—Spinning machinery.
1462. J. J. Bucknall, Liverpool—Hats and caps.
1464. J. M. Clements, Birmingham—Spring lock fastening for pockets, &c.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed June 26th*, 1855.

835. Edward Hammond Bentall, Heybridge—Improvement in the construction of harrows.
837. George Beard, Birmingham—Improved label and stamp setter.
854. Richard Bridge, Chadderton—Improvements in power looms.
871. Peter Lear, Boston, U.S.—Improved method of arranging and operating horizontal submerged propellers.
879. William Ryder, Bolton-le-Moors—Improvements in certain parts of machinery for slubbing and roving cotton and other fibrous substances.
890. Edwin Pettitt, Manchester—Improvements in preparing and spinning cotton and other fibrous substances, and in machinery for such purposes.
891. William Gerhardi, Manchester—Improvements in apparatus to prevent the lapping of straps round shafts.
896. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the consumption or prevention of smoke. (A communication.)
897. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in machinery or apparatus for spinning cotton and other fibrous materials. (A communication.)
903. Joseph Whitworth, Manchester—Improvements in ordnance, fire-arms, projectiles, and machinery for the manufacture thereof.
916. Matthew Andrew Muir, Glasgow—Improvements in the manufacture or moulding of railway chairs.
920. William Symington, Little Bowden, Northampton—Improvement in preparing peas and pearl and Scotch barley for culinary purposes.
923. James Wallace, jun., Glasgow—Improvements in bleaching, washing, or cleansing textile fabrics and materials.
947. Thomas Haley Burley, Ohio, U.S.—Machine for making dovetails.

*Sealed June 29th*, 1855.

2746. Andrew Dietz and John G. Dunham, Raritan, New Jersey—Improvements in mowing and reaping machines, by which the sickle cutting the grain is moved or worked directly by the driving wheel, or its equivalent, without the necessity of cog-wheels, cranks, &c.
16. William Kendall and George Gent, Salford, near Manchester—Improvements in machinery or apparatus for cutting metals, either solid or tubular.
25. George Walker Muir, Glasgow—Improvements in warming and ventilating.
28. George Bowden, 1, Little Queen-street, High Holborn—Improvements in the manufacture of united adhesive bookheadband and register ribbons.
64. Edward Booth, Gorton—Improvements in the mode and machinery for dressing, starching, and finishing textile and other fabrics and materials.
83. François Victor Guyard, Gravelines—Improvements in the electro telegraphic communications.
94. John Graham, Hartshead Print Works, near Stalybridge—Improvements in fixing certain colors in or upon yarns and textile fabrics.
121. Ambroise Quertinier, Charleroi—Improvement in glass furnaces.
142. Charles Frederick Stansbury, 17, Cornhill—Improvements in the construction and operation of self-acting railway breaks (A communication.)
161. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the construction of seats and similar articles of furniture. (A communication.)
164. Henry Carr, Peterborough—Improvements in railway crossings.
192. John Henry Johnson, 47, Lincoln's-inn fields—Improvements in machinery or apparatus for preparing cotton and similar fibrous materials. (A communication.)
294. Alfred Vincent Newton, 66, Chancery-lane—Improved construction of spur.
490. Richard Van Valkenburgh De Guinon, Brooklyn, New York—Improvements in anchors.
794. Charles Blunt, Wanstead, and Joseph John William Watson, Wandsworth—Improvements in the composition of artificial fuel, with the machinery employed in the manufacture thereof.

906. Alfred Jenkin, Zell on the Moselle—Improvements in furnaces for the reduction and calcination of lead and copper ores.
911. William Westley Richards, Birmingham—Improvements in repeating or revolving fire-arms.
912. Josiah Horsfall, Manchester—Machinery for mitreing moulded and other sashes.
984. Frederick William Harrold, Birmingham—Improvements in the manufacture of the frames of slates used for writing on.
987. Thomas Ridgway Bridson, Bolton-le-Moors—Improvements in preparing, beetling, or finishing textile fabrics.
1010. James Pearson, Pyle House, Totterdown, Bedminster, near Bristol—Improvements in the method of fastening tyres on wheels.

*Sealed July 3rd*, 1855.

27. Louis Jacques Martin, Paris—Improvements in the composition of colours for printing and dyeing, and in the application of such colours.
29. William Henry Bulmer, Queen's-head, near Halifax, and William Bailey, Halifax—Improvements in machinery or apparatus for combing wool, cotton, and other fibrous substances.
32. John Livesey, 20, Kensington-gore—Improvements in printing and in the materials and apparatus connected therewith.
34. Benjamin Cook, Green-street, Birmingham—Improved apparatus for separating filings of iron or steel from other metallic filings.
45. Robert McCall, Pallas-Kenry, Limerick—Improvements in the manufacture of iron and steel.
53. Joseph Offord, Wells-street, Oxford-street—Improvements in the construction of carriages.
54. André Gaspard Guesdron, Paris—A furniture table which may be used for different purposes.
56. Nathaniel Jones Amies, Manchester—Improvements in winding or balling thread or yarn, and in the machinery or apparatus connected therewith.
76. James Wood, 30, Barbican, London—An improved process for lettering and ornamenting glass, which the inventor terms Hyalotypy.
115. Jonathan Saunders, St. John's-wood—Improvement in the manufacture of axles and shafting.
189. Charles Frederick Burnard, Plymouth—Improvements in the manufacture of superphosphate of lime.
216. Henri Louis Dormoy, Paris—Improvements in braiding or platting machinery.
217. John Doddridge Humphreys, 20, Charlotte-street, Caledonian-road—Improvements in steam engines.
227. David Moline, Adelaide-place—Improvements in the manufacture of metallic window frames and skylights.
437. James Higgin, Manchester—Improvements in treating certain waste soap liquors and obtaining therefrom certain products applicable to purposes not hitherto known.
671. John Marland, Leeds—Improvements in preparing for and in sizing and warping woollen and worsted yarn.
763. Joseph Edwin Frost, 135, Goswell-street—Improvement in ball or float cocks.
843. George Fergusson Wilson, Belmont, Vauxhall, and Warren De la Rue, Bunhill-row—Improvements in combining fluids to be burned in lamps.
857. William Madeley and Thomas Hanlon, Manchester—Improvement in or applicable to power looms.
884. Samuel Cunliffe Lister, Bradford—Improvements in treating rheea plant, so as better to prepare its fibres before being spun.
946. William Shears, Bankside, Southwark—Improvement in cases or magazines for gunpowder or other explosive preparations or compounds.
954. Morris Lyons, Suffolk-street, Birmingham—Improved enamel for coating metals and bricks.
961. Alfred Vincent Newton, 66, Chancery-lane—Improvement in file-cutting machinery.
962. William Elliot Carrett, Sun Foundry, Leeds—Improvements in motive power engines.
1066. David Caddick, Ebbw Vale Iron Works, Monmouth—Improvements in puddling furnaces.
106. Richard Peters, 89, Union-street, Borough—Improvements in steam engines.

*Sealed July 6th*, 1855.

62. Bartholomew Predaval, 106, Great Russell-street, Bedford-square—Improving the production and manufacture of pulp for the making of paper.
68. Louis Pierre Lehugeur and Michel Uttinger, St. Denis, near Paris—Improvements applicable to machinery for printing fabrics.
123. David Davidson, Meiklewood by Stirling—Improved apparatus for pointing ordnance, and restoring the aim of the piece either by day or night when it is once obtained.
143. Stanislaus Joseph Paris, Manchester—Improvements in machinery for embossing.
148. Peter Armand le Comte de Fontaine Moreau, 4 South-street, Finsbury—Improvements in obtaining electro-motive power.
172. John Coates, Salford—Improvements in railways.
178. Richard Laming, Carlton-villas, Maida-vale—Improvements in obtaining and combining ammonia.
200. Joseph Leese, junior, Manchester—Improvements in the process of printing calicoes and other textile fabrics.
205. Robert Mallet, Dublin—Improvements in the manufacture of hollow shot and shells, and similar hollow bodies of cast iron or other cast metals.
236. George Price, Wolverhampton—Improvements in iron safes, chests, and boxes.
271. Joseph Gibbons, 345, Oxford street—Improvement in fixing the spindles of door locks to their knobs.
335. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in governors or regulators for steam engines or other prime movers. (A communication.)
480. Charles Iles, Peel Works, Birmingham—Improvements in apparatus for cutting, burnishing, and polishing cylindrical surfaces of metal and other substances.
481. Charles Iles, Peel Works, Birmingham—Improvements in the manufacture of tubes, knobs, and handles of doors, rollers of castors, and reels for cotton and thread.
539. William Smith, 10, Salisbury-street, Adelphi—Safety harness.
732. Charles Crews, 8, Montague-terrace, Bow-road, and Henry George Gray, St. James's-street—Improvements in preparing and using deodorizing or disinfecting compounds.
824. Jules Denoual, Samares lodge, St. Clements, Jersey—Improved means of enveloping medicinal preparations with soluble substances.
868. Alfred Vincent Newton, 66, Chancery-lane—Improved machinery for crushing and grinding mineral and other substances.
870. William Jones, Rhodes, near Middleton—Improvements in printing calico and other fabrics.
907. Alfred Vincent Newton, 66, Chancery-lane—Improved machinery for separating substances of different specific gravity.
908. William Gossage, Widnes—Improvements in the manufacture of certain kinds of soap.
917. Charles Piazzi Smyth, 1, Hillside-crescent, Edinburgh—Improvements in astronomical and geodetical instruments.
979. William Banks, Henry Hampson, and John Banks, Bolton-le-Moors—Improvements in machinery or apparatus for bleaching yarns or thread, either in the cop or hank.
1009. Robert Broadbent, Stalybridge, and Squire Farron and Benjamin Grundy, Ashton—Improvements in steam engines.
1014. Ebenezer Tyzack, Abbey Dale Works, Sheffield—Improvement in scythes.

*Sealed July 10th*, 1855.

63. William Thomas Henley, St. John street-road—Improvements in steam boilers or generators, and in apparatus in connexion therewith.
93. William Henry Nevill, Llanelly—Improvements in the construction of reverberatory furnaces for the collection and condensation of volatile substances.
98. Edward Lambert Hayward, Blackfriars road—Improvements in kitchen ranges.
106. George Riley, 12, Portland-place-north, Clapham road—Improved false bottom for brewers', distillers', and vinegar-makers' mash tubs.
107. Edward Haynes, jun., Bromley—A smoke-consuming furnace.
124. William Armand Gilbee, 4, South-street, Finsbury—Improved soap, to which he gives the name of saponitoiine.
1041. John Mayo Worrall, Salford—Improvements in machinery or apparatus for cutting piled goods or fabrics,
1042. John Mayo Worrall, Salford—Improvements in machinery or apparatus for cutting piled goods or fabrics.
1047. Cullen Whipple, United States—Preparing and combing wool.
1048. Samuel Grainicher, Zofingen, Switzerland—Improvements in the construction of pumps, parts of which improvements are also applicable to steam-engines. (A communication.)
1057. John Harris, Woodside, near Darlington, and Thomas Summerson, West Auckland, near Darlington—Improvement in the manufacture of iron railway wheels.
1062. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture of sulphuric acid. (A communication.)
1072. William Bridges Adams, 1, Adam-street, Adelphi—Improvements in the construction and propulsion of vessels for navigation moved by internal power.
1090. Alexander Robertson, Sheffield—Improvements in the construction of stoves and fire grates.
1092. Alfred Charles Garratt, Massachusetts—Facilitating the work of lubricating the axles or bearings of carriage wheels.
1095. George Tomlinson Bousfield, 8, Sussex-place, Loughborough-road, Brixton—Improvement in burning hydrocarbons in lamps.
1150. Alfred Vincent Newton, 66, Chancery-lane—Improvements in the construction of watches.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3734 | July 9. | An Improved Valve for regulating the pressure of Steam from Steam Boilers ........................ | Abbott and Forrest ............ | Blackburn. Lancashire. |

Journal of the Society of Arts.

*FRIDAY, JULY* 20, 1855.

## ARTIZANS' VISIT TO PARIS.

The Secretary has been informed that the French railways have undertaken the transit of passengers to visit the Exhibition at half price, or, in other words, will convey persons on their lines to Paris and back at one fare. The Secretary had hoped to have been able to insert a copy of the official letter from the Managers of the Northern of France, but up to the time of going to press it had not been received by him.

The following announcements have been made for assisting parties coming from the north. Messrs. Brownlow and Co., of Hull, advertise that

"The first-class steam-ship *Gazelle* is intended to sail from Hull for Antwerp every Saturday evening, as soon after six o'clock as the tide permits, during the Paris Exhibition. Best cabin fare, *out and home*, 15s., *with leave to return within a month*, by the *Gazelle* on Wednesdays, or *Emerald Isle* on Saturdays. Trains leave Antwerp for Paris every two hours, the fares being—First class, 29s., Second do., 21s. 6d., and Third do., 16s."

The North-Eastern Railway advertises cheap trips to Paris from Leeds or Normanton to Antwerp and back, and makes the following announcement:—

"The fares from *Leeds or Normanton to Antwerp and back, including cost of passports*, will be—First class, and saloon of steamer, 30s.; Second class and saloon, 28s. Trains leave Antwerp for Paris, which they reach in ten hours, every two hours during the day, proceeding by way of Ghent, Courtray, Lisle, Douay, and Amiens to Paris. In returning, the route may be varied, by taking the railway passing through Douay, Valenciennes, Mons, Brussels, and Malines, to Antwerp. The steamers return from Antwerp on Wednesdays and Saturdays, and the tickets are available for either boat. In order that the passports may be in readiness on board the steamer on the arrival of passengers at Hull, it is necessary that application be made to Mr. Goslett, passenger superintendent, Leeds, or to Mr. Smithson, booking clerk, Normanton. The hour of sailing for the remainder of the month will be as under —Saturday, July 21, 10.0 p.m., passengers leaving Leeds at 6.35 p.m.; Wednesday, July 25th, midnight, passengers leaving Leeds at 6.35 p.m.; Saturday, July 28th 7.0 p.m., passengers leaving Leeds at 3.40 p.m."

## DECIMAL COINAGE.*

By Frederic James Minasi.

[The object aimed at in the following lecture is, to present a popular exposition of this important subject comprised in a brief explanation of decimal arithmetic and its application to scales of money, weights, and measures; a short account of the decimal coinage movement; and a classified outline of the various proposals brought before the public for effecting the desired alteration, with the chief objections that have been made to them. The whole is designed to furnish information on the present state of the question, and better enable those who may be desirous of taking a part in the discussion, to obtain a general view of the subject.]

The ordinary method of counting by tens arose in the very earliest period of human society, and is believed to owe its origin to the circumstance of the possession of ten fingers (*digiti*). So universally is this method employed, and so completely has it obtained a hold in all our ordinary conceptions of number, that it is not without some degree of surprise that the student of arithmetic discovers for the first time that there really are other ways of reckoning besides that he has hitherto looked upon as the only possible one, and, in fact, that it is but one of an infinite variety of methods by which magnitude can be expressed. Accounting for the present method of notation in the ordinary way, it would be natural for one who desired numerically to record the magnitude of a mass composed of individual items, as a flock of sheep, for example, to count them by means of his fingers up to ten, beyond which he could not proceed without recourse to the expedient of a mark, perhaps upon one of the fingers, to signify that he had completed that number, by which he would disengage the ten digits for a repetition of the same process, to be registered in like manner upon a second finger; ten fingers thus distinguished would necessitate a second kind of mark, representing ten of tens, or hundreds; proceeding in this manner, he would now be free to count to thousands, when a fresh commencement by a third description of mark would enable him to proceed to ten thousand, and so on; the analogy of the ten fingers being kept up even when large numbers rendered it impossible or inconvenient longer to use those organs. This is essentially the ordinary or decimal scale of notation.

On this way of accounting for its universality, it is not difficult to believe that had man been possessed of twelve, instead of ten fingers, he would have proceeded to that number before recording it in the manner just pointed out; thence he would have advanced to twelve twelves, or 144, from that to 1,728, and so on in a twelve-fold progression, forming what is called the duodenary, or duodecimal scale. Similarly, other circumstances would have originated scales of notation based on higher or lower numbers.

World-wide as our method of counting is, it is, nevertheless, remarkable that until comparatively recent times it was employed only in the numeration of whole numbers, the unit being the lowest on the scale. One Stevin, to whom is attributed the introduction to public notice of a more complete application of the decimal scale to the representation of fractional numbers as well as integers, published a work on this subject in the Flemish language, which was translated into English in 1608, entitled "*Disme; the Art of Tenths, or Decimal Arithmetic: teaching how to perform all computations whatever, by whole numbers without fractions, by the four principles of common arithmetic, namely, addition, subtraction, multiplication, and division; invented by the excellent mathematician, Simon Stevin.*" From this it would appear that the application of the decimal scale to the arithmetic of fractional numbers has been in use less than three centuries. The invention of logarithms was doubtless a means of contributing to its extension.

In examining the composition of the scale of tens, it will be noticed that its base being composed of the product of the prime factors 2 and 5, no power of ten can be divisible without a remainder by any other figures than these or their combinations—in other words, no prime factors but 2 and 5 are to be found among the submultiples of 10 and its powers. On this account it is that the decimal scale is really inferior to the duodecimal system of notation, the prime factors of which are 2 and 3, and the submultiples —the various combinations that may be formed of their powers—as 2, 3, 4, 6, 8, 9, 12, &c., a condition highly advantageous in the representation of such common and

* A Lecture delivered before the Metropolitan Society of Schoolmasters, at Westminster, April 21, 1855.

useful divisions as thirds, sixths, twelfths, &c., which on the decimal scale can only be represented by an interminable progression.

The common method of enumerating by the dozen, or by the gross of twelve dozen, the subdivision of the shilling and pound troy into twelve pence or ounces, the foot into twelve inches, and, perhaps, the year into twelve months, are important examples of the want afterwards felt of a more useful scale of notation than that which had been established in the earlier ages of society, and seems to refute the opinion of an eminent authority in this matter, that "if an educated community had to begin again, all should be decimal, or in tens." It has even been proposed that a notational reform should be attempted, for the purpose of substituting the duodecimal for the decimal scale in arithmetic. In Swift's *Laputa* possibly such a recommendation might have been deemed worthy of being put into effect, but with the ordinary class of mortals so overwhelming and perplexing a change would be a task utterly hopeless to attempt; to our present mode of notation we are, no doubt, wedded while the world lasts.

The various operations of arithmetic being reducible to the four elementary processes of addition, subtraction, multiplication, and division, or, as some think, of *addition* and *diminution*, it becomes a question of no little importance, particularly with a great commercial and intelligent people, to enquire how far the employment of the compound scales of money, weights, and measures is necessary, and whether, by the adoption of others founded entirely on the base 10, as in simple numbers, the time employed both in the acquirement and use of commercial figures might not be greatly abridged, and at the same time, the operations of arithmetic, especially with concrete numbers, be simplified and rendered more certain.

I shall not here enter upon an inquiry into the origin and peculiarities of the various conventional scales of monies, weights, and measures, employed in this and other countries; it will be enough to say that their divisions are, for the most part, unnecessarily complex and most ununiform in character, rendering, in many cases, an arithmetical calculation an operation painfully troublesome even to the skilled computer, a state of things which has in not a few instances given rise to the formation of tables, or the employment of a simplified scale, to effect the process with greater ease and certainty. We have an example of this latter kind in the application of our measures of length and surface to the purposes of land surveying. In order to obtain the area of a field in acres, it would be necessary, if the legalised measures were used, after taking the dimensions in yards, and computing the area in square yards, to divide successively by 30¼, 40, and 4, to obtain the number of acres, roods, and poles, in the surface, a process which involves so much trouble, that it led to the invention of *Gunter's chain* of 100 *links*, which, by general consent, has become the instrument employed by the professed land-measurer in the highly important duty he is called upon to exercise, and by the aid of which he is enabled to make his calculation with simple arithmetic only; he, in fact, uses a decimal scale of length and surface. Had our money been

10 pence = 1 shilling.
10 shillings = 1 pound sterling,

Or our table of weights—

10 ounces = 1 pound,
10 pounds = 1 stone,
10 stones = 1 cwt.,

and other scales on the same principle, it is clear at once that compound and simple arithmetic, so far as such scales are concerned, would be identical.

The advancement of practical science, and the increasing demands of commerce, have combined to render this subject one of peculiar interest to the world at large. Already have many countries of Europe and America adopted such a reform in their monies, weights, and measures, by re-arranging them in a decimal progression. The following, according to Laurie,* is a list of the principal countries and places where a decimal system of coinage is employed:—

| | | | |
|---|---|---|---|
| Algiers | Corfu | Japan | Portugal |
| Bahia | Corsica | Leghorn | Rome |
| Basle | France | Lima | Russia |
| Belgium | Geneva | Madeira | St. Domingo |
| Brazil | Genoa | Mauritius | Turin |
| Chili | Greece | Milan | United States |
| China | Holland | Naples | Venice |

and, lately, Canada† has adopted the dollar of 100 cents.

The United States may be looked upon as taking the lead in this matter in 1786, and, subsequently, the French Republic, in 1795, introduced the decimal system among the many alterations they put into practice at that time. In the instance of America, a change was in some measure necessitated by the confusion that existed in the different States relative to the values of the various kinds of money then current among them. In the case of France, the alteration was of a most radical character, effecting an entire change of all weights and measures, their *Système Métrique* being founded on scientific principles, and the new denominations independent of those already in existence. The effect of a change so violent as this was to disturb the habits and familiar ideas of past centuries, and in its original shape the plan was not adopted by the majority of the population, so that subsequent legislation and even alteration became necessary to reconcile the habits of the people to the loss of their old and well understood measures and weights.‡

In our own country within the past forty years various attempts have been made to bring about a decimal system of monies, weights, and measures, in lieu of those now in use among us. In the year 1816, when the sovereign was issued instead of the guinea, which was the coin previously in circulation, and when the new silver money was substituted for that which was then called in, the subject of a decimal system of monies was agitated, and the matter was discussed in pamphlets and the public prints of the day, and, among the rest, the *Times* newspaper strongly urged the adoption of a system founded upon that of France. For some reason or other, however, the subject was dropped. In 1824, it was again brought before the legislature by Sir John Wrottesley, who urged a system founded on the pound, but without any success. In 1838, a Royal Commission was appointed to make inquiry into the advisability of decimalising the weights and measures of this country. In their report in 1841, it is remarked, that although not forming part of the subject of their inquiry, yet, as being so intimately connected with it, they felt bound to recommend the introduction of a decimal coinage. Another commission, having the same object as the previous one, was appointed in 1843, whose report appeared in 1853. In reference to public opinion on the subject, they observe—"We wish to state our opinion that, in reference to the decimal scale generally, the public mind is very greatly changed, and that the introduction of a decimal system will now be very easy in respect to many points which a few years ago would have offered great difficulties." They further allude to the decimal coinage in terms similar to those of the previous commission. A practical step was taken in 1847 by the issue, at the instance of Sir John Bowring, of the florin, or tenth of a pound, in the desire to introduce the change on the principle of a descending progression from the sovereign. In the early part of 1853, a committee of the House of Commons was appointed to investigate the question of a decimal coinage for this country. The committee consisted of the chairman, Mr. Tufnell, but subsequently, Mr. W. Brown, Messrs. Cardwell, John

* Expositor of Foreign Languages.

† It is reported that a decimal coinage has just been adopted in Sweden.

‡ Yates, on the French system of measures, weights, and coins, p. 5. See also Pasley's remarks on the same subject.

Ball, Alderman Thompson, Dunlop, Matthew Forster, Moody, Hamilton, John Benjamin Smith, Kinnaird, Lord Stanley, Sir William Clay, the Marquis of Chandos, Sir William Jolliffe, and Viscount Goderich.

The witnesses examined before this committee were:—Thomson Hankey, jun., Esq., late Governor of the Bank of England, James Laurie, Esq., wine merchant, Sir Charles W. Pasley, K.C.B., Lieut.-General in the Royal Engineers, Professor Airy, the Astronomer Royal, Sir John Herschell, the Master of the Mint, Mr. Augustus de Morgan, Professor of Mathematics at University College, London, Thomas E. Headlam, Esq., M.P., Mr. F. Strugnell, grocer and teadealer, R. C. L. Bevan, Esq., banker, Mr. S. Lindsey, grocer and teadealer, Mr. Chas. Meeking, draper, G. Arbuthnot, Esq., Auditor of the Civil List, the Duke of Leinster, Mr. W. Miller, cashier in the Bank of England, Mr. Henry Taylor, clerk to Messrs. Whitbread and Co., brewers, Mr. W. Brown, M.P., Rowland Hill, Esq., secretary to the Postmaster-General, Mr. Francis Bennoch, commission warehouseman, John B. Beard, Esq., architect and engineer, Thomas Bazley, Esq., President of the Chamber of Commerce at Manchester, Kenneth Dowie, member of the Liverpool Chamber of Commerce, Mr. Henry Kirkham, clerk and manager in a tea and grocery establishment at Liverpool, Charles H. Gregory, civil engineer, Mr. Jacob A. Franklin, professional auditor and public accountant, and Sir John Bowring, Her Majesty's chief Consul at Canton; in all 25.

It should not be unnoticed, that with some it is a question to what degree the composition of this committee was conducive to an unbiassed opinion on the important subject intrusted to its investigation, and how far the selection of the witnesses who were examined before it may be regarded as placing the question fairly before the public.*

Their report was published in August, 1853, in which, from the evidence before them, they arrive at the conclusion that our present monetary system, with its corresponding plan of accountancy, "is shewn to entail a vast amount of unnecessary labour and great liability to error, to render accounts needlessly complicated, to confuse questions of foreign exchanges, and to be otherwise inconvenient." They further state that a decimal system of coinage "would lead to greater accuracy, would simplify accounts, would greatly diminish the labour of calculation, and, by facilitating the comparison between the coinage of this country and other countries that have adopted the decimal system, would tend to the convenience of all those who are engaged in exchange operations, of travellers and others. An important benefit would be derived in several departments of the public service, and in every branch of industry, from the economy of skilled labour that would result from the proposed change, at the same time that the education of the people generally would be much facilitated by the introduction into our schools of a system so directly calculated to render easy the acquirement of arithmetic." On these points the witnesses examined seem to have been unanimous, nor has much opposition at any time been brought forward to these views.

It is not to be denied that there are opinions deserving the highest respect which refer to the sub-division of our money of account, as at present constituted, as one admirably adapted for the important requirements of retail trade, and superior in this respect to almost any that can be based upon the decimal scale only; and the division of the pound sterling into 240 pence, or 960 farthings, is looked upon as an evident arrangement to this end. The following tables exhibit a comparison between the sovereign divided respectively into 960 and 1000 parts:—

PROPORTIONAL PARTS OF A POUND AS AT PRESENT.

| | | | | | |
|---|---|---|---|---|---|
| 10s. 0d. | = | $\frac{1}{2}$* | 6d. | = | $\frac{1}{40}$* |
| 6 8 | = | $\frac{1}{3}$ | 5 | = | $\frac{1}{48}$ |
| 5 0 | = | $\frac{1}{4}$* | 4 | = | $\frac{1}{60}$ |
| 4 0 | = | $\frac{1}{5}$* | $3\frac{3}{4}$ | = | $\frac{1}{64}$ |
| 3 4 | = | $\frac{1}{6}$ | 3 | = | $\frac{1}{80}$ |
| 2 6 | = | $\frac{1}{8}$* | $2\frac{1}{2}$ | = | $\frac{1}{96}$ |
| 2 0 | = | $\frac{1}{10}$* | 2 | = | $\frac{1}{120}$ |
| 1 8 | = | $\frac{1}{12}$ | $1\frac{1}{2}$ | = | $\frac{1}{160}$ |
| 1 4 | = | $\frac{1}{15}$ | $1\frac{1}{4}$ | = | $\frac{1}{192}$ |
| 1 3 | = | $\frac{1}{16}$ | 1 | = | $\frac{1}{240}$ |
| 1 0 | = | $\frac{1}{20}$* | $0\frac{3}{4}$ | = | $\frac{1}{320}$ |
| 10 | = | $\frac{1}{24}$ | $0\frac{1}{2}$ | = | $\frac{1}{480}$ |
| 8 | = | $\frac{1}{30}$ | $0\frac{1}{4}$ | = | $\frac{1}{960}$ |
| $7\frac{1}{2}$ | = | $\frac{1}{32}$ | In all 27 divisions. | | |

PROPORTIONAL PARTS OF A POUND IF DIVIDED INTO MILS.

| Mils. | s. d. | | | Mils. | d. | | |
|---|---|---|---|---|---|---|---|
| 500 | (= 10 0) | = | $\frac{1}{2}$* | 20 | (= $4\frac{4}{5}$) | = | $\frac{1}{50}$ |
| 250 | ,, 5 0 | ,, | $\frac{1}{4}$* | 10 | ,, $2\frac{2}{5}$ | ,, | $\frac{1}{100}$ |
| 200 | ,, 4 0 | ,, | $\frac{1}{5}$* | 8 | ,, $1\frac{23}{25}$ | ,, | $\frac{1}{125}$ |
| 125 | ,, 2 6 | ,, | $\frac{1}{8}$* | 5 | ,, $1\frac{1}{5}$ | ,, | $\frac{1}{200}$ |
| 100 | ,, 2 0 | ,, | $\frac{1}{10}$* | 4 | ,, $\frac{24}{25}$ | ,, | $\frac{1}{250}$ |
| 50 | ,, 1 0 | ,, | $\frac{1}{20}$* | 2 | ,, $\frac{12}{25}$ | ,, | $\frac{1}{500}$ |
| 40 | ,, 0 $9\frac{3}{5}$ | ,, | $\frac{1}{25}$ | 1 | ,, $\frac{6}{25}$ | ,, | $\frac{1}{1000}$ |
| 25 | ,, 0 6 | ,, | $\frac{1}{40}$* | In all 15 divisions. | | | |

Those marked (*) are common to both divisions.

Nevertheless, for ease and simplicity in ordinary instances of computation, it is scarcely to be doubted that the employment of a decimal system of accountancy stands pre-eminent. Not only would there result a great saving of time, and, by consequence, of expense, in all cases where extensive calculations are carried on by its employment, but the various processes of arithmetic would be rendered more certain because more simple.* But to you, gentlemen, perhaps the most interesting result contemplated is that which has relation to the change that would take place in the school-room. We are pretty well agreed, I think, that what is called commercial arithmetic occupies a large portion of the time of both teacher and scholar; that the comparatively simple four first rules of arithmetic are only introductory to the more complex scales of money, weights, and measures. Then, indeed, comes the tug of war. What with mastering the tables and puzzling himself with every variety of multiple and submultiple, some of them actually fractional, and involving operation with operation, no wonder that much valuable time is consumed before the pupil thoroughly masters the application of arithmetic to practical purposes. The advocates of a decimal system therefore, not without reason, point to the advantages that would accrue in an educational point of view, to the establishment of so simplified a mode of computation. Professor De Morgan, who has paid much attention to this subject, says, "I think that taking all the schools in the country, commercial as well as classical, and considering in how many of them reading, writing, and arithmetic, form the great mass of what is taught, I am not putting it too high when I say that arithmetic forms the fifth part, in time, of all the primary education given in the country, that is, 20

Since writing the above, a leading journal of the day remarks as follows:—"The way in which the question has been brought forward seems to be this. A committee of the House of Commons was obtained to investigate the subject of a decimal coinage, which, by a curious coincidence, happened to consist not only of persons favourable to a decimal system of accounts and coins—for in that there would be nothing marvellous—but of persons who had made up their minds to one particular method of carrying out that system—that, namely, which is ordinarily known as the pound-and-mil scheme. By another coincidence, no less singular, this committee examined 26 witnesses, all of whom were in favour of this same scheme, and the testimony would have been as unanimous as the report, had not Mr. Headlam, the member for Newcastle, volunteered to give evidence of a plan of his own, and so jarred the accord."—*Times* leader, June 15, 1855.

* It has been computed that the saving in the public service ould amount to a considerable sum.

per cent. of all the primary education. I think that is under the mark. I am sure I am putting the evils of the present system rather low when I say that they cause one-fourth of that time to be uselessly employed, that is to say, one-twentieth part of the time spent in primary education in this country I consider to be thrown away by the present system of coinage, weights, and measures."* Mr. W. Brown, M.P., says, that a knowledge of arithmetic could, under a decimal system, be acquired in one-fourth the time employed at present.† In the *Eclectic Review* for November, 1854, a writer on this subject states that Practice and Proportion will virtually cease, and that Vulgar Fractions will also be done away with in commercial arithmetic, which will no longer require the pupil to employ the compound rules.‡

Whilst admitting, however, the great advantages of the decimal over the ordinary compound scales, some amount of caution should be used with statements coloured, perhaps, by the enthusiasm of those who thus seek to recommend the system to the public. Some writers on this subject are no doubt to be regarded simply as theorists—men who, however highly gifted they may be in scientific attainments, do, nevertheless, lack that practical acquaintance with educational routine that should more fairly and properly be sought from the intelligent teacher himself. Recurring to the references just made, for instance, it may be asked how far it would be possible or advisable to banish all knowledge of the arithmetic of the compound measures, especially when, leaving out the question of any advantage that might be considered to attend their employment as a praxis, they will be required while the change is taking place (considered by some to be not less than 20 years, and by others even longer), and whilst such numbers are employed in other countries, especially in exchange operations, or when the student of history would compute the measures and weights of bygone times; indeed it may even be questioned whether some of our present scales could ever admit of a decimal form, as the seven days to the week, or 365 days to the year; and as to Practice, Proportion, and Vulgar Fractions, why should they be of less moment, when they obviously furnish methods more simple, in some cases, than the employment of decimals only. A reference to Guilmin's *Arithmétique*, one of the authorised works for public instruction in France, will prove useful on this point. With a complete decimal system of money, weights, and measures, the pupil is there nevertheless introduced to "*Regles de Trois;*" "*Fractions ordinaires;*" "*Conversion des anciennes mesures en nouvelles, et réciproquement, et conversion des mesures étrangeres en mesures Françaises;*" processes which require, more or less, some acquaintance with compound arithmetic. Gentlemen, I recommend this part of the subject to your serious and careful consideration, confident that its true value will be fairly estimated in your hands.

(*To be continued.*)

## BRITISH IRON MANUFACTURE.

REMARKS ON THE REPORT OF THE SELECT COMMITTEE OF THE HOUSE OF COMMONS ON THE PETITION OF CONINGSBY CORT, ELDEST SON OF THE LATE MR. HENRY CORT.

BY RICHARD CORT.

The following is the Report, which is divided into paragraphs for the sake of reference:—

1. Your Committee in the first instance beg leave to state, that they have ascertained, by means of returns laid before them, particularly from the Custom House and Navy Board, that for several years past, British iron has regularly continued more and more to supersede the use of foreign iron for home consumption, except in the manufacture of steel; and that it has most rapidly increased as an article of export. Thirty years ago the iron imported averaged about 50,000 tons; in the year 1810 it amounted only to 20,500 tons. At the former period the export was no more than a few hundred tons; but in 1810 it had increased to 24,500 tons.

2. It appears to your Committee, that these alterations in such an important branch of trade and manufacture, have been effected by the industry and talents of numerous individuals, who, previous to the date of Mr. Cort's patent, and subsequent to it, have exerted themselves with much skill and perseverance and with a great expenditure of capital, for the purpose of conducting experiments on a large and practical scale; among these Mr. Cort appears to have possessed a considerable share of merit.

3. Your Committee have not been able to satisfy themselves that either of the two inventions claimed by him, one for subjecting cast iron to an operation termed puddling, during its conversion into malleable iron; and the other for passing it through fluted or grooved rollers, were so novel in their principles, or in their application, as fairly to entitle the petitioners to a parliamentary reward.

4. Moreover it appears to your Committee, that, in fact, no good malleable iron can at this time with certainty be made by the method claimed as the invention of Mr. Cort, unless the cast iron has previously been converted into what is called finery or finer's metal, by a process since found out.

5. Statements have been made, which your Committee deem worthy of most serious attention, inducing a belief that the bad qualities occasionally found in some British iron, must be imputed to the circumstance of workmen or manufacturers omitting this additional process, by which they save a considerable expense, and produce bar iron equal in appearance to that of the best quality, but wholly unfit for most useful purposes.

6. Yet, nevertheless, being convinced that Mr. Cort is fairly entitled to some share of the improvements so extensively beneficial to the country, your Committee entirely approve of the annuity of £200 a year granted to him, and of that of £125 a year since extended to his widow; and they would further observe, that the petitioners, viewing the merits of their late father through the medium of partial affection so natural to their situation, seem quite exempt from any charge of presumption in thus soliciting the bounty and liberality of parliament. Your Committee cannot therefore refrain from expressing a hope, that the House will deem it right, so far to comply with the prayer of the petitioners, as to bestow on them such a moderate sum as may cover the expenses necessarily incurred during the investigation.

March 20, 1812.

The following are the names of the gentlemen composing the Committee:—Mr. Davies Giddy, Chairman; Lord Arthur Somerset, Sir Thomas Thompson, Sir Richard Bickerton, Sir Charles Mordaunt, Mr. Benjamin Hall, Mr. Lyttleton, Mr. Lyggon, Mr. Davis, Admiral Markham, Admiral Moorsom, Mr. Wharton, Mr. Croker, Mr. Robert Ward, Mr. Hughes, Mr. Dugdale, Mr. Grenfell.

N.B. In the above list will be found several high official and naval authorities, secretaries of the Treasury and Admiralty, and merchants, but only one member connected *practically* with the *Iron Trade*, Mr. Benjamin Hall, of the Firm of Crawshay, Hall, and Bailey, the principal witness in support of the petition. Mr. Manners Sutton states, that he was commanded by His Royal Highness the Prince Regent to acquaint the House, that having been informed of the contents of the Petition, he recommends it to the consideration of Parliament.

Since this Report was drawn up 43 years have elapsed, and the present statistics of the Iron Trade by the last

* Evidence before Select Committee on Decimal Coinage, 709.

† Proceedings of Decimal Association, p. 17.

‡ Page 608.

returns to parliament for three years ending 5th January, 1855, shew on the average of three years, the results as compared with the following periods:—

| | Pig Iron, with Pit Coal. | Bar Iron. | Puddled, Rolled, &Wrought Iron. | Import. | Export Bars. | Export, all sorts, Cast & Rolled. |
|---|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. |
| 1782 | ... | ... | ... | 50,000 | 427 | .. |
| 1787 | 85,000 | 30,000 | ... | 70,000 | ... | ... |
| 1811 | 350,000 | 150,000 | 250,000 | 20,500 | 24,500 | ... |
| 1855 | 3,000,000 | 1,600,000 | 2,500,000 | 40,965 | 612,830 | 1,145,788 |

It will be seen by the above, that the import of bar iron, in 1855, was 20,465 tons more than in 1811. This was owing to the increased demand for the Swedish iron for the finest steel, the total quantity of the latter alone during the last ten years being not less than 260,000 tons besides supplies from Russia—yet, as compared with the import in 1787, the decreased import is equal to 29,035 tons.

Hence, from the statistics of the case, it will at once be observable that to whomsoever in a particular degree can be attributed the merit of these changes in the manufacture of British iron, which have increased the make of pig iron with the cheaper pit coal, instead of the dearer charcoal, from 85,000 tons to 3,000,000 tons; the manufacture of 30,000 tons of bad hammered iron to 2,500,000 tons of good rolled bar and wrought iron, including 1,600,000 tons of bar iron; decreased the import of bar iron from 70,000 tons to 29,035 tons, and increased the export of British iron from 427 tons to more than *eleven hundred thousand tons*, justly deserves to be placed in the highest catagory of those who are entitled to be accounted benefactors to their country and the human race.

No. 2.

In this paragraph the Committee alludes to the "alterations" in the manufacture of British iron which had occurred up to 1810 (1811), and to their having been effected by the industry and talents of "numerous individuals" previous to my late father's patents. But, whatever may have been the number of these persons, or whatever their merits, they were circumscribed, according to the showing of the Committee, to a few hundred tons in 1782. At the same time, some of the "numerous individuals" referred to by the Committee may have introduced improvements entitling them to commendation; but what they were, whether real or imaginary, whether depending on puddling or rolling for profitable existence or not, we are unable to state, not being aware of their distinctive nature or character; besides, the whole of the "numerous individuals," except my father, were nameless, while the merit of the latter was patent and notorious to all who had made or handled British iron in the three kingdoms for the last seventy years; his inventions being as under:—

In 1783, for rendering pig or cast iron malleable in an air furnace, heated by the flame of pit coal, without the aid of charcoal, blast, bellows, or cylinder, termed puddling; and the other in 1784, for grooved or fluted rollers, for the manufacture of bar, bolt, and rod iron, never before used, and since universally adopted.

From these two improvements, as from their fountain head, have flown these facilities, despatch, economy, and improved quality in the manufacture of British iron, has expanded this source of national wealth and industry, and extended the commerce of the country in this article alone to all the markets in the world.

No. 3.

The averment made by the Committee in this paragraph, that "they have not been able to satisfy themselves that either of the two inventions claimed by Mr. Cort were so novel in their principle or in their application as fairly to entitle the petitioners to a parliamentary reward," requires under this head that we should enter more fully into details; for if the Committee were unable to satisfy themselves, after all the principal ironmasters in the kingdom had so fully satisfied themselves, by using and profiting by both inventions, for more than 20 years previously, and after knowing that they had publicly declared themselves, only the year before, indebted to Mr. Cort for the principle and the application of both inventions, the Committee ought to have found no difficulty in satisfying their own minds on the same subject.

The Carron Company, in Scotland, had used pit coal successfully for making pig iron, but never for puddling in an air furnace previous to 1783 and 1784, and were so convinced of the novelty and importance of the principle and application of my father's discoveries, that in their letter, dated February 18, 1786, to John Wanchope, Esq., writer to the signet at Edinburgh, from Mr. C. Gascoigne, they voluntarily offered to supply my father with pig iron to any extent, to rent him a forge, and to place the entire direction of the works in his own hands, with or without his own workmen; besides which, it is well known that all previous attempts for puddling in an air furnace heated with pit coal had not succeeded, the last having been abandoned by the Colebrook Dale Company in 1782, as utterly hopeless, called "Buzzing."

Mr. Joseph Reynolds, the chief conductor of the Colebrook Dale Company, who subsequently was among the first to erect new works for puddling and rolling on my father's principle in 1788 and 1789, states, in his letter to Mr. Price, of Birmingham, dated 13th February, 1812, that "great credit was due to Mr. Cort for the use of rollers instead of hammers, the advantage of forming the iron with rollers being so very great, and may be fairly considered as the principal cause of the *great increase of the British iron trade*, by reducing the expense of the manufacture, and facilitating the production of prodigious quantities of bar iron with few workmen." Again, in a letter to my late brother, William Cort, dated 20th February, 1812, both read to the Committee, he observes, "I am convinced that your father's undisputed invention of rollers was of much more assistance to the iron trade than puddling from raw pig, even after some improvements were made."

The late Mr. Samuel Homfray, of the Penydarran Iron Company, one of the witnesses examined, admits in his evidence that "Finers' metal," being his own process, was afterwards puddled exactly as Mr. Cort did with the pig, and that he had seen iron rolled into *plates*, but never into bars, previous to 1783 and 1784. This witness attempts, nevertheless, to throw doubts on the novelty of my father's inventions, and to disparage his merits, but his whole evidence is contradictory in itself, and directly at variance with his own practice and previous admissions, as will be seen by the following communications. First, as to his own practice.

Mr. James Cockshutt, who had been twenty years in the iron trade previous to my father's patent, and was in partnership with the late Mr. Richard Crawshay, when the latter and himself visited my father's works, in 1787, and witnessed for the first time in their lives the operations of puddling and rolling, states in his letter to my late brother Coningsby Cort, dated 10th April, 1812, that, "Mr. Samuel Homfray always had a vigilant eye to their proceeding at Cyfartha, and not only borrowed of him the patterns of my father's puddling furnaces, which he had used for the erection of the works at Cyfartha, but also my father's workmen, to instruct him how to use both the puddling and rolling processes; besides which, he borrowed the very patterns which had been used for constructing the mill at Cyfartha, adding, if Mr. Crawshay had not been convinced of your father's just claims, he never would have signed an agreement *to pay ten shillings per ton for all the iron rolled under his patent*, and still less expended a large capital for the erection of works to use both the puddling and rolling processes." In a letter from the same witness, Mr. Samuel Homfray to the late Mr. Richard Crawshay,

dated the 10th November, 1787, read to the Committee, and admitted to be in his own hand-writing, he states that he considered Mr. Cort's plan to be "the best and cheapest."

Sir Jeremiah Homfray, likewise brother of the same witness, in a letter to my father, dated March 11, 1789, also read to the Committee, states, that "the Penydarran Iron Company was then using his plans for puddling and rolling, and that he was confident they could make one ton of good bar iron with 30 cwt. of pig iron, and that the forge in use by Mr. Crawshay, on his plan, was a noble work, and turning out three tons of blooms weekly. In confirmation, also, of the successful operation of the works carried on by the Penydarran Iron Company, under the direction of the witness, Mr. Samuel Homfray, and his brother, they not only profited by 20,000 tons of puddled and rolled iron sent to market under my father's patents, between 1788 and 1798, *gratuitously*, as will be more fully explained in another place, but also profited for thirteen years subsequently, previous to 1812, to a very large amount, by puddling and rolling. For or nearly the same period, twenty-four years, the Penydarran Company sent down the Glamorganshire Canal not less than 265,496 tons of puddled and rolled iron, and if *one-third* be added for *waste* in conversion, the iron consumed by puddling and rolling would be 353,994 tons [see Scrivenor's work, p. 124], so that it may be asked whether the whole quantity of pig iron made during the last sixty-five years by the Penydarran Iron Company did not closely approximate to *one million tons*, and the profit to *one million sterling*, including puddled and rolled iron, or how much more or less?

Among other preposterous statements made by Mr. Samuel Homfray, especially after borrowing my father's plans to build his own work for puddling and rolling, he assured the Committee that a Mr. Butler, of Newport, a tin plate manufacturer, was the inventor of grooved rollers, and the first to use them in 1782, yet the witness preferred exposing himself to legal proceedings by Mr. Butler in 1789, by adopting my father's plans instead of the plans of the original inventor, Mr. Butler, who had, according to his own evidence, a prior right to the invention, although no attempt was made by Mr. Butler himself, to stop the patent being granted to my father.

Besides, it may be asked, if all the benefit which had resulted from grooved rollers for 23 years previously to 1812, were due to Mr. Butler, and not to my father, why did all the principal iron companies in South Wales, including his own company, as well as others elsewhere, in 1811, *mistake* Mr. Cort for Mr. Butler by acknowledging themselves indebted to the former and not to the latter.?

As regards, however, Mr. Butler and his invention of grooved rollers in 1782, it will be seen from the following plain statement of facts by Thomas Llewellyn, in his letter to my late brother, the petitioner, dated 30th November, 1812, Llewellyn being at that time chief roller man at Cyfartha, where he had acted on my father's recommendation in the same capacity for 20 years, will show best why Mr. Homfray preferred using my father's plans and workmen to those of Mr. Butler's, for he states that, "he went to Mr. Cort's works at Fontley, in March 1784, to see the puddling and rolling of bar iron. In February, 1785, Mr. Cort sent for him to work as roller man at Fontley, and that he worked there till October 1785, when Mr. Cort gave him leave to fetch his wife and children, then living near Newport, and that as he was within less than half a mile from Mr. Butler's tin mills, having a brother in law and sister at work there, he called to see them. Mr. Butler, finding that he had been working for Mr. Cort, asked him if he thought that *bolts* could be rolled out of the shearings of tin plates with Mr. Cort's patent rollers, and having assured him he thought it might be done, he was requested to give Mr. Butler's foreman the requisite instructions for using Mr. Cort's rollers for this purpose (in 1785, not 1782), meaning to apprise Mr. Cort that he might call on Mr. Butler to pay for the patent right."

Under this head I have also to notice the evidence of Mr. William Crawshay, of the Cyfartha Iron Works. This witness stated that "if his family had pursued the plans of Mr. Cort, his family would have been ruined."

This is a strong remark, and if it could be proved to be correct, it would sweep away the very pedestal upon which my father's claim to public merit rests. But let me analyse the remark, and bring it to the touchstone of facts and proofs. This witness is still living, now a man of princely fortune, and was, in 1812, both a young and inexperienced ironmaster. To refute the statement above quoted, a letter was produced and read to the Committee, from the late Mr. Richard Crawshay, to Mr. James Weale, Secretary to Lord Sheffield, dated the 1st Dec., 1808; after describing his own works in exact conformity to the specification of my father's patents, he states he took the plans from a Mr. Cort, who had a little mill at Fontley, near Gosport, and that he was then making *ten thousand pounds annually*.

To shew that the late Mr. Richard Crawshay did *not* act upon the principle that he would be ruined if he pursued the plans of my father, he not only was the first to erect colossal works in exact conformity to his plans, but my father personally superintended the construction of them, and instead of not pursuing them when built, he had carried them on most extensively for nearly 20 years previous to the date of his letter, and when he died he left a princely fortune to his family, but never paid one farthing to my father for 40,000 or 50,000 tons of rolled iron before my father's patents expired.

Some idea may be formed as to the kind of plans that would have brought the family of Mr. Crawshay to ruin had they been followed, as they have been for 65 years, by the following facts:—

In twenty-four years, from 1817 to 1840, Messrs. Crawshay and Co. sent down the Glamorganshire Canal not less than 613,144 tons of puddled and rolled iron (see Scrivenor's work, p. 124 and 257); and, if *one-third* be added for waste in conversion, the whole quantity of iron consumed in these operations was not less than 817,430 tons, while for the preceding and subsequent years, from 1789 to 1754 inclusive, 65 years, the total make of puddled and rolled iron must have been enormous. In only one year, 1849, the total make of pig iron, by Crawshay and Co., at Cyfartha, Ynisfach, and Hirwain, is reported to have been 72,000 tons, or nearly as much as the whole make of Great Britain, exclusive of Scotland, in 1787 (when probably not less than 80 puddling furnaces were then actually in use); persons employed, 5,000; wages at the rate of nearly £200,000 per annum; see letter from Daniel Evans, Esq., who obtained, personally, this information at the works, in the *Morning Chronicle*, 20th March, 1850, so that it may be asked whether the whole make of pig iron, in 65 years, was not *two millions* of tons, and the profit on all sorts, including puddled and rolled iron, *two millions* sterling—or how much more or less? The Dowlais Iron Company, represented by the late Sir John Guest, Bart., M.P., are stated, in the same letter, by Mr. Evans, to be using 77 puddling furnaces, and the Plymouth Iron Works 48 puddling furnaces.

The following evidence, to which there is not the slightest allusion in the Report, although read to the Committee, will show that the statements made both by Mr. Samuel Homfray, on behalf of the Penydarran Company, and by Mr. William Crawshay, for Crawshay Hall, and Bailey, were completely at variance with the proceedings of a general meeting of the iron trade of Great Britain, held at Gloucester, on the 29th March, 1811, when it was unanimously resolved, that the iron trade was greatly indebted to the late Henry Cort for his exertions in introducing the puddling process to public attention, and for his invention of grooved rollers for the manufacture of bar iron; also, that a subscription be forth-

with commenced for the relief of his widow, Elizabeth Cort, and her family, when the principal iron companies then assembled subscribed as under:—

| | |
|---|---|
| Crawshay, Hall, and Bailey ... ... ... | £21 |
| Dowlais Iron Company ... ... ... ... | 21 |
| Penydarran Iron Company ... ... ... | 21 |
| T. W. and B. Botfields ... ... ... ... | 21 |
| Robert Thompson ... ... ... ... ... | 21 |
| William Reynolds and Co. ... ... ... | 21 |
| Benjamin Gibbins and Co. ... ... ... | 21 |
| R. J. and A. Hill ... ... ... ... ... | 21 |
| John Adenbrooke ... ... ... ... ... | 21 |
| Treve, Cook, and Powell ... ... ... ... | 21 |
| Colebrooke Dale Company ... ... ... ... | 21 |
| Harford, Crocker, and Co. ... ... ... ... | 21 |
| Tredegar Iron Company ... ... ... ... | 21 |
| Reynolds, Blakemore, and Co. ... ... ... | 21 |
| John Read . . ... ... ... ... ... ... | 21 |

Other Iron Companies afterwards subscribed, making the whole nearly £1,000.

## ON HYDRAULIC LIMES, ARTIFICIAL STONES, AND DIFFERENT NOVEL APPLICATIONS OF SOLUBLE ALKALINE SILICATES.

By M. Fr. Kuhlman.

(From *Cosmos.*)

Entrusted, about the close of the year 1840, with some trials relative to some abundant efflorescence, which was formed on a perfectly new building, and which was considered to be due to the formation of nitre, I was soon convinced that the efflorescent salts were formed to a great extent of carbonate of soda, and that the lime which had been used (hydraulic lime, from the neighbourhood of Tournay), was the cause of the efflorescence which had been observed. A closer examination soon taught me that all limes, and particularly hydraulic limes and natural cements, contained appreciable quantities of potash and soda.

### Theory of Hydraulic Limes.

In a work which I had the honour of presenting to the Academy, at a meeting held on the 5th of May, 1841, I endeavoured to explain the part which potash and soda might play in stones and cements, and I admitted that these alkalies served to bring the silica to the lime, and thus to form silicates, which, by means of the application of water, solidified a portion of the mass, producing the formation of a hydrate, analagous to that which takes place with plaster. I have pointed out since then to the Academy numerous facts as the basis of this theory, and that, among others, of the immediate change from fat lime to hydraulic lime, by simply treating with a solution of silicate of potash. If, after the burning of the limestone, potash is in contact with silica, the silicate which is formed must necessarily react, and this can only take place as soon as the burnt lime is brought into contact with water.

I have greatly added to my experiments on this head, and I have established the fact that, with fat lime and silicate of potash, both of them pulverised and mixed in the proportion of 10 or 12 of silicate to 100 of lime, a lime can be obtained which shall have all the characteristics of hydraulic lime. If these substances are not well pulverised the reaction will be very incomplete, and an effect will subsequently be produced, bringing on disintegration. If from my former trials there results the possibility of converting a fat lime into an hydraulic mortar, by sprinkling it with a solution of an alkaline silicate, in my more recent trials I have found a means of producing at once with a vitreous silicate and lime, hydraulic cements of any required degree of strength. This will enable us to form, at a reasonable expense, buildings to stand the action of water, in places where fat limes alone are now found. Powdered silicate of potash in some sort becomes an agent for producing this hydraulic property, of which future experience will determine the value.

### Artificial Stones.

Looking at the great affinity of lime for silica dissolved in potash, I was naturally led to examine the action of alkaline silicates on calcareous stones. Here I was still more fortunate, for the alkaline silicates became at once the means of a variety of applications of the highest utility. Let us look at what is said on this point in the *Comptes Rendus* of the Society's meetings.

"By mixing some powdered chalk in a solution of silicate of potash, a cement is obtained, which hardens slowly in the air, assuming a degree of stiffness, which, under certain circumstances, renders it applicable for the restoration of public monuments and the manufacture of moulded articles.

"Chalk, whether in an artificial paste or in its natural state, plunged into a solution of silicate of potash, takes up, even when cold, a quantity of silica, which may be increased considerably by exposing the chalk alternately to the action of the siliceous solution and the air. The chalk assumes a smooth appearance, a compact grain, and a colour more or less yellow, according as it is more or less impregnated with iron.

"Stone thus prepared is susceptible of a high polish. The hardness, which is at first but superficial, penetrates by degrees into the centre, even where there is considerable thickness. It appears capable of becoming of incontestible utility in the formation of works of sculpture, and ornaments of the most delicate workmanship; for when the silicifying process—"*silicatisation*"—has been effected on well-dried chalk, without which good results are not possible, the surfaceremains unalterable.

"Some attempts made to render this stone applicable for lithography give promise of great success.

"This method of converting soft limestone into siliceous limestone is likely to become a great acquisition in the art of building. Ornaments, unaffected by damp, and of great hardness, may thus be obtained at little cost; and, in many cases, a plaster made with a solution of silicate of potash will preserve from subsequent decay ancient monuments formed of soft limestone. This same plaster may become of general application in those countries where, as in Champagne, chalk forms almost the only building material."

I have shown experimentally that that one part of the silica from the silicate becomes separated by the action of the carbonic acid of the air, but that those parts of the silicate which have come into contact with a sufficient quantity of carbonate of lime pass into the the state of silicate of lime. My work, presented to the Academy in 1841, pointed out numerous industrial purposes to which the impregnating of porous bodies of mineral substances might be applied, whether the objects operated upon were organic or inorganic. Considering these applications of the art as of the first importance in building, I have attempted to extend them, and I have just laid before the Academy a new series of observations.

### Harmonising the Shades of the Silicified Stone.

I have given the name of "*silicatisation*" to this remarkable conversion of soft and porous limestone into siliceous and compact limestone. As the operation of this process to articles of sculpture and building materials gives rise to a colouring very frequently so marked as to render the joinings more apparent and the veins more distinct, I have been compelled to seek a remedy for this objection.

There are two essential and general points to be met. Chalk walls are too white, while some kinds of ferruginous limestones are too sombre in their shades. To obviate this inconvenience, I perform the *silicatisation* of limestones which are too white with a double silicate of potash and magnesia. This is a vitreous substance, which forms a brown solution, and which when used in the process causes a little oxide of manganese to be deposited in the artificial siliceous paste. Oxide of cobalt, too, will

combine, though in very small quantities, with silicate of potash. Silica precipitated by a current of carbonic acid is of a brilliant azure blue. This silicate may be used in the treatment of white marbles.

When the shades of the stone are too decided, and that is the most common defect, I obtain good results by mixing in the silicate solution a small quantity of artificial sulphate of barytes, which in penetrating the porous stone, whilst it forms a layer of silica, remains fixed, entering, as we shall see below, into a state of chemical combination. As regards the joints, they may be made with common cements, the shades of which may be rendered lighter by means of some white substances, but they may be still more entirely concealed with broken pieces of the stone itself mixed with silicate of potash, the whole being well pulverised previous to its use, and applied in a state of liquid paste.

COLOURING THE STONE.

In the course of my researches for giving to these silicified stones shades which would cause those portions of our buildings which had been submitted to this process to harmonise with those which had not, I was led to submit the stones to an actual dyeing process by impregnating them in the first instance with certain metallic salts which by precipitation would produce the required colour.

Thus, impregnating the stone with salts of lead or copper, and afterwards bringing it into contact with sulphuretted hydrogen gas, or a solution of hydrosulphures of ammonia, I obtain at will grey, black, or brown shades with salt of copper and ferrocyanide of potassium I get shades of copper colour, &c.

In the present case I have made an observation which in a chemical point of view is not devoid of interest.

I have stated that the porous limestones, when submitted at a boiling heat to solutions of metallic sulphates whose bases are insoluble in water, give rise during the whole reaction, to a disengagement of carbonic acid, and to the fixing in sufficient depths metallic oxides in intimate combination with sulphate of lime. When the metallic sulphates have a coloured base, very beautiful tints of different and perfect shades are obtained. Thus, with sulphate of iron we get the production of a tint in red rust, more or less deep according as we operate with solutions of green vitriol more or less concentrated; with sulphate of copper the stone takes a magnificent green tint; with sulphate of manganese brown shades are obtained; with a mixture of sulphate of iron and sulphate of copper we get a chocolate colour. I have also experimented with sulphates of nickel, chromium, cobalt, &c., and with mixtures of these sulphates.

The affinities which determine the reactions in question are sufficiently powerful to cause the metallic oxides to be completely absorbed by the stone, so much so, that certain oxides, such as that of copper, for instance, entirely disappear from the solutions after boiling with an excess of chalk.

It is remarkable, that when in operating with mixtures of salts of copper and salts of iron or of manganese, the oxides of iron and manganese are the first to be thrown down.

When we operate with sulphates having a colourless base, such as sulphate of zinc, magnesia, or alumina, we equally obtain the precipitation from the oxide, and their penetration to a certain depth in the stone, with a disengagement of carbonic acid.

The bi-sulphate of lime gives analagous results.

In general, when we intend to use coloured stones in buildings, &c., or to form mosaics, it will be found useful to increase their hardness by the silicifying process.

We may proceed in the same way with articles in shell, white coral, &c., in which the colour may be produced by the same process, acting at different pressures.

I will conclude this head with an important observation, which is, that the double sulphates which are formed in penetrating the stone, make a body with it, and increase its hardness to such an extent, that when certain sulphates are employed, such as that of zinc, the silicifying process becomes unnecessary.

The editor of "Cosmos" adds, the process which has just been described, is likely to tend to the production of a great and new industry, splendid specimens of which are to be found in the Exposition Universelle, placed in the central gallery of the "Annexe," on the banks of the river, opposite the produce from the mines of Anzin. We shall examine these specimens with care, and give a detailed account of them when we treat of the section of the chemical arts. The display made by the celebrated chemist of Lille is one which deserves great attention.

## Home Correspondence.

### MEN OF SCIENCE AND PATENTEES.

SIR,—In your last, Mr. W. Bridges Adams adverts to three most important desiderata, namely, the establishment of a proper system of remunerating and encouraging the labours of men of science, properly so termed, the improvement of the system of adjudicating in matters of patent rights, and a statute of limitations (so to speak) in regard to evidence as to the validity of patent rights. Now although I fully coincide in the necessity of every one of these, yet I differ both with Mr. Adams and Sir J. Paxton, as regards the propriety of appropriating any part of the Patent Office revenue for the purpose of remunerating the man of science, as such, for if there be any considerable surplus beyond what is necessary, or *might be made available* for the efficient working of the patent law, then I think equity requires that patent fees be reduced, in accordance with such surplus, and then, of course, there would be no fund out of which the payment could be made. As regards the benefits conferred by men of science upon inventors, although they are great, yet I do not think the body of patentees ought to pay the scientific explorers instead of the public, for they are in reality joint participators in a *public work*—social and industrial progress—therefore *the public* should pay both parties; moreover, I think Mr. Adams will readily admit, that it would be rather hard to call upon those patentees to pay the men of science, whose only advantage has been to pay for great seals, stamps, &c., and expend time and ingenuity in that which has never realised a penny. It appears to me, that as regards working for the public without remuneration, the men of science and men of practice are pretty much in the same position,—there is in reality no better chance of obtaining proper remuneration for the one than for the other.

With regard to improving patent law adjudications, I would reiterate what I have so often stated when advocating patent law reform, previous to the passing of the Patent Law Amendment Act, viz., that this must go hand-in-hand with cheapening and facilitating the obtainment of patent rights if any real good is to be done, for on the one hand the public have a right to the means of protection against the undue assumption of patent rights, and on the other, real inventors ought to have the means of securing their property assured to them in a ready and inexpensive manner. In this matter I would suggest that whereas the plaintiff now procures a scientific witness (as it is termed) to combat on his behalf against the defendant's scientific witness, neither of them giving the court and jury a view of the whole case, but only a view of the case *in favour* of the party for whom he may be called, that instead of this, a list of scientific and practical men should be kept at the Patent Office, who should be referred to *by the court*, and this without extra expense to the litigants, the expense of these official witnesses be made to fall on the Patent Office revenue, thus the court and jury would obtain unbiassed opinions for their guid-

ance, and the parties relieved of the greatest part of the expense.

As regards limiting the evidence of want of novelty, either by reason of public use or public record, as against the validity of a patent, I quite agree with Mr. Adams, though I would make the term as short as 30 years. Such an enactment would be in accordance with the saving clause of the statute of monopolies, which is the keystone of our patent law, for it says that new inventions for any manner of new manufactures "within this realm *which others at the time of making letters patent and grants shall not use*," shall be valid, thus making the great test the use or non-use *at the time* of granting the patent, not the use or non-use 1000 years previous.

I am, sir,
Your obedient servant,
F. W. CAMPIN.

Strand, July 17, 1855.

## UTILISATION OF SLAG.

Sir,—Mr. Mushet, in his letter last week, referred to my manufacture of artificial slag, in combination with other manufactures, by using the waste heat (so easily and generally applied) from a reverberatory furnace, for generating steam, &c.

As the ironmasters cannot be prevailed upon to use their slag, and it is not to be expected they will allow others to use their premises (even where the premises would admit), I am driven to the use of artificial slag, to shew that we are not entirely dependent on them for an economical and abundant supply, which is practically proved (to some extent) by Messrs. Chance, of Birmingham, with the Rowley ragstone, melted in a reverberatory furnace, as patented by Mr. Adcock, *subsequent* to my first patent for "clay and other plastic materials;" but as that material is confined to certain districts, similar to the ironstone, it is not likely to be generally used. By analysis it will be found that the common brick earths contain the elements of slag, namely, lime, silica, and alumina, and some of them have been taken direct from the pit to the furnace, and run into slag in less than two hours, without requiring any mixture, thereby proving that for general use, either on a *small or large* scale, there is no slag material equal to the common brick earths, which not only establishes the novelty of my first patent, but shows the applicability of the same to every locality, for the purpose of manufacturing numerous articles of unlimited demand; and as slag connot be manufuctured by any process without a loss of about 80 per cent. of heat, which may be applied (on a small scale) to generating steam for grinding corn, tempering, moulding, drying, and burning of common bricks, pipes, tiles, pottery, cement, &c., &c., or used in combination with any other manufacture requiring steam, by making one fire answer the purpose of several, and in many cases making a double use of the tall chimneys, kilns, furnaces, and other buildings now actually in operation in almost every country town in England. Having shown the capability of using the waste heat, I admit it is incumbent on me to show some process in addition to those now before the public, as published by Dr. Smith (*ante*, page 338), by which slag can be manufactured alone, at a profit; I, therefore, beg to submit the following calculations for public opinion and discussion:—

Slag as Compared with Slate.

Duchess slates, 24 inches by 12 inches, at £12 10s. per thousand (the price of slate will vary in every locality).

180 slates at 3d. per slate, 5¼lbs. each—8cwt. 49lb. worth £2 5s. = 360 square feet of slag, ½-inch thick, 6¼lbs. per foot, 1 ton worth £2 5s.

360 slates at 3d. per slate, 5¼lbs. each—16cwt. 98lbs. worth £4 10s. = 720 square feet of slag, ¼-inch thick, 3lbs. per foot, 1 ton worth £4 10s.

720 slates at 3d. per slate, 5¼lbs. each—1 ton 13cwt. 84lbs., worth £9 = 1,440 square feet of slag, ⅛-inch thick, 1½lbs. per foot, 1 ton worth £9.

One reverberatory furnace will melt 5 tons of raw material in 24 hours, the cost of which cannot exceed the following estimate (on a small scale) suitable to every locality (on a large scale the expenses in labour would be much less).

| | £ | s. | d. |
|---|---|---|---|
| 4 tons of coal, at £1 5s. per ton ........... | 5 | 0 | 0 |
| 8 furnace-men and moulders ............... | 2 | 0 | 0 |
| 4 packers in ovens ............................. | 1 | 0 | 0 |
| 8 boys ................................................ | 0 | 16 | 0 |
| 2 overlookers ....................................... | 1 | 0 | 0 |
| Wear and tear, interest, rent, &c. ......... | 0 | 15 | 0 |
| 6 tons of raw material (dug on the spot)... | 0 | 12 | 0 |
| Cost of 24 hours in succession | 11 | 3 | 0 |
| | | | 3 |
| Cost of 3 days and 3 nights ... | 33 | 9 | 0 |

| Produce. | £ | s. | d. |
|---|---|---|---|
| 5 tons of manufactured ½-inch slabs ............ | 11 | 5 | 0 |
| 5 tons ditto ¼-inch slabs...... | 22 | 10 | 0 |
| 5 tons ditto ⅛-inch slabs...... | 45 | 0 | 0 |
| | £78 | 15 | 0 |

| | £ | s. | d. |
|---|---|---|---|
| Profit ............................................ | 45 | 6 | 0 |
| | £78 | 15 | 0 |

Slag is particularly adapted for roofing similar to the Crystal Palace, and may be manufactured and used similar to rough glass, with putty and paint, and if so used, the above calculations may be nearly doubled, as they are supposed to be worked as slate. Thin slabs may also be used instead of plastering, as Dutch tile are frequently used, and will admit of papering or painting immediately, and will be found a certain remedy for damp and vermin.

If worked on a large scale, a small blast furnace may be used for melting, the material to be dried by the waste heat, but as it will then be mixed with the fuel in the furnace, it will require refining, and may also at the same time be coloured, as fully described in Dr. Smith's paper, (*ante*, page 335.)

I am, sir,
Your obedient servant,
W. F. ELLIOTT.

Blisworth, July 17, 1855.

## MECHANICS' INSTITUTIONS AND WORKING MEN.

Sir,—The following remarks were suggested by a letter communicated to your *Journal* by S. L. Rymer, on Mechanics' Institutions and Working Men.

Mr. Rymer thinks his letter may catch the eye of some one of experience, who will *try* to answer the question, "Why have Mechanics' Institutions not been sufficiently taken advantage of by working men?" With the experience of being a member of a working men's reading-room in Carlisle, and in the absence of anything better that may come to hand, I beg to submit the following for his perusal.

Institutions in general, Mechanics' Institutions in particular, ought to be formed and conducted so as to admit of the members feeling themselves at home, as it were, whilst attending for literary instruction and entertainment. Sensible working men do not feel themselves free enough in the company of those who are much above them in the scale of wealth and education, to enable them to take advantage of Mechanics' Institutions. To insure the attendance of working men to a literary institution, they must feel an interest in the society's welfare, have a say

in the management of it, and the subscription must be within their ability. They must hold a position equal to, and enjoy the same privileges as, the other members of the society.

To some extent this has been the case with the Mechanics' Institution of Carlisle, and probably in other parts of the country. Any member paying 8s. a year, might go upon the committee *if elected.* Notwithstanding the existence of this, universal suffrage, vote by ballot, &c., the management has for the most part fallen into the hands of the higher classes. This is natural enough. We all have a prejudice in favour of those respectable in appearance. The remedy which Mr. Rymer suggests has long been tried without success. It is in vain to tell a poor man he ought not to feel backward in the presence of those much above him in the scale of wealth and education. It is in vain to suggest to the man of wealth and education, that he should endeavour to feel himself comfortable in the company of rags, dirt, and ignorance. Let Mr. Rymer ask himself if he would like, dressed in his superfine, to elbow his way through among dusty coats; or, if he wanted a quiet read, to have his polite ears offended with the jargon of the workshop, or to pay more for his membership than he thinks he is able.

Literary Institutions for working men must be formed for those for whom they are intended. To make them successful they must be managed and supported by working men. Of this there is sufficient evidence in Carlisle. The Institution which I attend is avowedly a working man's reading-room; any other may become members, subject, however, to the rule which excludes other than working men from the committee. This may seem very odd, but it has worked well since 1848. It does not prevent the higher from mixing with the lower classes. The rich can read, suggest, vote, and enjoy *all the privileges, except being a member of committee.* It is, perhaps, a question, whether any are so likely to know the wants of working men as a committee of their own order.

The payment, a penny a week, is expected to be within the reach of most people (and can be paid easier than 2s. a quarter, or 8s. a year.) When a member is sick or out of work, he can attend without paying. For the last five years the number of names on the book has seldom been less than 200. On the second of July, they numbered 252. They are nearly all working men, who work at ill-paid employments. The member who, for a considerable period, with promptitude and energy, has discharged the duties of chairman, works at his employment for considerably less than 8s. a week. In the society he possesses, perhaps, more influence than any other member. The committee consists of twelve, besides the chairman, secretary, and treasurer. It is unnecessary to say that the funds are managed with scrupulous care. Guided by the economical housewife principle of making the income meet the expenditure, the committee manage in a manner that might put to the blush wealthier and abler committees. During the five or six years I have been a member, I do not remember a single quarter audit that showed the reading-room in arrears. This contrasts strangely with a similar Institution in Carlisle, managed by the clergy and gentry, whose balance-sheet, last year, showed them £25 in debt.

I need not tell the readers of this *Journal* that working men's reading-rooms are likely to do much good. That they are calculated to bring about a reform worthy of the name, is implied by their existence. In our Institution the papers are read for those who cannot read for themselves. The daily *Times* can be seen by the poorest as soon as it is seen by the richest. It is placed in a frame, similar in form to a small clothes horse, with only the top and bottom rail, so as to show both sides at once, and so that a number of members may read at the same time.

With the fact before him, that working men can enjoy the use of daily and weekly papers, periodicals, &c., and a library selected by their own choice, I think Mr. Rymer will agree with me when I say that, penny-a-week working men's reading-rooms are a valuable improvement upon Mechanics' Institutions.

I am, sir,
Your obedient servant,
JOHN SKINNER.

Lord-street Working Man's Reading-room, Carlisle, July 9, 1855.

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## TRADE MUSEUMS.

Sir,—The subject of Trade Museums has for some time past occupied the attention of the Society of Arts, and the first section of the animal department is now open for public inspection, and judging from the letters which have appeared in the *Journal,* as well as the casual observation of visitors, the general current of opinion seems to be in favour of its further development.

Having watched the progress of the collection with much pleasure, as the untiring exertions of Professor Solly enabled him to secure the numerous specimens of which he was in search, and having done my humble something towards the good work, I feel interested in the experiment, and should regret if the improper location of the collection should impair the usefulness of which I believe it to be capable. A rumour prevails that either Marlborough House or the Crystal Palace will be the final home of the specimens, and it is because I incline to the opinion that neither place is appropriate that I trouble you with these remarks.

The three great groups of mineral, vegetable, and animal substances, form the raw materials of all manufactures, with infinite degrees of combination. Of the first, a very interesting and instructive museum exists in Jermyn-street; of the second group there is a similar one at Kew, and the nucleus of the third is now being exhibited at the Society's house.

The principal seat of the English mineral manufactures and commerce is not in London, and, therefore, as a matter of scientific and educational interest, it does not appear to be of much importance in what locality the metropolitan specimens may be deposited; but with respect to vegetable and animal substances the case is quite different.

An enormous amount of business is daily transacted in vegetable and animal substances in London, and it is surprising what a small amount of knowledge buyers and sellers possess of the nature, sources, properties, reasons of supply and deficiency of the articles in which they deal. Of this fact I could give several ludicrous and curious instances. Such being the case with importers, brokers, and merchants, gentlemen whose interest it is to be conversant with these subjects, how much inferior in this respect is the condition of many manufacturers, and still more to be lamented is the want of knowledge among the operatives and those who deal in the manufactured articles. Where can a person engaged in any of the trades grouped by Mr. Solly in the explanatory memorandum, learn even the principal features of the material which is the source of his living? Where can the importer of a new article get experiments fairly tried? Where can experimenters learn what has been previously attempted, and the results? Where can inquirers for new, useful, and ornamental materials, ascertain whether the articles they seek exist, and that in many cases the trade only requires encouraging? With all such matters, the directors or curators of the respective museums should be conversant, and the information be easily accessible to the public.

It is on behalf of the large classes above referred to that I object to Marlborough-house, as being inconveniently situated as a place of reference for the great number of them, and Sydenham not only on account of its distance, but also that I cannot consent that a Joint Stock Company should make use of what should be a national and free collection, as a bait to attract visitors.

The museum at Kew is instructive in itself, and for a imilar reason, an Animal Trade Museum attached to the Zoological Gardens would be interesting; nevertheless, for the purpose I have in view these are insufficient, and duplicate vegetable and animal trade collections should be deposited in the centre of the city of London.

And as enlightened is infinitely superior to unintelligent inspection, and having reference to the early-closing movement, I consider it desirable to establish, in connection with such museums, regular Saturday afternoon lectures, and I believe no difficulty would be found in obtaining the gratuitous use of Gresham Hall for their delivery. The nature, varieties, peculiarities, mode of treatment and manufacture, with many other points which at once suggest themselves, would form exceedingly attractive and instructive subjects for a course of lectures; the charge for admission should be small, say 6d. each person. On this plan, I believe, the museum would be self-supporting, for I give the young men of London, operatives, clerks, and shopmen, credit for desiring to obtain information respecting the articles by the manipulation of which they procure their living, and I am quite certain they would not be worse workmen, or buyers or sellers, by the instruction I point out. If well written, these lectures might form standard text books for similar collections in large towns, and ultimately in schools, and it should be the duty of the director to facilitate the obtaining and distribution of such educational desiderata.

I am, &c.,

WAIMA.

## CEDAR FROM CANADA.

Sir,—In the arsenal at Woolwich is being consumed for all kinds of common purposes, as purchased at a common price, a wood of very remarkable quality. It is a cedar of the usual colour and odour, but of a grain and veining equal to the finest maple. I was informed that it comes from Canada amongst the usual supplies. I never recollect to have seen it in Canada, where very durable post and rail fences are made of common straight-grained (pencil) cedar. Perhaps it might have been shown in the Great Exhibition, but if so I did not remark it. Possibly some of your correspondents, either here or in Canada, may give us the information, and make this wood known for the purposes it is better fitted for in the elegancies of life. The Temple of Solomon in all its glory could have had no more beautiful cedar than this, supposing the temple cedar to have been red and not white, as the modern cedars of Lebanon.

It almost makes one think that trees have faculties like the higher classes of human beings to grow like by proximity. This cedar looks as though it had been dry-nursed by a maple, and had caught its manners and features while preserving its own complexion.

Yours faithfully,

W. BRIDGES ADAMS.

1, Adam-street, Adelphi, July 13, 1855.

## THE PARIS EXHIBITION.

Sir,—Having recently returned from Paris, I have read, with much pleasure, the notice of the Universal Exhibition, by Mr. Audley, in the last number of the Society's *Journal*. I find, both in London and in the provinces, an almost general impression that the Exhibition is a failure, far inferior to Hyde-park, and not presenting any overwhelming attractions for so long a journey as a visit to it would entail, especially from the North of England or Scotland. Now, I venture to say, that nothing can be more erroneous than such a view. As regards the *area* of space or the *cubic content* of the buildings appropriated to the Exhibition, that of Paris, in the aggregate of the several edifices employed, exceeds Hyde-park Crystal Palace. The variety is greater—the facilities for arrangement are more complete, and the splendour of many of the establishments for the display of articles of luxury, is such as cannot be understood without inspection. How is it, then, that so different and so general an impression prevails?

This is easily answered. The separation of the Exhibition into different parts entirely prevents the visitor feeling the force of vast magnitude which was unfolded by a single glance on entering Hyde-park Glass Palace. Until very recently the interior was very far from complete, and, in fact, it is only by the rapid and most extraordinary development of the last few weeks, that the true character of the Paris Exhibition has been displayed. On entering the principal building—"the Palace" of Industry, the wide arched roof of glass which covers the central portion terminates by ends of highly ornamented and conspicuous stained glass, which appear like the extremities of the building, but beyond these are extensive galleries, which complete a length of 900 feet, or nearly one-half of the Hyde-park Palace of 1851. From this a gallery leads to a large circular building, around which a very extensive temporary building has been constructed, and from these another covered gallery leads to the "annexe," a building for machinery, the length of which is nearly three-quarters of a mile. These latter have only been opened to the public about a fortnight. Another very extensive building is appropriated to the fine arts. In every one of these departments the visitor will find collected so amazing a variety of rich and interesting objects, as to remove all doubts as to the exceedingly great value and attractiveness of the Exhibition, and I venture to say that the facilities it presents for observation and instruction, will meet the expectations of any who proceed thither with these objects in view, and that it is most worthy of the attention of all who are interested in any of the chief departments of national industry, or in studying the present condition of the fine arts.

I remain, sir, yours truly,

THOMAS SOPWITH.

Allenheads, Haydon-bridge, July 16, 1855.

## MORTARS AND CANNON.

Sir,—I write merely to correct an error into which "Cosmos" has inadvertently fallen in his communication inserted at page 599 of your last *Journal*, where he says that, "It is obvious that horizontal fire must give a greater range than vertical fire with a weapon of a given power." The greatest range of any piece theoretically, will be at an elevation of 45 degrees, but practically, with the resistance of the atmosphere, at a few degrees lower.

HENRY W. REVELEY.

July 16th, 1855.

## To Correspondents.

*** In reply to R. N., and to numerous other similar applications, the Secretary begs to state that Messrs. Field and Son, of Birmingham, the successful competitors for the Society's Prize Microscopes, have not yet completed their arrangements for the supply of the instruments. Early intimation will be given on this point.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 9th July*, 1855.

Par. No.

361. Naval Payments—Copy of Order in Council.
317. Sandhurst Royal Military College—Report from Committee.
225. Bills—Public Libraries and Museums (as Amended by the Committee, on Re-commitment, and on second Re-commitment).
226. Bills—Lunatic Asylums (Ireland).
228. Bills—Lady Raglan and Lord Raglan's Annuities.
    Colonial Land and Emigration Commission—15th Report.
    Education (Schools and Parochial Unions)—Minutes of the Committee of Council, &c.

*Delivered on 10th July*, 1855.
336. Land Tax (East India)—Returns.
346. East India (Torture)—Copy of a Despatch.
350. County Courts—Returns.
364. Court of Chancery—Return.
352. Standing Orders—Report from the Select Committee.
232. Bills—Stage Carriage Duties, &c.
229. Bills—Turnpike Trusts Arrangements.
231. Bills—Merchant Shipping Act Amendment (Amended).

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, July 13th*, 1855.]

*Dated 7th June*, 1855.
1308. R. Peters, Union-street, Borough—Ordnance shells.
*Dated 14th June*, 1855.
1358. E. Hollis, Birmingham—Securing ramrods to firearms.
*Dated 20th June*, 1855.
1407. J. Green, 27, Charlotte-street, Portland-place — Moderator lamps.
*Dated 22nd June*, 1855.
1431. W. Teall, Wakefield—Treating soapy waters.
1435. A. E. L. Bellford, 32, Essex-street, Strand—Screw-fastenings. (A communication.)
1437. A. E. L. Bellford, 32, Essex-street, Strand—Pulverising quartz, &c. (A communication.)
1439. Capt. H. N. Penrice, R.E., Woolwich—Propelling vessels.
*Dated 23rd June*, 1855.
1441. T. Walker, Birmingham—Projectiles.
1443. W. Pearce, Poole—Pipes, tiles, and hollow bricks.
1444. G. Whish, Birkenhead—Oscillating steam engines.
1445. I. J. Silbermann, 32, Essex-street, Strand—Globes, &c.
*Dated 25th June*, 1855
1447. J. Gedge, 4, Wellington-street south—Measuring liquids. (A communication.)
1449. J. Harris, Clogwynhyfryd, Merioneth—Crushing and pulverising machine. (A communication.)
1451. S. Smith, Hyson Green Works, near Nottingham—Safety valves and dampers.
1453. P. M. Parsons, Duke-street, Adelphi—Moulds for casting metals.
*Dated 26th June*, 1855.
1455. T. B. Sharp, Manchester, and A. Yorston, Belfast—Furnaces.
1457. J. Ronald, Liverpool—Hemp and flax machinery.
1459. B. Bonnet, Belleville, near Paris—Weaving.
1461. C. M. Pouillet, Paris—Railways.
1463. F. Raux and L. Poret, Paris—Artificial mineral waters.
1465. H. J. Distin, 31, Cranbourn-street—Rendering field bugle chromatic.
*Dated 27th June*, 1855.
1466. F. Russell, 13, Cumberland-market—Hanging windows and shutters.
1467. T. Swinburne, South-square, Gray's-inn—Motive power.
1468. D. D. Buhler, Paris—Fencings.
1469. F. Lucas, Duston, Northampton—Iron.
1470. L. J. F. Margueritte, Paris—Glass and crystal.
*Dated 28th June*, 1855.
1471. H. Walker, Sambourn, Warwick—Ploughs.
1472. J. Raywood, Wentworth—Stopping railway trains.
1473. C. Moreau-Darluc, Paris—Separating substances.
1475. S. Davey, Tucking Mill, Illogen, Cornwall—Safety fuzes.
1476. Lieut. C. C. Engstrom, 18, Buckingham-street, Strand—Breech-loading ordnance.
1477. G. Lilley, Islington—Water meters.
1478. R. Besley, Fann-street, Aldersgate-street—Metallic alloy. (A communication.)
1479. J. Skelley, Kilcurry, Longford—Carriage wheels.
1480. A. E. L. Bellford, 32, Essex-street—Manufacturing, lighting, and heating gases. (A communication.)
*Dated 29th June*, 1855.
1481. P. A. le Comte de Fontaine-Moreau, 4, South-street, Finsbury—Axle boxes. (A communication.)
1485. C. A. Busson, Paris—Teeth of toothed cylinders.
1483. E. J. Hughes, Manchester—Concentrating colouring matter of madder, munjeet, &c.
1484. J. B. de Lorenzi, Paris—Organs.
1485. General Dembinski, Paris—Generating steam without combustible matter.
1486. J. Eccles, Blackburn—Bricks, tiles, &c.
1487. J. Broadbent and S. P. Youle, Manchester—Machinery for cutting out gores of umbrellas, parasols, &c.
1488. W. Heaps, Forton, Lancaster—Machinery for cultivating land.
1489. J. Weems, Johnstone, N.B.—Drying grain.
*Dated 30th June*, 1855.
1490. W. Woodcock, Manchester—Making bricks, &c.
1491. T. Barling, Weymouth—Furnaces.
1492. W. Johnson, 47, Lincoln's-inn-fields—Manures. (A communication.)
1493. J. Birch, Bradford—Iron.
*Dated 2nd July*, 1855.
1494. W. H. Tooth, 4, South-street, Southwark—Earthenware and plastic articles.
1495. J. A. Mignon, Paris—Maps, charts, plans, &c.
1496. F. Lycett, Wood-street—Glove. (A communication.)
1497. W. Knapton, York—Consumption of smoke.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed July 13th*, 1855.
50. Samuel Smith Shipley, Stoke Newington—Improvements in machinery and apparatus for washing or cleansing.
109. Urbain Charles Choisnet and Charles Emile Giajola, Birmingham—Improvements in moderateur lamps.
118. George William Garrood, Burnham, Essex—An improved apparatus to be used in conjunction with windlasses on ships, cranes on land, and with other machinery for raising or lowering weights for the purpose of guiding and controling the action thereof.
120. Joshua Horton, Birmingham—Improvements in packing or storing gunpowder.
125. James Higgins and Thomas Schofield Whitworth, Salford—Improvements in moulding for casting shot, shells, and other articles.
127. Edward Hall, Salford—Improvements in combining metallic wires with textile materials or fabrics for forming "wire ribbon."
149. Thomas Coendoz Hill, Stanton Lacy, Shropshire—An improvement in drain pipes and tiles.
158. Auguste Edouard Loradoux Bellford, 32, Essex street, Strand—Improvements in paddle-wheels for propelling vessels in water. (A communication.)
162. John Gedge, 4, Wellington-street south, Strand—Improvements in laminating metals either in relief or bas-relief. (A communication.)
174. William Dray, Swan-lane—An improved machine for cutting chaff.
176. James Fenton, Low Moor, Yorkshire—Improvements in the manufacture of axles, shafts, rods, and bars.
187. Barnett Samuel, Sheffield—Improvements in the manufacture of knife handles, umbrella and stick handles, door knobs, articles of furniture, and other articles having the appearance and transparency of solid tortoiseshell.
190. Alexander William Anderson, Birmingham—Improvements in posting or exhibiting advertisements.
208. Samuel Mayer and William Bush, Bristol—Improvements in reducing flint and other substances, rendering them suitable for the manufacture of porcelain and other earthenware articles.
242. Auguste Edouard Loradoux Bellford, 32, Essex-street—Improvements in machinery for forging nuts and washers. (A communication.)
264. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—An improved invention for constructing hulls of vessels.
265. John Henry Johnson, 47, Lincoln's-inn fields—Improvements in the manufacture and construction of steam boilers or generators, and in the application of materials to such manufacture. (A communication.)
285. Peter Armand le Comte de Fontaine-Moreau, 4, South-street, Finsbury—An improvement in the mode of applying as motive power heated air combined with the vapour of ether or of any other liquid easily vaporised.
561. John Gracie, Stanley-terrace, Lower-road, Rotherhithe—Improvements in wood-planing engines.
877. John Charles Pearce, Bowling Iron Works, near Bradford—Improvements in making the joints of pipes and other articles.
893. Henri Schoofs, St. Gilles, near Brussels—Improvements in making, fixing, or attaching artificial teeth, gums, and palates.
1083. William Robertson, Edinburgh—Improvements in the treatment of fuel, and its use for heating purposes.
1103. Alphonse René Le Mire de Normandy, 67, Judd-street, Brunswick-square—Improvements in converting fatty and oily substances into fatty and oily acids, and into soap.
*Sealed July 14th*, 1855.
105. James Peter Lark, Nine Elms-lane, Vauxhall—Improvements in effecting the combustion of fuel and the consumption of smoke in steam boiler and other furnaces.
*Sealed July 17th*, 1855.
133. Evan Leigh, Collyhurst, Lancaster—Improvements in machinery or apparatus for preparing cotton and other fibrous substances for spinning.
151. William Smith and Thomas Phillips, Snow-hill—Improvements in cocks or taps, and in balls or floats to be used therewith.
160. William Eisenmann, Berlin—A new construction for a hearth applicable to all firing constructions or fire places.
168. François Arsène Vasnier, Paris—Improvements in fire places.
177. George Brooks Pettit and Henry Fly Smith, New Oxford-street—Improvements in stoves and other apparatus for generating heat from gas, and in the employment and removal of the vapours produced by its combustion.
182. John Livesey, New Lenton, Nottingham—Improvements in lace machinery.
194. Richard Archibald Brooman, 166, Fleet-street—A power accumulator or apparatus to be employed with hydraulic presses. (A communication.)
197. William Binns, Claremont-villa, Victoria-grove, Brompton, and James Haughton, Bank Side New Mill, Oldham—Improvements in valves for stopping, retarding, and regulating the flow of steam, water, or other fluids.
522. John Norton, Dublin—Improvements in fire-arms and ammunition.
841. Philippe Amédée Devy, 10, Old Jewry-chambers—Improvements in the frames of swing looking-glasses.

Journal of the Society of Arts.

*FRIDAY, JULY* 27, 1855.

## SOCIETY'S VISIT TO PARIS.

The Council have much pleasure in laying before the members the following letter, from Colonel the Hon. C. B. Phipps, written by command of H.R.H. Prince Albert, the President of the Society:—

Osborne, July 23, 1855.

My dear Sir,—His Royal Highness the Prince having considered the subject which seems to have been under discussion in the Council of the Society of Arts, namely that of the Society visiting the Paris Exhibition in a body, and, if possible, together with the delegates from the four hundred associated Institutions, has commanded me to express to you his conviction that much good would arise to the prosecution of the many important and useful objects, which the Society is constituted to promote, by the execution of this plan.

The prominent part taken by the Society in originating the Great Exhibition of 1851, naturally suggests the wish that its members should visit together its sequel at Paris.

The point, however, to which His Royal Highness would attach most importance, would be their being enabled to discuss on the spot (together with the members of the affiliated Societies) upon a close inspection of that vast collection of the products of all nations, and a conscientious comparison of them with those of the Exhibition of 1851, the question by what means the progress of Science and Art would best be promoted in this country.

The visit would also afford an opportunity of testing the principles upon which the acknowledged vast improvements lately made in the French metropolis have been carried on, and considering how far they may, with advantage, be applied to our circumstances at home.

Sincerely yours,

C. B. PHIPPS.

P. Le Neve Foster, Esq.

In accordance with the above gracious recommendations, a visit of the Society to Paris has been fixed to take place from Monday the 3rd of September, to Saturday the 15th of September.

The Council have it in their power to announce, that the English and French Railway Companies have at length consented to issue return tickets to Paris and back at reduced fares, and they are at present in negotiation with the Railway Companies to reduce the fares in favour of the Society of Arts on this particular occasion. These tickets are to be available for going and returning by any trains, at any time during the above period.

The Council are now organising arrangements by which they hope to be able to issue, at the House of the Society, in the Adelphi, the return tickets to Paris and back, the French passports, and a list of hotels and lodgings in Paris at moderate charges.

The Council will also provide a central office in Paris, near the Great Exhibition, as a point of reunion for the members of the Society of Arts and their friends, and for the representatives of the Associated Institutions, at which information will be afforded as to lodgings, guides, &c., and at which from day to day visits to the several departments of the Universal Exhibition, and to different points of interest in Paris, will be organised, and excursions to the celebrated places in the vicinity arranged.

With a view of extending the advantages thus offered, every member of the Society will have the privilege of taking, in addition to his own, tickets for two friends, either ladies or gentlemen.

The associated Institutions will each have the privilege of nominating a representative and two other persons, ladies or gentlemen, to join the party.

Further details will be given as early as possible, but in the meantime the Secretary is prepared to receive and register applications.

As the accommodation which the Society can promise must necessarily be restricted, owing to the numbers now visiting Paris, the Council beg distinctly to state, that they can only issue a limited number of tickets, but they pledge themselves to issue those tickets in the order of the applications.

The Members of the Society and of the associated Institutions are to understand that the visit alluded to above is quite distinct from, and forms no part of, the plan for the Artizans' Visit to Paris.

## THE NATIONAL COLLECTIONS.

In the House of Commons the other evening, Mr. Ewart inquired of the First Lord of the Treasury, whether the Government was willing to cause to be affixed to the works of art (paintings, statues, monuments), and specimens in our different national collections—the National Gallery, Hampton Court Palace, the British Museum, and similar public institutions—short descriptive tablets or inscriptions, giving the subject of the work, the name and date of the artist, the school to which he belongs, and such other brief historical or scientific information as might be instructive to the public, and supply, to those who cannot afford to buy one, the place of a catalogue?

Lord Palmerston said, the suggestion of the hon. member was one which might be naturally expected from one who had, like the hon. gentleman, devoted his mind to the diffusion of useful and entertaining knowledge among the humbler classes. He thought the suggestion was deserving of adoption, and did not apprehend that it would be attended with any material expense or trouble. The Government were indebted to the hon. member for the suggestion, and would give it their attention.

## DECIMAL COINAGE COMMISSION.

House of Commons, Monday, 23rd July.

In reply to Mr. H. Hamilton,

The Chancellor of the Exchequer stated, that the Commissioners for inquiring into the propriety of a Decimal Coinage were Lord Monteagle, Mr. Hubbard (late Governor of the Bank), and Lord Overstone. The commission itself was not yet complete, but when it was, there could be no objection to lay a copy upon the table.

## DECIMAL COINAGE.

By Frederic James Minasi.

*(Continued from page 606.)*

Leaving, then, the question of advantages to be derived by the introduction into this country of a decimal system of money and accounts in place of those at present used among us, as a subject upon the merits of which there exists very little difference of opinion amongst those who may be considered to have studied the matter, we shall proceed to the more important and practical part of the question, that which relates to the BASIS upon which a decimal system of money for the United Kingdom should be founded. On this point there does not appear the same unanimity either in the Select Committee of the House of Commons or among those who have, since the publication of their report, taken part in the discussion going on. Referring to this, the essential part of the whole question, the Committee state that "the only points on which any difference of opinion was expressed by the witnesses relate to the precise basis which should be adopted, and the practical measures to be employed for introducing the decimal system, so as to produce the least amount of temporary inconvenience, and the smallest extent of unwillingness to encounter the change on the part of the classes who are the most likely to be affected by it."* And the series of pamphlets since published, and the discussions carried on during the last eighteen months at the various scientific societies and in the public prints, fully prove such to be the state of the question. To the different proposals now before the public for establishing a system of decimal coinage for this country I shall now proceed to invite your attention.

In regard to the question of the mode by which such a system is to be introduced, and the basis upon which it should be founded, two courses seem to be open, either to create a decimal system of coinage independent of that now in use amongst us, or, so far as it can be done, to re-arrange it in the required progression. In the former of these two modes of procedure, we must either create an entirely new system of money, or adopt for the purpose one already in use in some other country, or at least, one formed on its model. So far as I can learn, no scheme has been proposed fairly coming under the description of an entirely new series of coins; a near approach, however, to it will be found in the following proposal, emanating from Mr. Alexander Munro, of Glasgow.† "I would propose," he says, "400 mils as our unit, and it seems to me an unanswerable argument for so doing, that it would introduce the Octagal into our Decimal system, and is also of the nearest approximation to the value of the French coinage:—

| | | | | |
|---|---|---|---|---|
| As 1 sov. | = | 1000 mils | = | 25 francs. |
| Hence | | 40 mils | = | 1 franc. |
| And | | 400 mils | = | 10 francs. |

This unit I would name an *Imperial*, being an integral of the imperial standard: then our monetary calculations would be as under, viz.,

| | | |
|---|---|---|
| 1 mil | = | 24-25ths farthing. |
| 4 mils are............... 1 cent | = | 3,21-25ths ,, |
| 40 mils or 10 cents are 1 decim | = | 9,6-10ths pence. |
| 400 mils or 10 decims are 1 imperial | = | 8 shillings sterling. |

Acting on this plan, our books would not be altered, as 40 imperials, 9 decims, 9 cents, and 1 mil, would be entered as at present, thus:—

| Imp. | Dec. | Cents. | |
|---|---|---|---|
| 40 | 9 | 9¼ | and so on." |

The objections that may be urged against this proposal will be more evident as we proceed. Its peculiar advantage is, that "while each column ascends and descends by *tenths*, each denomination is capable of *halves*, *fourths*, and *eighths*, without a fraction." Its disadvantage, common to every plan of this class, is the difficulty of introducing a system so entirely novel in its construction, and affording so little comparison with that it is intended to displace. Of propositions for adopting in this country a foreign system of moneys, no doubt the most important is that of Mr. James Yates, F.R.S., whose paper on this subject, read at the Institution of Civil Engineers in February, 1854, gained for its author the Telford medal of that year. Mr. Yates advocates the introduction into this country of the entire French *Système Métrique*. It is not possible here to give a detailed account of the origin and introduction into France of this highly-scientific system of metrology, such as is given in the paper in question, since published under the sanction of the council of the institution. I make a few quotations, however, to enable you to form some idea of the proposition: "The coins used in France are adjusted decimally; the franc, which weighs five grammes of silver, is the unit of all monies, its fractions being called décimes and centimes." 1 franc = 100 centimes = 9·5157 pence nearly. The following table, extracted from Mr. Yates's paper, will explain the coins he proposes should be used:—

| Denominations. | Values in francs. | Approximate Equivalents. |
|---|---|---|
| GOLD— | | |
| Royal .................. | 100 | £4 sterling. |
| Half Royal ......... | 50 | English double sovereign. |
| Sovereign ......... .. | 25 | English sovereign; Belgian Leopold. |
| Louis or Napoleon. | 20 | Dutch Willem, or 10-guilder piece; Prussian Fredericks d'or. |
| Ten-franc piece ... | 10 | Dutch 5-guilder piece; Indian pagoda. |
| SILVER— | | |
| Five-franc piece or dollar......... | 5 | Dollars of Europe or America. |
| Two-franc piece or florin......... | 2 | Dutch guilder; Indian rupee; Russian half-ruble, &c. |
| FRANC ............... | 1 | Dutch half-guilder, &c.; Greek drachmos; English 10d. or postage stamp. |
| Half-franc... ........ | ·5 | Russian 10-copeck piece; carlino of Naples. |
| Quarter-franc ...... | ·25 | |
| PAPER, BRASS, AND COPPER— | | |
| Blue postage stamp. | ·2 | Dutch 10-cent piece; Russian 5-copeck piece. |
| Red do., receipt do., Penny ... | ·1 | English penny; Dutch stiver, &c. |
| Halfpenny............ | ·05 | English halfpenny, &c. |
| Two-cent piece ... | ·02 | English farthing. |
| CENT .................. | ·01 | Prussian pfenning; Greek lepton, &c. |

It is stated by the author, that this "table of coins supplies equivalents in all current English coins, so far exact as to enable payments to be made, in all cases, to within the fifth of a farthing. If any person owed a farthing, he would be unable in the proposed medium to pay the fraction with accuracy, and would either gain or lose about the fifth part of a farthing, because there would be no coin of that exact value. In all other respects it would be much easier to reckon, express, pay, and receive in this series of coins, than by the use of those now current." Such is a very brief outline of a proposal which has gained for its author so much honour. To this plan objections have been raised, chiefly having reference to the great amount of disturbance that, it is thought, would arise in forming a relation between the old and new money should they continue in circulation together; the length of time, too, employed in its introduction in France, notwithstanding the strictness with which its use is enforced by law, is pointed to as a further reason for not entertaining this plan for a decimal coinage. Its author, however, in a subsequent paper,* proposes to withdraw the present money, by the substitution of a paper currency, representing the equivalent in francs, which might, after

* Report of the Select Committee on Decimal Coinage, 1853.

† Published letter to the Chancellor of the Exchequer, dated March 1st, 1854.

* On a method of substituting francs and centimes for the present English metallic currency. Read before the Statistical Section of the British Association, 1854.

an interval, requisite to prepare the new money, be exchanged for metal.

Under this head may also be placed the proposal to introduce the dollar of 100 cents, or the system of the United States of America, a plan that has already been followed in one of our most important colonies, Canada, as previously noticed. The application of a dollar, value 4s. 2d. of our present currency, to the solution of this question, forms also a scheme to which reference will presently be made in the second series of propositions for a decimal coinage.

A further proposal, under the present division, consists in an adaptation of the Portuguese system of accountancy, by which to effect the desired end. Its author is Mr. James Alexander, of Edinburgh, who advocated it in a paper* read before the Royal Scottish Society of Arts. It is not possible, in a brief notice like that I now offer, to do justice to this paper. The author explains the mode of keeping accounts in Portugal, which is "in one simple denomination, that of *rees* and *milrees*," or thousands of rees. The *ree* itself is not an actual coin, the lowest piece in circulation being of the value of 5 rees, all other coins in use are, therefore, multiples of 5. A remarkable analogy is shown to subsist between the Portuguese and English systems, which Mr. Alexander believes would secure the introduction of a decimal system of accountancy in this country, with the moneys at present in circulation, in the same way as the Portuguese accounts are kept in decimals, while a non-decimal money circulates among the people. This analogy may be seen in the following tables:—

| British Money. | | | Portuguese Money. | | |
|---|---|---|---|---|---|
| 4 farthings | make | 1 penny. | 4 five-rees | make | 1 vintem. |
| 12 pence | ............... | 1 shilling. | 12 vintems | ...... | 1 half-crusado. |
| 20 shillings | ............ | 1 pound. | 20 half-crusados | | 1 moidore. |
| 10 florins | ............... | 1 pound. | 10 crusados | ...... | 1 moidore. |

Hence,

| | | | | | |
|---|---|---|---|---|---|
| 5 rees | or | ·005 | (the 960th of a moidore) | is analagous to | 1 farthing |
| 1 vintem | ,, | ·020 | ( 240th ,, ) | ,, | 1 penny. |
| 1 half-crusado | ,, | ·240 | ( 20th ,, ) | ,, | 1 shilling. |
| 1 moidore | ,, | 4·800 | ............................... | ,, | 1 pound. |

Mr. Alexander would restore us the guinea at the value of 1,000 farthings; and by the intervention of a new silver coin of the value of 10d., to be called a "Victoria," proposes a very simple method by which accounts might henceforth be kept in farthings:—

"24 Victorias would change the sovereign.
25 ,, ,, ,, new guinea.
5 ,, would pay 200 farthings.
10 ,, ,, 400 ,,
15 ,, ,, 600 ,,
20 ,, ,, 800 ,, "

It will be seen that this proposal is not in reality the importation of the Portuguese money into this country, but rather the modification of our own existing coinage on the model of that system of accountancy.

Proceeding to the next class of plans—those which seek to introduce a decimal system of moneys as well as of accounts—which shall include, so far as possible, the most important of those now in use, in order not only to disturb as little as may be the existing ideas of the people in connexion with money, but also for the purpose of more readily establishing the relation between the new and old coinage. It will not have escaped notice, at the outset, that the pound sterling, being built up of 240 pence, cannot be decimalised to that coin; nor, on the other hand, can any decimal multiple of a penny produce the pound; hence, we cannot form a purely decimal system that shall include these two important coins as *moneys of account* simply.

As a starting-point, because naturally looked to as deserving most respectful attention, I proceed to lay before you the plan proposed by the late Committee of the House of Commons. The report states:—"The first question to be decided is, what shall be the unit of the new system of coinage?—and your Committee have no hesitation in recommending the present pound sterling. Considering that the pound is the present standard, and, therefore, associated with all our ideas of money value, and that it is the basis on which all our exchange transactions with the whole world rest, it appears to your Committee that any alteration of it would lead to infinite complication and embarrassment in our commercial dealings; in addition to which it fortunately happens that its retention would afford the means of introducing the decimal system with the minimum of change. Its tenth part already exists in the shape of the florin, or two-shilling piece, while an alteration of four per cent. in the present farthing will serve to convert that coin into the lowest step of the decimal scale which it is necessary to represent by some actual coin, viz., the thousandth part of a pound. To this lower denomination, your Committee propose, in order to mark its relation to the unit of value, to give the name of mil. The addition of a coin to be called a cent, of the value of 10 mils, and equal to the hundredth part of the pound, or the tenth of the florin, would serve to complete the list of coins necessary to represent the moneys of account, which would accordingly be pounds, florins, cents, and mils."

This plan, which had previously been ably advocated, in 1834, by Sir Charles Pasley, in his very admirable work on this subject*, and subsequently by Professor De Morgan, in the *Companion to the Almanac* for 1841, may be traced to an anonymous writer, who, under the title of "Mercator," in the *Pamphleteer* for July, 1814, gives, "A Sketch for a New Division and Subdivision of Money, Weights, and Measures,"—his proposed coins being:—*Gold*, 1,000 mils =£1, and 500 mils=10s.; *Silver*, 250 mils=1 crown, 125 mils=half-a-crown, 50 mils=1s., 25 mils=sixpence; *Copper*, 5 mils=1 penny, 1 mil=1 farthing.

In noticing the objections which have been made to this scheme, it will be found that but little opposition is made to the first step in the decimal scale—the florin, which seems easy and natural, affording a very useful coin, not attended with inconvenience in its use,† since its value is precisely two shillings of the existing currency. It is to the next two steps that the chief amount of opposition is raised; the creation of the *cent*, in value equal to $2\frac{2}{5}$d. of our present money, and the *mil*, equal to $\frac{24}{25}$ of a farthing.

It is contended that such a plan as this would, by its interference with the present copper currency, amounting to no less than between 5,000 and 6,000 tons in weight,‡ produce a very great amount of disturbance in all our settled ideas founded upon the penny, besides the confusion that might be expected to arise from such coins existing side by side for many years after its introduction with those in use, and with which they would be altogether incommensurable, as exhibited in the following table:—

| Cents. | | Pence. | Mils. | | Farthings. |
|---|---|---|---|---|---|
| 1 ............... | = | $2\frac{2}{5}$ | 1............ | = | $\frac{24}{25}$ |
| 2 ............... | ,, | $4\frac{4}{5}$ | 2............ | ,, | $1\frac{23}{25}$ |
| 3 ............... | ,, | $7\frac{1}{5}$ | 3............ | ,, | $2\frac{22}{25}$ |
| 4 ............... | ,, | $9\frac{3}{5}$ | 4 ......... | ,, | $3\frac{21}{25}$ |
| 5 ............... | ,, | 12 | 5............ | ,, | $4\frac{4}{5}$ |
| 6 ............... | ,, | $14\frac{2}{5}$ | 6............ | ,, | $5\frac{19}{25}$ |
| 7 ............... | ,, | $16\frac{4}{5}$ | 7............ | ,, | $6\frac{18}{25}$ |
| 8 ............... | ,, | $19\frac{1}{5}$ | 8............ | ,, | $7\frac{17}{25}$ |
| 9 ............... | ,, | $21\frac{3}{5}$ | 9............ | ,, | $8\frac{16}{25}$ |
| 10 or 1 florin . | ,, | 24 | 10 or 1 cent | ,, | $9\frac{3}{5}$ $=2\frac{2}{5}$d. |

and conversely—

* Suggestions for a Simple System of Decimal Notation and Currency after the Portuguese Model; read December, 1853.

* Observations on the Expediency and Practicability of Simplifying and Improving the Measures, Weights, and Money used in this Country.

† I refer to its commensurate value only; objections have been made to it on the ground of similarity in size to the half-crown.

‡ In 1844, Sir J. Morrison estimated the weight of the copper coins of this country to be 5,000 tons. In the past year alone, there were added 270 tons, forming above 25 million of single pieces, viz., 6,800,000 pennies, 12,400,000 halfpennies, and 6,500,000 farthings.

| Pence. | | Cents. | Mils. | Pence. | | Cents. | Mils. |
|---|---|---|---|---|---|---|---|
| 1 ............... | ,, | | $4\frac{1}{6}$ | 7 ............... | ,, | 2 | $9\frac{1}{6}$ |
| 2 ............... | ,, | | $8\frac{1}{3}$ | 8 ............... | ,, | 3 | $3\frac{1}{3}$ |
| 3 ............... | ,, | 1 | $2\frac{1}{2}$ | 9 ............... | ,, | 3 | $7\frac{1}{2}$ |
| 4 ............... | ,, | 1 | $6\frac{2}{3}$ | 10 ............... | ,, | 4 | $1\frac{2}{3}$ |
| 5 ............... | ,, | 2 | $0\frac{5}{6}$ | 11 ............... | ,, | 4 | $5\frac{5}{6}$ |
| 6 ............... | ,, | 2 | 5 | 12 or 1 shilling | = | 5 | 0 |

$\frac{1}{4}$d. = $1\frac{1}{24}$ mils; $\frac{1}{2}$d. = $2\frac{1}{12}$ mils; $\frac{3}{4}$d. = $3\frac{1}{8}$ mils.

It is objected that it is neither possible nor expedient to do away with the present penny, in consequence of the important position it holds, being essentially the poor man's coin, the household coin, and the fiscal coin—the coin upon which the pound is itself founded. That the proposal to substitute the 5 *mils* for the penny* would be an act of injustice, especially to the labouring man, involving a loss to his means, upon all small sums, of 20 per cent. That it will not do to argue that in the case of pennyworths, by measure or weight, he would get a greater quantity for his 5 mils, as either small shopkeepers would take advantage of the difference, or, in the event of an increased quantity, it would still be a loss to his means by enforcing the purchase of more than might be needed. That there are a vast number of things sold the prices of which are ruled by the penny, the bulk of which could not be increased, while, at the same time, the profit on them is too small to permit the reduction of their price to 4 mils. That by altering the penny to 5 mils the present shilling, or 50 mils, would only purchase 10 pennyworths. That the question of postage, tolls, railway fares, receipt stamps, the pay of soldiers and sailors, the important subject of piece-work in the manufacturing districts, are herein involved; and that no satisfactory solution of these prime difficulties is to be found in the report of the committee just referred to. It is further objected that the advocates of this division of the pound treat it almost wholly as a banker's question, professing a desire not to employ coins of account below the 5 mils, or even less than the cent. That it would be inconvenient for the comparison of foreign exchanges with most of those countries in which decimal systems of money are already employed. That it would occasion vast labour in calculating quantities of small value, and would be inapplicable to minute fractions in matters of account, particularly in relation to manufactured goods, the minute value of some of which render it necessary for them to be sold in parcels corresponding to the aliquot parts of a shilling for the convenience of calculation.† As a further class of objections may here be noticed, the arithmetical difficulties connected with this plan more particularly applicable to the period of transition from the old to the new system, a point that does not appear to have received a fair share of attention; and, first, it is urged that of 960 amounts commencing at one farthing, and increasing by the same sum to £1, only 40 of them can be represented *exactly* in the new money, the 920 remaining being *approximations* only. From this fact the conclusion is drawn that every operation of commercial arithmetic involving these approximations will be attended with more or less of error and uncertainty. In the process of multiplication, for instance, it has been shown that when the multiplier is only moderately large a very considerable difference is found in the results calculated under new and old systems. The following has been adduced as an example:—"Determine the value of 8,765 articles at 11s. 3d. each.

PRESENT SYSTEM BY PRACTICE.

| | | |
|---|---|---|
| 10s. | $\frac{1}{2}$ | 8765 |
| 1s. 3d. | $\frac{1}{8}$ | 4382 10 |
| | | 547 16 3 |
| | | £4930 6s. 3d. |

PROPOSED SYSTEM OF 1000 MILS TO THE POUND.

```
     8765
      563 mils.
    -----
    26295
   52590
   43825
   -----
£4934·695 = £4934 13s. 11d.
```

or an amount of error of not less than £4 7s. 8d. in a single operation." *

The following extract from a letter published in the *Liverpool Mercury*† may not prove uninteresting on this point: it is in reference to questions on this subject which were proposed to the students of the Normal Schools at Christmas last. Quoting Section III. of the arithmetic:—"Express the sums of money mentioned in the following question in the *decimal coinage;* work the sums decimally, and reduce the answers to the present currency." The writer proceeds as follows:—"In Question 1 we have to determine how many dozens of spoons can be purchased for £44 8s. 3d., at 7s. 9d. for one spoon; the correct answer to which will be found to be $9\frac{205}{372}$ dozen, or 9·551075. Now let us proceed to obtain a solution on the pound-and-mil system: 7s. 9d. expressed decimally is *exactly* £·3875, that is a sum *between* 387 and 388 *mils*, one of which must be determined on as the *fixed* representative of 7s. 9d. in the Committee's plan. In like manner £44 8s. 3d. (= £44·4125 exactly) would be represented by either £44 412 *mils*, or £44 413 *mils*. Let the question now be worked out with these values, and it will be found that the results of four solutions will be four *different* answers, and *all of them incorrect*. The second question proposed is as follows:—"A man who owes £2348 pays 12s. $9\frac{1}{2}$d. for every pound he owes; how much does he pay in all?" The correct reply to this is, £1501 14s. 10d., but worked on the proposed system we obtain £1500 7s. $5\frac{1}{2}$d., or £1502 14s. 5d., according as we take 6 *florins* 3 *cents* 9 *mils*, or 6 *florins* 4 *cents*, to represent 12s. $9\frac{1}{2}$d., the exact value in decimal *fractions* of which is ·639513, where the last 3 is to be repeated *ad infinitum*, and by the use of which, of course, a correct result may be obtained, but at such an additional expense of labour that the friends of the Decimal Association have not attempted to exhibit so awkward an illustration of their 'labour-*saving*' plan in those examples which have been brought forward by them."

Leaving this proposal for a decimal coinage, we pass to one which is founded upon the half-sovereign as the unit of account. This plan, termed the *Ducat* system, has been ably advocated by Mr. W. T. Thomson, in a paper entitled "Decimal Numeration and Decimal Coinage," read before the Institute of Actuaries.‡ After adducing several objections against the £1 unit, he proceeds to set forth the advantages of a 10s. unit, which he says, "would enable us to retain the shilling as a coin of account, being the first decimal of the unit. The tenth of a shilling becomes $1\frac{2}{10}$d., a convenient coin, which need not exceed in size the present rimmed penny, while the tenth of a penny gives very nearly our present half-farthing. The 100 scale would run thus—the first decimal of the unit always corresponding with the existing shilling:—

| Shilling. | | | Cent. | | | | Mil. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | = | ·1 | 1 | (= $1\frac{2}{10}$d.) | = | ·01 | 1 | (= $\frac{3}{25}$d.) | = | ·001 |
| 2 | ,, | ·2 | 2 | ,, $2\frac{4}{10}$ | ,, | ·02 | 2 | ,, $\frac{6}{25}$ | ,, | ·002 |
| 3 | ,, | ·3 | 3 | ,, $3\frac{6}{10}$ | ,, | ·03 | 3 | ,, $\frac{9}{25}$ | ,, | ·003 |
| 4 | ,, | ·4 | 4 | ,, $4\frac{8}{10}$ | ,, | ·04 | 4 | ,, $\frac{12}{25}$ | ,, | ·004 |
| 5 | ,, | ·5 | 5 | ,, 6 | ,, | ·05 | 5 | ,, $\frac{15}{25}$ | ,, | ·005 |
| 6 | ,, | ·6 | 6 | ,, $7\frac{2}{10}$ | ,, | ·06 | 6 | ,, $\frac{18}{25}$ | ,, | ·006 |
| 7 | ,, | ·7 | 7 | ,, $8\frac{4}{10}$ | ,, | ·07 | 7 | ,, $\frac{21}{25}$ | ,, | ·007 |
| 8 | ,, | ·8 | 8 | ,, $9\frac{6}{10}$ | ,, | ·08 | 8 | ,, $\frac{24}{25}$ | ,, | ·008 |
| 9 | ,, | ·9 | 9 | ,, $10\frac{8}{10}$ | ,, | ·09 | 9 | ,, $\frac{27}{25}$ | ,, | ·009 |
| 10 | ,, | 1·0 | 10 | ,, 12 | ,, | ·10 | 10 | ,, $\frac{30}{25}$ | ,, | ·010" |

To this plan the chief objections are, firstly, those urged by the advocates of the pound unit, "that the bulk of our

* "The five-mil piece would take the place of the present penny; the two-mil piece of the present halfpenny."—*Statement of the Decimal Association*, 29th March, 1855.

† See Laurie's Decimal Coinage, p. 11.

* Author's Paper; *Journal of the Statistical Society.* February 2, 1855.

‡ January 30th, 1854. Prior to the appearance of Mr. Thomson's paper, the same system, which also came before the late Committee on Decimal Coinage, was advocated by Mr. Ryley, actuary, who proposed to term his unit (the half-sovereign), *an angel*, his coins of account being,

10 *crosses* = 1 [new] *penny.*
10 [new] *pence* = 1 *shilling.*
10 *shillings* = 1 *angel.*

gold circulation cannot possibly consist of 10-shilling pieces. It is impossible to coin enough of them, in a given time, to meet emergencies. We must stick to the pound—it is a national institution, engrained in all our notions, and impossible to oust it. *The true object* of the 10-shilling piece is, to break the sovereign, and lessen the amount of silver necessary to be kept up."* And secondly, the advocates for the preservation of the penny urge the same difficulties against this as against the undivided sovereign,—the incommensurability of its cents and mils with the present copper currency. The main advantage here offered is, the retention of the shilling as a coin of account, as at present, but such sums as 1d., 2d., 4d., 5d., 7d., 8d., 10d., and 11d., are inconvertible under this system, whose monies of accounts would be *ducats*, *shillings*, *cents*, *and mils.*

The next† proposal for a decimal coinage which invites our attention is that founded upon the *florin*, or two-shillings, as the prime unit of account. This plan has lately been very ably enforced by Mr. Hugo Reid, in a paper read before the Society of Arts.‡ He says:—"I may state at once that the system which I recommend is, to take the florin, or two-shilling piece, for the leading coin or *unit*, and to divide it into 100 parts, to be called *cents*,—*florins* and cents being the only denominations to be used as coins of accounts.

"The following four points appear to me," he continues, "to be essential in introducing a decimal system of money and accounts:—

"1. That it shall be completely decimal, not composed of a decimal and a non-decimal part.

"2. That there shall be only two coins of account, one leading coin or unit, the other the hundredth of that coin.

"3. That the less coin of account shall be of sufficiently low value to meet all ordinary requirements of the poorer classes, and render fractions very seldom necessary.

"4. That the leading existing coins shall be preserved in, or be easily convertible into, the new coins of account."

The system here recommended is acknowledged to be "practically the same as that brought forward by the Parliamentary Committee, with only a slight modification of form," to adapt it to the preceding conditions. The *cents* here spoken of would, of course, be the same as the committee's *mils*, and as such are open to the same objections that have been already referred to. A further argument has been raised against this, and some other units, which would be of silver, as tending to the establishment of that metal as a monetary standard.* On the whole, perhaps, this plan may be considered to exhibit qualities superior to that of the pound divided into 1000 parts, to which it is convertible by the simple expedient of removing the decimal point one place to the left, thus—

796·45 florins = £79·645 *mils.*

As we have here the tenth of the pound proposed as the chief unit, so likewise has the tenth of the half-sovereign or shilling† been mentioned as a fitting coin to occupy that prominent and important post; this divided into 100 cents would, of course, bear the same analogy to the *ducat* scheme as the florin does to the sovereign. After what has already been remarked, the objections to it will at once be anticipated.

(*To be continued.*)

* See Proceedings of Decimal Association, p. 10, note at foot.

† Since this lecture was delivered the following proposal for a decimal coinage founded upon the crown or 5s. piece has been published in the *Birmingham Journal.* Its author is Mr. S. A. Goddard, and the plan is briefly as follows:—

"Let the crown be taken as the unit of value, and 100 as its exponent. The coins would then rate as follows, viz.:—

The 5s. piece would represent 100, called the crown, or 100 cents.

| | | | | | | |
|---|---|---|---|---|---|---|
| 2s. 6d. | ,, | 50 | ,, | half-crown | 50 | ,, |
| 2s. | ,, | 40 | ,, | florin | 40 | ,, |
| 1s. | ,, | 20 | ,, | shilling | 20 | ,, |
| 6d. | ,, | 10 | ,, | sixpence | 10 | ,, |
| 3d. | ,, | 5 | ,, | threepence | 5 | ,, |
| 1 cent piece copper coin | | 1 | ,, | cent | 1 | ,, |
| ½ | ,, | ½ | ,, | half-cent | ½ | ,, |

There would, however, be *no necessity* for coining cents and half-cents at present. The value of pennies and halfpennies would not be disturbed, nor their use interrupted; for, as they form aliquot parts of a crown, decimal calculations could be worked in pennies, and turned into the new denomination of money with perfect facility. The coinage of pennies and halfpennies would, however, cease, and cents and half-cents would be coined from time to time, as might be found convenient. The sovereign would pass for four crowns, in the same way as a bank-note passes for five pounds. Bank-notes could pass as they now are, or their value in crowns could be struck across their face in large figures.

All present values in accounts, or in books of account, could be changed into the new denomination simply by multiplying by 4. Thus:—£100 10s. 6d. × 4 = 402 dols. 10 cents, that is, 402 crowns 10 cents. By the same rule sums in the new denomination could be changed into pounds, &c., by dividing by 4. Thus:—402 dols. 10 cents ÷ 4 = £100 10s. 6d., and for the most part this could be done mentally." In subsequent communications the author more fully illustrates the advantages which he considers belong to his plan for a decimal coinage.

Against this system the advocates for the undivided sovereign would most likely urge objections similar to those made by them to the florin and dollar units; whilst those who contend in favour of the present copper currency remaining intact will point, as in the preceding instances, to the incommensurability of the cent with the penny, since 1 penny = 1 cent × 2-3rds; and 1 cent = 3-5ths of a penny, &c.

‡ February 14, 1855.

* Sir John Herschel, the late Master of the Mint, in reference to the florin system, says:—"It assumes a silver monetary standard, whereas, for good or for evil, for better for worse, we are married to a gold one. I do not mean to say a silver standard would not be better. I believe it would, and I believe a binary standard, half silver, half gold, at the option of either party to insist on, would be better than either; but gold is our standard of value, and we are lashed on to it, and we must be carried along with it, toss as it may."—Evidence before the Select Committee on Decimal Coinage—516.

† A "Retired Merchant" proposes to keep accounts in "pounds, shillings, and *centimes*, 100 centimes being equal to a shilling."

## BRITISH IRON MANUFACTURE.

REMARKS ON THE REPORT OF THE SELECT COMMITTEE OF THE HOUSE OF COMMONS ON THE PETITION OF CONINGSBY CORT, ELDEST SON OF THE LATE MR. HENRY CORT.

BY RICHARD CORT.

(Continued from page 609, of No. 139.)

Although in the report of the Committee of the House of Commons, attempts are made in one or two sections to glance outwardly at facts, there is not one atom of evidence internally to prove them, or to support in any shape a single opinion advanced; nor is it anywhere stated in the Report, that any witnesses were examined or evidence taken, yet both witnesses were examined and evidence taken.

The witnesses were the late Benjamin Hall, Esq., one of the members of the Committee, then partner in the firm of Crawshay, Hall, and Bailey, at Cyfartha, and Herwain, the principal iron manufacturers in South Wales. This gentleman was father of the present Right Honourable Sir Benjamin Hall, Bart., M.P., P.C., now Chief Commissioner of Works, and brother-in-law to the present William Crawshay, Esq., another of the witnesses, the latter being directly opposed to the petition, while the former, after much longer practical experience as the partner of the late Mr. Richard Crawshay, not only gave his evidence *orally*, but in *writing*, strongly in support of the petition, being in direct contradiction to his own brother-in-law, who was then a very young man, and present to hear it.

The other witnesses were the late Mr. Samuel Homfray, representing the Penydarran Iron Company, whose evidence, like that of Mr. William Crawshay, against the merits of my late father, was in direct contradiction not only to the acts, but the declarations of their respective companies only the year before.

R. Hill, Esq., of the firm of R. J. and A. Hill, of the Plymouth works, one of the subscribing companies to the resolutions of the general meeting of the iron trade of Great Britain, the year before, not only confirmed the proceedings of the meeting by testifying by his own presence on that occasion, but in the strongest terms supported the evidence given by Mr. Benjamin Hall, confirmatory of my father's merits. Mr. James, also, one of the master-smiths appointed by the government to superintend the trials of my father's patent puddled and rolled iron in 1785, in all the royal dockyards, with Mr. Thompson and Mr. Hawkes, both gentlemen of great experience in the iron trade, each of whom bore the most conclusive testimony to the *originality* and efficiency of my father's inventions, besides various documentary evidence, returns from the Custom House, Navy Board, and other government departments, all speaking, in one shape or the other, to the same effect.

The petitioner, thus supported against parties who were obliged to contradict themselves in any opposition they might offer to the petition, had every reason to calculate upon a very different result, although he was cautioned in the Committee room, that if the chairman called his noisy friend, Mr. Samuel Homfray, the petition would be "upset."

In addition to the recorded judgment of the iron trade of Great Britain (given in the last *Journal*), so directly at variance with the averment of the Committee in paragraph No. 3 of their report, which, though totally groundless, was deemed sufficient to disentitle the petitioner to a parliamentary reward, we have now all the knowledge of 42 years of additional experience in the art of making and working iron, to prove beyond all quibble or question, the *originality* of my father's invention.

But to go back only to three months after the Committee had so wrongly reported as to negative the prayer of the petitioner, here is an extract from the letter of one of the oldest iron masters, 20 years in the trade previous to my father's patents in 1783 and 1784, the late Alexander Raby, Esq., iron manufacturer, then of Llanelly, in Carmarthenshire, addressed to my late brother, the petitioner, Conningsby Cort, dated 20th June, 1812.

No. 4.

This letter speaks as to what was the judgment of the iron trade, not only as regards the undisputed right of my father to both inventions for puddling and rolling, but as to the value of "Finery," or "Finers' Metal," in direct contradiction to another averment made by the Committee in paragraph No. 4 of their report, touching the merits of the nameless inventor of the latter process, said to be since found out, without which my father's inventions were declared to be good for nothing, but making *bad* iron, as no good malleable iron could be made by puddling, unless the cast iron was first converted into "Finers' Metal."

"Oh! lame and impotent conclusion!"

Mr. Raby states that, "attempts had been made to roll *round* iron into hollows turned in rollers, but never to roll bar iron in grooved rollers, which is very different, as *round* iron is not rolled in grooves but *loose semicircles;* no man, I think, will attempt to say that he was the inventor of rolling bar iron in grooves, nor prove that your father was not.

"Some improvements soon after took place, by first refining the pig or cast iron (Finers' metal) before they puddled it, but it was obliged to be puddled before it was made into bars, nor could the refined metal be worked to profit or with expedition by any other mode than by puddling. I will venture to say, that owing to that syst m, and the use of grooved rolls, this kingdom is indebted for its present proud state of the iron trade, when, instead of being obliged to bow down to the north of Europe for a scanty supply of that useful article at a very high price, we are enabled to supply all our wants with an immense annual saving to the country; but were not only all Europe, but all the world to depend on us for bar iron, Great Britain would be able to supply the whole both good and cheap. And to whom is all this grand improvement and national benefit owing? and with whom did it originate *but with your father?* Envious persons may want to deprive him of the merit that was due to him, but when I recollect the trouble, pains, and expense he was at, to make converts, so as to increase the quantity made by his mode, when he was himself convinced of its utility, and the premium some great men then in the trade were willing to pay for the use of his patent, surely that alone is sufficient to prove that *the inventions were his own.* I can only add, I am happy to be called upon to pay this small tribute to the memory of your father, to whom I consider this kingdom, the world at large, and the *Iron Trade* in particular, are greatly indebted."

Mr. James Cockshutt, who had been in the iron trade quite as long as Mr. Raby, and was in partnership with the late Mr. Richard Crawshay in 1787, also contradicts the averment of the Committee in paragraph No. 4 of their report, for he states in his letter to the petitioner, dated Wortley Iron Works, 23rd April, 1812, "Since my last, it has occurred to me, that as much stress, I understand, has been laid upon the discovery of run out, or finers' metal, without which, it is said, that the puddling method of making iron would be of no benefit or advantage, I am of opinion that it is only *in* the puddling furnace that run out, or finers' metal, is of any advantage; for, though many trials have been made to use the run out metal in a common finery, I do not know one instance where it is continued. The only probable advantage in using run out metal in a common finery is, that by shortening the process it may prove a saving of fuel; while in the puddling process, the pernicious cinder being first separated by a previous operation, exactly as in the beginning process in a common finery, but with greater expedition, an *improved* kind of iron is obtained; so that it appears to me, without the use of the puddling furnace, the discovery (if it may be deemed a discovery) of making run out, or finers' metal, would be of little or no advantage."

These authorities, however, although probably two of the most skilful and experienced in the iron trade of Great Britain, are not the only evidence to prove the injustice done to the case of the petitioner by the averment of the Committee in paragraph No. 4. Not the slightest reference is made in the report to the evidence of Mr. James, because, had it been noticed in any shape, the averment so damaging to my brother, the petitioner's case, must have been left out altogether.

For the trials under the superintendence of Mr. James, in 1785, in all the Royal Dockyards, of my father's patent puddled and rolled iron, were made under the most disadvantageous circumstances, out of common ship ballast, the coarsest kind of cast iron; yet even out of this material, the patent iron was severely tested by 48 different experiments against the heaviest anchors and other naval implements made of the best Swedish iron, on the strength and toughness of which this country has for ages depended for the safety of our fleets, the lives of our seamen, and the naval and military defence of the nation. Yet, my father's iron was proved equal in all the trials, and in many instances superior, to the best Swedish iron, and the Committee had in evidence before them "A Brief Statement of Facts [published by my father in 1787] relative to the New Method of Making Bar Iron with Raw Pit Coal and Grooved Rollers, discovered and brought to perfection by himself; to which is added, an Appendix containing Observations of Lord Sheffield, and Letters approving of his method, from David Hartley,

Esq., Dr. Black, professor of chemistry at Edinburgh, and others."

Dr. Black in his report states that "In five out of six different trials of the heaviest anchors, weighing 34 to 59 cwt. each, made from the best Swedish iron, the patent puddled and rolled iron proved the strongest. These anchors were drawn equally against each other with a purchase that is almost incredible that either should have borne without giving way, and notwithstanding those made of the best Swedish iron did give way at last, while the patent iron did not, yet it was not till after withstanding a strain much greater than any other iron could have borne, or the severest test of actual service would ever require."

Lord Sheffield, at this time, in his "Observations on the Commerce of the American States," remarks "If Mr. Cort's very ingenious and meritorious improvements in the art of making and working iron, the steam-engine of Boulton and Watt, and Lord Dundonald's discovery of making coke at half the present price should all succeed, it is not asserting too much to say, that event would be more advantageous to Great Britain than thirteen colonies; it would give the complete command of the iron trade to this country, with all its vast advantages to navigation."

Mr. David Hartley, also one of the most scientific authorities, after examining the operation of puddling and rolling at my father's works at Fontley, in his letter, dated 19th June, 1786, observes:—"Mr. Cort may be considered to have discovered for this country an immense iron mine above ground, as all forge and common ballast iron may be purified by this process into *good* metal."

The Committee also had in evidence before them the Returns from the Navy Board, showing the contracts which the Commissioners of the Navy had entered into with my father for the following quantities of puddled and rolled bar iron:—

| | | | | |
|---|---|---|---|---|
| In | 1787 | for | 150 | tons. |
| „ | 1788 | „ | 150 | „ |
| „ | 1789 | „ | 150 | „ |
| | Total ... | | 450 | |

The two first of these contracts were completed; the other only in part, in consequence of my father's bankruptcy in 1789.

The Commissioners of the Navy were so satisfied with my father's iron, after using more than 300 tons for naval purposes instead of the best Swedish iron, at a saving averaging more than 30 per cent. as compared with the latter, that in their subsequent advertisements for more puddled and rolled bar iron, they expressly stated that no tender would be regarded unless the parties were able to prove that the iron had been puddled and rolled in exact conformity with my father's patent principle.

The following comparative view of the prices of British and foreign iron, furnished by a partner in one of the principal iron firms, was submitted to the Committee in 1812:—

"The contract price for the Swedish ore-ground iron of first marks has never within the last ten years been under £35 per ton, and has varied from that to £40, the last being £37 6s. 8d. per ton, from which deducting £6 13s. 4d. duty paid here per ton, leaves £30 13s. 4d. as the outgoing upon every ton so contracted for. The British puddled and rolled bar iron which has been found of a quality sufficiently good to supersede the necessity of importing the other for the use of the navy, has been contracted for at £20, and from that to £28, and calling the average price £24, the saving to the country, speaking of the Navy Board only, would be £13 6s. 8d. per ton, and to the country at large £30 13s. 4d. per ton, because the total cost of the British puddled and rolled bar iron is composed of materials abundant and otherwise useless, and of British labour.

"Every ton of iron now used in the navy is rolled with Mr. Cort's patent grooved rollers.

"The ore-ground or Swedish iron is now lower than it was when Government were the principal consumers, but if their consumption was re-established the price would be the same as it was before."

Now, as 1785 was the first time in the history of this country that naval authorities high in office, and British admirals, among the members of the Committee, ever knew that British bar iron had proved superior to the best Swedish iron for anchors, tackle hooks, the strapping and hooks of blocks, bolts, and all other iron work belonging to the building, rigging, and navigation of ships; that large quantities had been contracted for by the Navy Board for naval purposes in 1787, 1788, and 1789, and had ever since, for 23 years previous to 1812, been used for the same purpose; it presented, practically, a strong proof of the *originality* of both inventions of puddling and rolling, and the very reverse of the averment in paragraph No. 4.

For instead of not being able to make good malleable iron, the latter could not be made good by any other means than puddling, while bar iron had been actually made in all the Royal Dockyards superior to the best Swedish iron, which the inventor of finer's metal, with all his resources and works had never been able to accomplish.

The difference between my father's method of refining and "finers' metal" is, that by the latter process charcoal fuel is used; whereas the method patented by my father, termed puddling, is not effected by using charcoal, but by causing the puddling furnace to be heated by the *flame* alone of the cheaper pit coal, thus avoiding the mixing of the dross of the coal with the iron when in a liquid state; my father's principle being to expel the impurities altogether, and afterwards to consolidate the metal by squeezing it through grooved or fluted rollers (many times more expeditiously than by the hammer, by which the iron becomes cold and hardened before all the impurities are driven out of it, instead of being expelled by the roller) while the iron is in the softest state at a welding heat. It is, therefore, quite impossible to account for the extraordinary omission of such facts and proofs as to novelty of principle and application, in a Report, flatly denying both, by a Select Committee of the House of Commons, appointed to examine the merits of the petitioner's claim to a parliamentary reward.

No. 5.

The Committee in this paragraph have been prompted to assert, no doubt by the same nameless inventor of "Finers' Metal," that the bad qualities of British iron are attributable to the omission of this particular process. Now whether the badness of the quality be owing to the presence or the absence of finery, or "Finers' Metal," I leave to more competent judges to determine. But I may remark that, had my father's inventions not created a great revolution in the iron trade, from *bad* quality to *good*, instead of *eight millions* of tons of puddled and rolled iron having been exported to all the markets in the world during the last 62 years, and now progressing at the rate of more than *eleven hundred thousand tons annually*, the export might have remained at the few hundred tons, as stated by the Committee in 1782, instead of being in quantity at least 2,600 times greater!

From this paragraph it would seem that the Committee attributed the alterations in the iron trade, which in 1812 had *decreased* the imports nearly 30,000 tons, as compared with 1787, and *increased* the exports to 24,500 tons, to certain "improvements," which are designated by the Committee as having been so "extensively beneficial to the country," to "some share" in which my father is said to be justly entitled. But who was entitled to the other share, or what were the "improvements" made by others, whether their name was unit or legion? or merely "Finers' Metal," pronounced both by Mr. Raby and Mr. Cockshutt

as being good for nothing without puddling? still if it was so "extensively beneficial," why did not the iron trade of Great Britain acknowledge itself greatly indebted to the inventor of it, and not to Mr. Cort for puddling and rolling?

The Committee were appointed to sit on a petition limiting their inquiry to the merits of my father's inventions, yet from the loose way in which they speak in this paragraph, it might be inferred that there was a multitude of improvements and claimants for parliamentary reward, whereas all the improvements in 1812, of any ascertainable value or efficiency, were three only in number—the puddling process, the rolling process, and the finers' metal process, and of these three two were the property and invention of my father, whilst as before pointed out (and as is notorious to all engaged in British iron manufacture), the "Finers' Metal process" apart from puddling is a nonentity.

No. 6.

With this disgraceful, and let us hope not wilful disparagement of my father's merits, to whom it may be justly said, that *nine-tenths* of the improvements belong, the Committee in this paragraph approve entirely of the very inadequate annuity of £200 per annum granted to my father, and £125 since extended to his widow, while they omit altogether to state in their report under what circumstances either of these annuities were granted.

The first annuity was granted in consequence of a letter addressed to the Right Honourable William Pitt, in 1794, then Prime Minister, by fifteen of the principal bankers and merchants in London, including ten members of Parliament, expressing the high opinion they entertained of my father's conduct and character, and commiserating the treatment he had experienced in return for the national benefits which they considered had been derived from his inventions, even at that time, now 60 years ago. The authorities were as under:—

Samuel Thornton, M.P., Robert Thornton, M.P., John Hunter, M.P., Alderman Curtis, M.P., Alderman Le Mesurier, M.P., Sir George Jackson, Bart., M.P., Brook Watson, M.P., Francis Annesley, M.P., George Smith, M.P., Robert Smith, M.P., Sir Watkin Lewis, William Chute, J. and J. Angerstein, J. Ewer, and J. M. Wilson.

The second annuity was granted on a Report made to the Lords of the Treasury in 1801, by Sir Andrew Hammond, Bart., the Comptroller of the Navy, who knew the history of my father's trials of his patent iron in all the Royal Dockyards in 1785, and the contracts which had been entered into with him by the Navy Board for the use of it, and how he had been ruined most unnecessarily to cover the debt of his partner, the Deputy-Paymaster of the Navy, who died a defaulter to the State. He, therefore, stated in his Report, that he believed the widow of the late Mr. Henry Cort and her family were real objects for national relief, which he never would have stated had there been the slightest ground then, more than half a century ago, for considering that my father's inventions of puddling and rolling were neither novel in principle or in application, while the *saving* realised by the country on the first 450 tons of puddled and rolled iron, used for naval purposes, instead of the best Swedish iron, being, as before shown, £30 13s. 4d. per ton, was equal to more than five times all the pensions received from 1794 to 1811, inclusive.

Yet, no allusion is made in the Report to the ruin of my father, or to the circumstances which led to it, though so well known to the government authorities at that time, as well as the cruel treatment he experienced in return for having rendered this country independent of foreign powers for *bar iron*, and for having provided the means of adding so enormously to the wealth and commerce of the nation. For his finances were so exhausted by the heavy expenses necessarily attending the prosecution of his valuable improvements, including his own private fortune left to him by his father, who had been extensively engaged in trade at Lancaster, (where he was born, in the year 1740,) that he was obliged to dispose of one half of his works, trade, land, and wharf, which had been demised to him, to the late Adam Jellicoe, then Deputy-Paymaster of the Navy, and subsequently to assign his patents as a collateral security for more capital advanced, besides taking his son into partnership. This arrangement, however, never would have been made, had not my father believed that he was treating with a gentleman of large fortune, who had been selected for his known integrity to fill a high position of trust under the government at that time.

Mr. Jellicoe having died suddenly, and, to the astonishment of all who knew him, insolvent, my father was deprived of all pecuniary resources, and was compelled to fail in 1789. By this distressing event, his iron works at Fontley and Gosport, with all his property, trade, stock, land, and patent rights, worth at least fifty thousand pounds, were seized under extents from the Crown, not to satisfy any debt of his own to the State, but to cover the defalcation of his partner, Mr. Adam Jellicoe, the latter having advanced to my father £27,000, out of monies held by him belonging to the State, in consideration of receiving not only 5 per cent. interest, but also, as before stated, one entire half of all the profits of my father's trade and patents, besides the taking his son into partnership, thus sacrificing for the loan of £27,000, the moiety of a trade and patent rights, that might have paid (had my father not been driven to bankruptcy) the whole of the debt due from Mr. Jellicoe, and produced the same princely fortune since realised by Messrs. Crawshay and others.

Nor was this the only injury so improvidently inflicted upon my father at this time, instead of redeeming through his inventions and trade the debt of the defaulter, Mr. Adam Jellicoe; for the patent rights were kept locked up in the office of the solicitor to the Crown, and rendered not only profitless for satisfying the debt for which they had been seized, but suffered to be of no benefit whatever to my father for discoveries, not in embryo or speculative, but actually proved in all the Royal dockyards, for making puddled and rolled bar iron superior to the best Swedish iron. Nevertheless, some of the wealthiest iron masters were allowed to work under the patents, thus locked up, *gratuitously*, for nearly ten years, till they expired, including the companies represented by the witness Mr. Samuel Homfray, and the other witness against the petition, Mr. William Crawshay, although it was well known that the late Mr. Richard Crawshay and others had signed contracts to pay to my father *ten shillings per ton* for all iron rolled under his patent for grooved rollers.

The following is an *Estimate* showing the *Loss* sustained by my father and the *State*, also the profit gained by the Iron Trade in 1798, by the locking up of the patent rights, together with the total quantities of Pig, Puddled, Rolled, and Wrought Iron made in 1798, 1811, and 1854.

| | Pig Iron. | Puddled, Rolled, and Wrought Iron |
|---|---|---|
| | Tons. | Tons. |
| 1788 ......... | 55,000 | ... |
| 1789 and 1790 ......... | 120,000 | 30,000 |
| 1791 to 1795 ......... | 400,000 | 210,000 |
| 1796 ......... | 125,000 | 95,000 |
| 1797 and 1798 ......... | 300,000 | 165,000 |
| Total for 10 years, when the Patent expired, in 1798 ...... | 1,000,000 | 500,000 |
| Do. ending with 1811, 13 years | 3,000,000 | ... |
| Do. for 23 years, in 1811......... | 4,000,000 | 2,500,000 |
| Do. for 42 years, in 1854......... | 36,000,000 | 22,000,000 |
| Total for 65 years......... | 40,000,000 | 25,000,000 |

Assuming the premium payable for patent rights in 10 years, on 500,000 tons, to average only 7s. 6d. per ton, the total amount *lost* by my father and the *State*, by suffering the patents to be worked *gratuitously*, would be £187,500, which would have covered *six* times over the capital advanced by the defaulter to my father, and *nine* times the private fortune sacrificed by the latter, while the increased profit to the iron trade, say on 500,000 tons of puddled, rolled, and wrought iron, averaging only 25s. per ton, would be £625,000, and including gratuity saved, £812,000, as the additional profit may be appreciated by the fact, that 200 tons of bar iron were made in one week of the best quality, with a very few hands, by grooved rollers, instead of ten tons under the hammer, in the same time, in quality so inferior as to be wholly unfit for exportation.

It will be seen likewise, in the concluding summary in the next Number, that the total amount for national benefits derived from my father's inventions of puddling and rolling for the first 23 years, ending with 1811, only a few months before the Committee reported to the House that my brother, the petitioner, was "not fairly entitled to any Parliamentary reward," may be estimated at not less than *thirty millions sterling;* the apology, therefore, offered by the Committee in paragraph No. 6, for my brother's "*presumption*" on the ground of "partial affection so natural in his situation," was quite out of place, unless it be deemed reasonable to apologise for saving the country THIRTY MILLIONS sterling.

(*To be continued in the next Number of the Journal.*)

## HAMPTON COURT PALACE.

HOUSE OF LORDS, MONDAY, 23RD JULY.

Lord St. Leonards said, he heard that, in consequence of the loss of a painting from Hampton Court Palace, orders had been given to screw down all the pictures. This seemed to him a dangerous mode of protecting them, for if a fire should break out in the palace, all the pictures would be destroyed, from the impossibility of moving them.

Earl Granville said that the Chief Commissioner of Works had given orders for a strict inquiry to be made into the loss of the picture. The suggestion relative to the screwing down of the pictures was worthy of consideration.

Lord Monteagle wished to remind the noble earl that the Vernon Gallery, that noble gift of a private citizen, was now in a building not fire-proof, and consequently required all cautionary measures. There ought to be some safe and suitable building for the pictures of the nation. He trusted that no restrictions would be placed upon the facility of access to the pictures at Hampton Court. That palace was a source of great pleasure to thousands of people, and until the present time he had heard from all the parties having the care of that collection but one expression of satisfaction at the mode in which the people of England, admitted freely and without distinction of rank into that building, had conducted themselves.

Earl Granville said that the Government had done all in their power to protect that most valuable collection of pictures at Marlborough House. The Government had now under their consideration a more satisfactory mode of exhibiting the pictures belonging to the nation.

## Home Correspondence.

### PARIS EXHIBITION—COST OF LIVING IN PARIS, &c.

SIR,—I should be glad to add my humble testimony to that of Messrs. Audley and Sopwith on the subject of the Great Exhibition at Paris. It is a truly rich, beautiful, and magnificent collection, arranged and displayed with that order and taste which characterise the French people; undoubtedly like the Great Exhibition of 1851, but exceeding it in the number of exhibitors, and differing materially from it in the proportions of objects in different departments and from different countries. In 1851, of about 17,000 exhibitors, 8000 were British, and 9000 foreign; in the Paris Exhibition, of nearly 19,000 exhibitors, only 3,600 are British, the rest, above 15,000, are of other nations—French, Austrian, German, Belgian, Swiss, Italian, &c Thus, the British visitor to the present exhibition has the opportunity of examining the products of nearly twice as many exhibitors from other countries as he had in 1851; and in this important point of view, therefore, the Paris Exhibition is more valuable *to the British*, as a great school for instruction and improvement in the arts, than our own exhibition was. We know that a teacher or writer endeavours to study every leading author on his subject—each gives something omitted by the others, places some part in a different point of view, or varies in his illustrations. So the artist, artisan, and manufacturer, cannot but be benefited by examining the works of other men and other nations, and never before was so rich an opportunity of this description within reach of the British people. It is to be hoped that they will not neglect it.

The French Exhibition consists of two distinct parts, in separate buildings; the *Palais de l'Industrie* between the Champs Elysées and the river, and the *Exposition Universelle des Beaux Arts* in the Avenue Montaigne. The Palais de l'Industrie consists essentially of three parts, the principal or stone building, fronting the Champs Elysées, devoted chiefly to the mixed decorative and useful arts; a round building joined to it, containing the tapestry and Sèvres china, and on an elevated platform in the middle, the crown jewels of France, both of the former and present dynasties; and connected with this by a passage, and running alongside the river, a remarkable structure, called the "galerie annexe," about two-thirds of a mile long, devoted to objects more strictly belonging to the useful arts, and containing specimens of valuable natural products from all parts of the world, products of the chemical arts, and every variety of machinery. In this immense room will be found a rich and varied collection of the highest efforts of the chemical and mechanical skill of France, Belgium, Austria, Germany, Switzerland, and the United States of America, the privilege of examining which can hardly be too highly estimated by the British chemist, manufacturer, or artisan. They should seize the opportunity while they may; this part of the palace of industry is the least likely to be permanent.

It seems very desirable that numbers of our working artizans should visit the Paris Exhibition, but there are many difficulties in the way. The loss of a week's wages is a very serious matter to an artisan, and when in addition to this, he must spend from two to three pounds, it does not seem likely that many of our operative class will enjoy the present opportunity, if the matter be left to their own unaided efforts. Yet it will hardly be disputed that it would be for the national benefit that as many as possible of the most skilled and intelligent British artisans should have the opportunity of examining the Paris Exhibition, and the other treasures of art in that city. The artisans themselves cannot afford to be at the whole expense; nor can we expect their employers to defray their expenses; the advantage to be derived by them is not likely to be immediate and tangible, and not certain to be derived by the employer who may send this or that artisan, who may leave him at a week's notice for another, or set up for himself. The benefits to be derived will be gradual, somewhat remote, and national, and, therefore the nation should contribute towards the expense. The only individual certain to be benefited is the artisan, and we know that he cannot bear the whole burden. The nation would never think £1,000 or £1,500 ill spent in giving a thousand of our artisans from all trades, and all parts of the

country, a free passage to and from Paris on the present occasion; and it would be but a natural and graceful compliment to the French Exhibition on the part of our Government, and a proper public acknowledgement of the excellence of the Exhibition that would be very gratifying to the French Government. Without some such external aid, it does not seem likely that any considerable number of our operatives will be able to take advantage of the present opportunity of instruction and improvement. If the Government were to offer a free passage to a thousand picked men from the operative class in various parts of the country, intimating this to the mayors in the different towns, the public spirit and liberality of each district would probably do the rest, aided by the employers and the artisans themselves.

In the meantime, some few of the artisan class, and others not much richer, may be induced to visit the French Exhibition at their own charge; and I shall add a few hints to those who are resolved to make an effort for this purpose, but who have little money, and little time to spare. It is for these only that the following observations are designed.

Where the visitors are ignorant of the language, they had better engage the services of an interpreter-guide, who may be had for 10 francs per day and his café or restaurant expenses (with perhaps an abatement if engaged for a week). This, divided amongst a party of eight or ten would cost but little. M. Baillot, 8, Rue Basse du Rempart, Boulevart des Capucines, provides interpreters on the above terms; he understands and speaks English well, and on being written to would send an interpreter to meet a party by any train. The cheapest quick route is that by Newhaven (near Brighton), by which the journey from London to Paris may be made in from 15 to 18 hours, including from 6 to 8 hours sea voyage. The second-class fare *to Paris* by this route is at present one pound, and the same back; but this will likely soon be further reduced, at least for a return ticket to see the Exhibition. Instead of going to an hotel, it is an economical mode to take a furnished lodging, or sleeping apartment, which is enough for those who are to be out sight-seeing all day. The most expensive parts of the town are the vicinity of the Madeleine and the Champs Elysées, and the Faubourg St. Germain on the south side of the river, but even there a very nice, well furnished, and cleanly-kept apartment may be had for a franc and a half (about 1s. 3d.) per day, up three or four stairs; and coffee with bread and butter will be given in the morning at the rate of from 12 to 15 sous for one (the sou is very nearly a halfpenny in value). The north parts of the town, adjoining the Barriere Clichy and the Barrière Montmartre, are cheaper districts; also, the Students' Quarter, or Quartier Latin, on the south side of the Seine, between the Jardin des Plantes and the Rue de Seine, which runs from the Institute to the Luxembourg; near the Rue de l'Ecole de Medecine; also the region east of the Palais Royal.

*Sights to be seen by those who have but a few days to spend in Paris.*—Let the *mechanician*, whose interest is in machinery, instruments, apparatus, devote himself to the Galerie Annexe in the Exhibition, and the Conservatoire des Arts et Metiers in the Rue St. Martin, near the Boulevards. Let the *architect* or *builder* study the Louvre, Tuileries, and Hotel de Ville, and particularly their internal decorations; the triumphal arches in the Champs Elysées, the Place du Carrousel, and at the Portes St. Denis and St. Martin in the Boulevards; the Place de la Concorde, the Madeleine, the Bourse, the Palais Royal, the church of St. Eustache at the foot of the Rue Montmartre, the church of St. Germain l'Auxerrois near the Louvre, the cathedral church of Notre Dame, and the Palais de Justice, the churches of St. Sulpice and St. Geneviève (Panthéon) on the south side of the river, the Palais Bourbon (Corps Legislatif), the Palace of the Luxembourg, the tomb of Napoleon in the Hotel des Invalides, and the Ecole des Beaux Arts in the Rue des Petits Augustins (now, I think, the Rue Bonaparte, near the Institute). Let the *sculptor*, *painter*, and *designer*, devote himself to the Exposition Universelle des Beaux Arts in the Avenue Montaigne, the bronzes, china, and tapestry in the Palais de l'Industrie, the very fine collection of ancient statues in the lower floors of the Louvre, and the paintings in the upper rooms of the Louvre, and in the Luxembourg. Let the *horticulturist* view the Exposition d'Horticulture, in the Champs Elysées, opposite the Palais de l'Industrie, the Gardens of the Luxembourg and the Tuileries, the Jardin des Plantes, and the cemeteries of Père la Chaise and Montmartre. Let the *antiquarian* see the Musée des Thermes, Hotel Cluny, Rue des Mathurins, (a continuation of the Rue de l'Ecole de Medicine), the old church of St. Etienne du Mont, near the Panthéon, containing the tomb of St. Geneviève, and all that part of Paris around the Sorbonne and the College de France; the church of St. Germain des Pres, and the neighbouring prison of the Abbaye; Notre Dame and the Palais de Justice, and the church of St. Germain l'Auxerrois. And let him who delights in books, or wants to see any particular rare or costly work, step into the Bibliothèque Royale, Rue Richelieu, the B. Mazarin, at the Institute, or the B. St. Geneviève, at the side of the Panthéon, and ask for any book he wants. It will be supplied to him, with leave to sit all day and read it, or make extracts. It is quite impossible to see *all* in a few days, and each should devote himself chiefly to that which is his business or his hobby, and reserve certain of the sights for a second visit.

As to the cost of living in Paris, this need not be great. In the hotels, or certain of the cafés and restaurants, living is costly, and the francs disappear with extraordinary rapidity. Let the working man, or the humble clerk or shopman, who desires to take a week's holiday in Paris, take his coffee in the morning at his lodging; he may have it good and plenty, with milk, bread, and butter, for 6d. or 7½d. But he may manage still cheaper than ths. At a *laiterie*, he may have a large basin of coffee or chocolate, with milk, for 2½d., and bread, ½d. or 1d., as he pleases; a boiled egg for 1d., so that he may have breakfast, with two eggs, for 11 sous (5½d.) There are laiteries in all parts of the town. A very good one, where tea also may be had, is at Rue Jean-Jacques Rousseau, 4, opposite the post-office. In many parts of the town, particularly in the region east of the Palais Royal, (west of it is, mostly, an expensive district,) may be found restaurants at which dinner is given at a particular price, as 2 francs, 1 fr. 80 centimes, 1 franc, and even so low as 75 centimes. Dinner at 1 franc may be had at the restaurant called Au Rosbif, Rue de la Bourse, 3; at Courtois, Rue Coq-Heron, 7, near the post-office; and at many places in the Rue Montmartre, Rue St. Denis, and other streets in that region. There is an excellent restaurant kept by Beicher, Rue St. Marc 4, (between the Rue Vivienne and the Rue Montmartre); dinner is not given at a fixed price there, —each dish is ordered separately, but the charges are very moderate, as 3 sous for a basin of bouillon (a kind of beef-tea, very strong and nourishing); beef with vegetables, 5 sous (the beef of which the bouillon is made, I suppose, —I do not warrant this); but the *bifteck* or *cotelettes* will be found more palatable, at 7 or 8 sous; a large bottle of common beer (*bière blanche*), 6 sous; a carafon (¼ bottle) of vin ordinaire, 4 sous; café, with un petit verre (of brandy), 8 sous. There is a very large and cheap establishment in the Rue Montesquieu, 6, near the Palais Royal, with branch establishments at Rue de la Monnaie, 21; Rue Coquillière, 15; Rue Beauregard, 2; where bouillon, potage (soup), beef, roast meat, wine by the carafon or ¼ bottle, beer, coffee, salad, dessert, &c., may be had at very moderate charges, all fixed, and mentioned on a card, which is given to every one on entrance.

I need not pursue this further. All I wish to show is, that those who are so disposed may live very economically, and yet comfortably, at Paris, at a rate which may be easily judged of from the charges I have mentioned above. For two francs (1s. 8d.) a day, an artisan may

live very comfortably indeed; allow 1 franc for his lodging, he thus has board and lodging for 3 francs (2s. 6d.) a day.

The lower we can reduce the costs of the journey, the greater the number who will visit the French Exhibition; and believing that such visits will be for the advantage of the British arts and manufactures, and indeed beneficial to the people of both countries, I have thought the preceding details might be acceptable to some of the readers of your *Journal*.

Admission to the Palais de l'Industrie is 4 sous on Sundays, 5 francs on Fridays, and 1 franc on each of the other days of the week.

I am, sir, yours, &c.,

H. REID.

Greenwich, July 23, 1855.

## Miscellanea.

OIL AND ALCOHOL.—A letter from Algiers, of the 15th inst., says that M. Duplat, a chemist attached to the military hospital at Blidah, had succeeded in producing oil and alcohol by distillation from acorns growing in the oak forests which cover Mount Atlas. One hundred pounds weight of acorns produced half-a-pound of oil and five pounds of alcohol, perfectly suited for chemical purposes.—*Times* Paris correspondent.

DISTRIBUTION OF PARLIAMENTARY PAPERS.—Mr. Bolton Corney, in writing on this subject lately, says that had he been examined before the Select Committee of the House of Commons in 1852, he should have been inclined to offer the following advice:—"Give away no entire sets; you will tax the parties in the shape of house-rent. Give away no selections; you will deceive those who are in search of full information. Give rather a *compendious catalogue* of the papers, and offer the articles at a reduced price; you will then do the parties a real service, and commit no waste."

## To Correspondents.

BRITISH IRON MANUFACTURE.—In Mr. Richard Cort's remarks on this subject, in the last number of the *Journal*, the following errata occur:—page 608, col 1, line 12, for *three* tons read *thirty*; col. 2, line 21, for *pounds* read *tons*—line 43, for 1754 read 1854—line 47, for *Herwisen* read *Herwain*; page 609, col. 1, line 13, for *Treve* read *Frere*.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 11th July*, 1855.

Par. No.
298. Court of Chancery (Ireland)—Returns.
363. Kilmainham Hospital—Copy of the Royal Warrant.
372. Office of Speaker—Report from the Committee.
Midland Railway—Report upon an Accident of 22nd November, 1854.

*Delivered on 12th July*, 1855.

352. Army Commissions—Return.
367. Sweet or Made Wines—Returns.
368. Ministers' Money (Ireland)—Returns.
371. Officers' Widows Pensions—Return.
373. Education (Ireland)—Annual Report.
377. London Writ—First Report from the Committee.
378. Assay Offices (York, &c.)—Return.
227. Bills—Turnpike Acts Continuance.
236. Bills—Slave Trade (Sherbro).

*Delivered on 13th July*, 1855.

360. Poor-Law (Scotland)—Return of Parishes.
370. Yeomanry Corps—Return.
376. Public Income and Expenditure (Balance Sheet)—Account.
379. Thames Marsh Drainage—Return.
369. Auckland Islands—Returns.
233. Bills—Assizes and Sessions.
237. Bills—Downing-street Public Offices Extension (as Amended by the Select Committee).
239. Bills—Navigation Works (Ireland).
Eastern Papers (Communications with the Austrian Government)—Part 15.
Kneller Hall Training School—Report by the Rev. H. Moseley.
Prisons (Ireland)—33rd Report of the Inspectors-General.

*Delivered on 14th and 16th July*, 1855.

380. Criminals—Return.
382. Downing-street Public Offices Extension Bill—Report, Evidence, &c.
235. Bills—Friendly Societies (as Amended by the Lords).
242. Bills—Accidents on Railways.
208. Bills—Chinese Passenger Ships.
234. Bills—Metropolis Local Management (as Amended in Committee and on Re-commitment).
241. Bills—Nuisances Removal, &c., (as Amended by the Select Committee and on Re-commitment).
243. Bills—Trinity College (Dublin).
244. Bills—Lunatic Asylums, &c. (Amended).
246. Bills—Court of Judicature (Prince of Wales Island, &c.).
248. Bills—Crown Suits.
238. Bills—Inverness Bridge.
245. Bills—Treasurers of Counties (Ireland) (Amended).
Convict Prisons (Ireland)—1st Annual Report of the Directors.
Railways—Reports upon certain Accidents (March, April, May, and June, 1855).

*Delivered on 17th July*, 1855.

345. Workhouse Farm Accounts (Ireland)—Workhouse Manufacture Account (Ireland)—Return.
375. Chelsea Royal Military Asylum—Return.
381. Prisoners Tried at Assizes—Return.
388. Stage Carriage Duties—Copies of Applications.
389. Mileage Duty—Copy of Report.
395. Gibraltar—Copy of Despatch.

*Delivered on 18th July*, 1855.

316. Criminal Law, &c., Bills—Returns,
249. Bills—Lunatic Asylums (Ireland) (Advances) (as amended by the Select Committee, and on re-commitment.)
250. Bills—Powers under Improvement Acts Regulation.

*Delivered on 19th July*, 1855.

319. Constabulary (Ireland)—Abstract of Statement.
374. New Churches—Account.
385. Proprietors of Lands (Scotland)—Return.
387. Tea Warehouses—Return.
390. Benefices United—Return.
393. Militia—Abstract of Return.
396. Lancaster Shot Manufactory—Return.
254. Bills—Incumbered Estates (Ireland) Acts Continuance.
255. Bills—Convention with United States.
Turkish Loan—Convention.

*Delivered on 20th July*, 1855.

282. Metropolis Sewers—Copies of Reports of Surveyors.
392. Convict Prisons (Ireland)—Return.
400. Smyrna Hospital—Return.
403. Powers vested in the Companies for the Improvement of Land—Lords Report.
240. Bills—Grand Juries (Ireland) (No. 2).
256. Bills—Nuisances Removal, &c. (Ireland).
Department of Science and Art—Report.
Consolidating the Statute Law—Report from the Commissioners.

*Delivered on 21st and 23rd July*, 1855.

383. West Coast of Africa—Return.
406. Slave Trade (Sherbro)—Copies of Treaties.
394. Livings—Returns.
408. Education—Copies of Minutes.
410. Navy—Supplementary Estimate.
411. Transport Service—Supplementary Estimate.
257. Bills—Public Houses (Ireland).
258. Bills—Customs Laws Consolidation.
259. Bills—Customs Tariff Acts Amendment and Consolidation.
260. Bills—School Grants, Security for Application.
261. Bills—Ledbury Prebend.
262. Bills—Youthful Offenders (No. 2,) as Amended by the Lords.
263. Bills—Office of Speaker.
264. Bills—Turnpike Acts Continuance (Ireland).
265. Bills—Joint Stock Banks (Scotland).
266. Bills—Island of Tobago Loans.

*Delivered on 24th July*, 1855.

308. Poor Removal—Report from the Committee.
253. Bill—Public Health (as Amended by the Select Committee, and on Re-commitment).

*Delivered on 25th July*, 1855.

404. Court of Chancery (Ireland)—Returns.
268. Bill—Turkish Loan.
Eastern Papers (Instructions to Lord John Russell on proceeding to Vienna)—Part 16.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette*, *July* 20*th*, 1855.]

*Dated 25th April*, 1855.

922. A. Crosskill, Beverley—Machinery for cutting and reaping.

*Dated 26th May*, 1855.

1198. J. C. Ricu and C. Bartocci, Fuligno—Beverage.

*Dated 4th June*, 1855.

1270. H. J. Kaye, 71, Denbigh-street, Belgrave-road, and P. Burrell, Hermitage, Camberwell-grove—Communicating to two trains in motion the distance they are from each other.
1274. G. Green, Mile End-road—Sawing machinery.

*Dated 3rd July*, 1855.

1499. R. Muckelt, Salford—Etching machinery.

*Dated 4th July*, 1855.

1500. G. Guillaume, 81, Marland-place, Southampton—Communicating power.
1501. G. A. Tabourin, Lyons—Metallic arch.
1502. R. Tidmarsh, 23, Foxley-road, Camberwell New-road—Lubricating metallic and other surfaces when in motion.
1503. W. Clay, Liverpool—Manufacturing forged iron.
1504. C. Hide, Worthing—Connecting earthenware pipes.
1505. J. Inglis and A. Cowie, Glasgow—Moulding metals.

*Dated 5th July*, 1855.

1506. S. G. Flagg, Philadelphia—Folding boat. (A communication.)
1507. J. Connor, Coventry—Communicating between drivers and guards of railway trains.
1508. W. Gerhardi, Manchester—Safety valves.
1509. S. Oddy, Adelphi Iron Works, Salford—Bearings of mule spindles.
1510. J. and T. Horton, Birmingham—Paper, pasteboard, and pulp.
1511. J. Howard, Bedford—Ploughs.
1512. T. Felton, Birmingham—Glass reflectors.
1513. R. A. Brooman, 166, Fleet-street—Figured net and other fabrics. (A communication.)

*Dated 6th July*, 1855.

1514. J. V. Asbury, Enfield—Neutralizing collision of railway trains.
1515. J. Bullough, Accrington, R. Willan, Blackburn, and J. Walmsley, Accrington—Warping by power.
1516. J. A. Bellay, Paris—Earthenware and china articles.
1517. W. Balk, Ipswich—Portable steam engines.
1518. A. H. A. Durant, Tong Castle, Salop—Extracting castor oil.
1519. W. R. and W. Morris, Deptford, and R. Chrimes and G. Eskholme, Rotherham—Preventing waste of water from service pipes or cisterns.
1520. J. Beckett and W. Seed, Preston—Spinning machinery.
1521. W. Boyes, Preston—Looms.

*Dated 7th July*, 1855.

1522. J. Gedge, 4, Wellington-street South, Strand—Aerated waters. (A communication.)
1524. E. V. Neale, 4, Russell-place, Fitzroy-square—Vitreous substances for labels, tablets, finger plates, tiles, &c.
1525. J. Pym, Stanley-street, Pimlico—Materials for building purposes.
1526. F. Yates, Birmingham—Dinner and dessert fork.
1527. C. F. Werner and L. Piglhein, Hamburg—Elastic stuffing for chairs.
1528. A. White, Glasgow—Grinding grain.
1529. E. W. Burrows, Clerkenwell—Increasing efficiency of steam-engine and other power.

*Dated 10th July*, 1855.

1538. G. Riley, 12, Portland-place North, Clapham-road—Mills.
1542. H. E. Flynn, Retreat, Ranelagh, Dublin—Preventing evil effects of recoil of cannon.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1567. Charles Byrne, Dublin—Preparation of fish combined with pepper, wine, and other condiments, for sandwiches.—13th July, 1855.
1599. William Pidding, Putney—Coverings for the feet.—17th July, 1855.
1600. William Pidding, Putney—Manufacture of building materials.—17th July, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed July 20th*, 1855.

173. Frederic Prince, 3, South-parade, Chelsea—Improvements in cartridges for fire-arms.
180. Sir James Caleb Anderson, Bart., Fermoy, Ireland—Improvements in steering ships.
184. William Edward Newton, 66, Chancery-lane—Improved machinery for raising and forcing fluids.
212. Henry Nightingale and Robert Nightingale, Chorley—Improvements in machinery or apparatus for slubbing, roving, and spinning cotton and other fibrous materials.
281. Peter Smith, Glasgow—Improvements in machinery or apparatus for printing textile fabrics and other surfaces.
322. John Ramsbottom, Longsight, near Manchester—Improvements in the construction of certain metallic pistons.
378. Benjamin Goodfellow, Hyde, Chester—Improvements in machinery for pumping, which improvements are applicable to the air pumps of steam engines and to other purposes.
452. Stanislas Vigoureux, Rheims—Improvements in printing, ornamenting, and dressing woven and textile fabrics.
651. David Elder, junior, Glasgow—Improvements in moulding or shaping metals.
1060. Edward Humphries and Thomas Humphries, Pershore—Improvements in machine riddles for separating straw from grain, and for other similar purposes.
1088. Thomas Charles Eastwood and Thomas Whitley, Bradford—Improvements in preparing and combing wool and other fibrous substances.
1177. Theodor Baron Von Gilgenheimb, Widenau, Silesia—New machine for tilling land.
1236. Alfred Vincent Newton, 66, Chancery-lane—Improved calculating apparatus.

*Sealed July 24th*, 1855.

181. Charles William Tupper, 3, Mansion House-place—Improvements in the construction and arrangement of coverings for buildings.
183. Augustus Edward Schmersahl and John Augustus Bouck, Miles Platting—Improvements in the manufacture of sulphuric acid, and in apparatus for effecting the same.
204. George Searby, 154, Sloane-street, Chelsea—Improvements in the manufacture of boots and shoes, also applicable to other articles made of or partly formed of leather.
207. John Hutchinson, Longroyd-bridge, Huddersfield—Improvements in apparatus to economize steam.
234. Arthur Lyon, Windmill-street, Finsbury—Improvement in sausage making or mincing machines.
240. John Francis Porter, Bessborough-street—Improvements in the manufacture of bricks and other articles of clay or brick earth.
251. Jules Castel, and Frederic Mauricheau Beaupré, Marseilles—A new system of burner for lamps called the Pyro pneumatic Burner.
252. Isidore Carlhian and Isidore Corbière, 27, Castle-street, Holborn—Improvements in moderator lamps.
261. Thomas Allan, Adelphi-terrace—Improvements in obtaining and transmitting motive power.
267. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improved mode of preserving railway and other tickets.
286. William Warbrick, Dukinfield, and John Walker, Compstall-bridge, near Stockport—Improvements in machines for preparing, spinning, doubling, warping, and dressing cotton, wool, and other fibrous substances.
311. John Langman, Plymouth—Improvements in portable buildings specially adapted to campaigning purposes.
314. George Henry Ingall, Throgmorton street—Improvements in telegraphic communication and apparatus connected therewith.
453. Thomas Sadleir, Mulla, Tullamore—Improved apparatus and method of manufacturing charcoal, which can also be applied to cooking and other purposes.
535. George Tomlinson Bousfield, Sussex-place, Loughborough-road, Brixton—Improvements in preparing wool and other fibrous substances for spinning. (A communication.)
587. William Monday, jun., Kingston upon-Hull—Improvements in preparing, mixing, and grinding the various kinds of plumbago, graphite, or blacklead, either together or separate, and with or without other materials, for polishing, lubricating, and for other purposes, and in otherwise preparing the same for sale.
647. James Willis, 75, Cheapside—Improvements in certain parts of the frames and furniture of umbrellas and parasols.
664. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in machinery or apparatus for dressing flax, hemp, and other fibrous materials. (A communication.)
1033. Alfred Vincent Newton, 66, Chancery-lane—Improved construction of air engine.
1068. Adam Guild, Manchester—Improvements in the process of bowking.
1099. George Tomlinson Bousfield, 8, Sussex-place, Loughborough-road, Brixton—Improvements in the manufacture of wrought nails.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3735 | July 16. | Allen's Wood Trestle Folding Camp Bedstead | J. W. and T. Allen | 18 and 22, Strand. |
| 3736 | " " | Envelope Paper | Frederick Wm. Ralph | 36, Throgmorton-street. |
| 3737 | " 17. | Grand Universal Safety Pocket Detector for Watches | Albert Hatchett Jones | 19, Helmet-row, Old-street. |
| 3738 | " 24. | Improved Washing Machine or Churn | William N. Nicholson | Newark-upon-Trent |
| 3739 | " " | A "Buddings" Mowing Machine | Thomas Green | Leeds. |

Journal of the Society of Arts.

*FRIDAY, AUGUST* 3, 1855.

## SOCIETY'S VISIT TO PARIS.

In accordance with the gracious recommendations contained in the letter of H.R.H. the Prince President of the Society, and which appeared in the last number, a visit of the Society to Paris has been fixed to take place from Monday the 3rd of September to Saturday the 15th of September.

Members will understand that, although the foregoing dates are mentioned, it is not necessary that parties joining in this visit should go and return on those days only. All that is meant is, that the Society will be represented officially in Paris during the period named.

For the accommodation of Members and their friends, arrangements have been made with the South Eastern Railway Company, and with the Brighton Railway Company, for the issue, at the Society's House, of return tickets to Paris and back.

The Passports when required will also be issued at the Society's House. The cost of the Return tickets to Paris and back will be as follows:—

By the South-Eastern Railway (Boulogne or Calais route), £4 10s. first class, £3 5s. second class.

*On the above fares a considerable reduction is expected in the event of the Council being able to assure the South-Eastern Railway Company of sufficient numbers adopting this Route.*

By the Brighton Railway (Dieppe and Rouen route), £2 8s. first class, £1 12s. second class.

The return ticket by the South-Eastern Railway is available for going and returning at any time within one month from the date of the ticket.

The return ticket by the Brighton Railway is available for going and returning at any time within fifteen days from the date of the ticket.

The cost of passports will be 5s. each.

A rendezvous for the use of the Members of the Society and their friends, and the Representatives from the Institutions during their stay in Paris has been obtained. Lord Stanley (of Alderley), the President of the Board of Trade, has kindly acceded to the request of the Council, and granted for this purpose the use of the House 14, Rue du Cirque, taken by the Board of Trade as the Head Quarters of the British Section of the Exhibition.

At this rendezvous information will be afforded as to Lodgings, Guides, &c., and from day to day visits to the several departments of the Universal Exhibition, and to different points of interest in Paris will be organized, and excursions to the celebrated places in the vicinity arranged.

A card, not transferable, entitling the holder by name to the privileges of this excursion, will be issued to the members on application at the Society's House, and also, on and after the 3rd of September, at the Rendezvous, 14, Rue du Cirque.

Every Member of the Society will have the privilege of taking, in addition to his own, tickets for two friends, either ladies or gentlemen.

The associated Institutions will each have the privilege of nominating a representative and two other persons, ladies or gentlemen, to join the party.

*In order that any reduction may be obtained in the* SOUTH-EASTERN FARES *as mentioned above, Members and Institutions are especially requested to send in their names on or before the 15th of August,* so as to enable me to ascertain what numbers are likely to take that route.

The railway tickets, passports, and cards will be issued from the Society's house, on and after the 27th of August, on receiving a remittance for the amount. Parties requiring tickets, &c., *must* send in *their names* and *those of their friends*, stating what *route* they purpose to take, and whether first or second class, and whether passports will be required, in which latter case the *Signatures* of the parties requiring passports must be sent.

## ARTIZANS' VISIT TO PARIS.

By arrangements which have just been concluded, Artizans holding the Foreign Office passports, granted them free under the regulations lately issued, are entitled, on presentation of that passport, to travel at half-fares on the French lines of railway from Calais or Boulogne to Paris. The South-Eastern Railway has accorded the same privilege to Artizans travelling from London to Calais or Boulogne. The artizan has the choice of three fixed trains per day from London to one or other of those places, and an evening tidal train, viz., 8.10 a.m. express, 9.30 a.m., and 5.30 p.m. to Calais, and the evening tidal train for Boulogne; the departure of which latter train varies as the tide serves for crossing.

Third-class covered carriages are attached to each of the foregoing trains.

The *half* fare from London to Calais or Boulogne, is 10s. second class, 7s. 6d. third class.

From Boulogne to Paris, the *half* fare is 8s. 6d. second class, and 6s. 3d. third class.

From Calais to Paris, the *half* fare is 11s. 7d. second class, and 8s. 8d. third class.

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In addition to the foregoing, the Eastern Counties Railway, in connection with a boat from Tilbury, undertake to convey passengers to

Boulogne and back for 15s. first class, and 12s. second class.

The following are the departures advertised for the present month:—

FROM LONDON *VIA* TILBURY.

| Days of Departure. | Trains leave Fenchurch and Bishopsgate Stations. | | | Steamer leaves Tilbury. | |
|---|---|---|---|---|---|
| Saturday . . . | 4 Aug. | *8.7 | A.M. | 9.15 | A.M. |
| Tuesday . . . | 7 ,, | 9.37 | ,, | 10.45 | ,, |
| Thursday . . . | 9 ,, | 10.37 | ,, | 11.45 | ,, |
| Saturday . . . | 11 ,, | 12.7 | P.M. | 1.15 | P.M. |
| Tuesday . . . | 14 ,, | 3.22 | ,, | 4.30 | ,, |
| Thursday . . . | 16 ,, | 3.22 | ,, | 4.30 | ,, |
| Saturday . . . | 18 ,, | *8.7 | A.M. | 9.15 | A.M. |
| Tuesday . . . | 21 ,, | *8.7 | ,, | 9.15 | ,, |
| Thursday . . . | 23 ,, | 9.37 | ,, | 10.45 | ,, |
| Saturday . . . | 25 ,, | 12.7 | P.M. | 1.15 | P.M. |
| Tuesday . . . | 28 ,, | 2.7 | ,, | 3.15 | ,, |
| Thursday . . . | 30 ,, | 4.22 | ,, | 5.30 | ,, |

* No Trains from Bishopsgate.

A refreshment room has been attached to the Exhibition, originally intended for the convenience of persons connected with the Exhibition, under the title of "Cantine Modèle."

The following are the Rules under which it was established, but since the opening the Imperial Commission has extended them, and Exhibitors, their Representatives and Servants, and Visitors to the Exhibition, are now allowed the privilege of making use of the "Cantine Modèle."

1st. A "Cantine Modèle" is established as part of the Exhibition in the south-east part of the garden near the "Cours la Reine." It is undertaken especially for the convenience of those acting under the Imperial Commission.

By the terms of the concession, the party undertaking this "Cantine Modèle" seeks no profit to himself, but devotes to works of charity whatever surplus the receipts will afford after payment of expenses.

2nd. The price of each article of food is fixed according to the tariff hereto annexed, approved by the Commissioner-General.

3rd. The Cantine furnishes gratuitously all articles for table use for those agents who wish to bring their own provisions, even when they require to be furnished with no additional articles of food; the Cantine takes charge of these provisions in a place specially provided until required.

4th. The hours for meals are fixed according to the Rules hereto annexed.

5th. Except at the hours of meals, no one will be received in the Cantine without a special pass.

6th. Agents and workmen employed in the Exhibition are admitted to the Cantine at the request of their masters, on the express condition of their observing the rules laid down.

7th. The consumers must abstain from everything tending to disturb order and raise disputes; a register is established for receiving all complaints.

The head of the Cantine and his staff must on their part place on this register every subject of complaint which the consumers make.

ORDER OF THE ARRANGEMENTS.

The Cantine opens at 6 o'clock, a.m.

From 6 a.m. to 6·55—Agents of all classes, such as inspectors, superintendents, and other persons acting under the Imperial Commission.

From 9 a.m. to 9·55—The workpeople of the exhibitors.

From 2 to 2·55—The workpeople of the exhibitors.

From 10 a.m. to 10·40—The keepers.—1st Series.

From 10·45 to 11·55—The keepers.—2nd Series.

From 12 to 12·40—Agents, workmen, and servants employed in the Exhibition.—1st Series.

From 12·45 to 1·45—Agents, workmen, and servants employed in the Exhibition.—2nd Series.

From 7·15 p.m. to 8 p.m.—Agents of all classes.

The Cantine closes at 8 o'clock in the evening.

List of the Articles Supplied at the "Cantine Modele," with the Prices.

*** *Five centimes may be reckoned as a halfpenny, and one franc twenty-five centimes as one shilling.*

| | f. | c. |
|---|---|---|
| Bouillon (a kind of beef tea) without bread ... | 0 | 15 |
| Ditto, with bread ......... | 0 | 20 |
| Common beef soup, with the beef in it ............ | 0 | 30 |
| Beef (plain) ..... ......... | 0 | 25 |
| Beef à la mode ............ | 0 | 35 |
| Stewed Mutton ............ | 0 | 35 |
| Ditto, half the quantity . | 0 | 20 |
| Roast meat .................. | 0 | 35 |
| Vegetables .................. | 0 | 20 |
| Salads ........................ | 0 | 20 |
| Dessert........................ | 0 | 15 |
| Coffee, small cup, with a small glass of brandy . | 0 | 40 |
| Café-gloria .................. | 0 | 30 |
| Wine (the bottle) ......... | 0 | 90 |
| Dito, quarter bottle ... | 0 | 25 |
| Burgundy ................... | 1 | 0 |
| Bordeaux...................... | 1 | 25 |
| Ditto, white ............... | 1 | 25 |
| Macon (Old) ............... | 1 | 50 |
| Strong beer (the bottle) | 0 | 30 |
| Ditto (a large glass)...... | 0 | 15 |
| Strasburg Beer, la canette........................ | 0 | 50 |
| StrasburgBeer,la choppe | 0 | 25 |
| Beer of the North, la canette ................... | 0 | 50 |
| Ditto, la choppe ......... | 0 | 25 |
| **Biere Anglaise. — (English Beer.)** | | |
| Porter ......................... | | |
| Ale .............................. | | |
| Common Brandy (small glass) ..................... | 0 | 10 |
| Best Brandy, ditto......... | 0 | 15 |
| Rum, ditto .................. | 0 | 15 |
| Cassia, ditto .............. | 0 | 10 |
| Aniseed, ditto............... | 0 | 10 |
| Curaçao, ditto ............ | 0 | 10 |
| Absinthe, ditto ............ | 0 | 15 |
| Syrup of Currants (the glass) ..................... | 0 | 15 |
| Ditto, d'Orgeat, ditto ... | 0 | 15 |
| Ditto, de Gomme, ditto. | 0 | 15 |
| Seltzer Water (the bottle) ....................... | 0 | 30 |
| Ditto (the half bottle)... | 0 | 20 |

NOTICE TO INSTITUTIONS.

Mr. E. W. Martin, Hon. Sec. to the Guilford Institution, writes, "A person calling himself Frederick Young, late of Heidelberg, Professor of Elocution, and giving his address, London Mechanics' Institution, has been in this town, and upon the faith of being 'about' to deliver a Lecture on Poetry, has obtained, from several of our members, money for tickets in advance. The Lecture has *not* been delivered. The same person went to Godalming and, unwarrantably, made use of my name; there, however, I believe he did lecture."

DECIMAL COINAGE.

By Frederic James Minasi.

(*Concluded from page* 619.)

We have now, I believe, exhausted all the plans which are founded upon the sovereign, or some one of its chief parts, as the principal unit of account, and from which it is proposed to descend in a decimal progression to the lower coins. It remains in the last place to consider those systems which recommend an ascending ratio from a low to a higher coin.

By analogy, founded upon the division of the sovereign into 1,000 parts, Mr. Headlam, M.P., one of the witnesses before the late Committee on this subject, after adducing a series of very grave objections to that plan, proposes to found a system of decimal coinage upon the present farthing, as follows:—

10 *mils* (or farthings) = 1 *cent* or 10-mil piece = 2½d.
10 *cents* (or 100 farthings) = 1 *florin* = 2s. 1d.
10 *florins* (or 1,000 farthings) = 1 *Victoria* = £1 0s. 10d.

As a means of introducing this, sometimes called the *new guinea* plan, Mr. Headlam proposes to stamp on all existing coins, as well as upon any new ones that might be issued in accordance with the plan, the number of

farthings which it represented; thus, the sovereign would be marked "960," the Victoria "1000," the shilling "48," &c., by which he does not seem to intend that these numbers should be used as integers in accounts, but as distinguishing each coin by its value in *mils*, that is, in $\frac{1}{1000}$th parts of the Victoria, or unit. This system is, in fact, scarcely different from that we have already noticed in the plan of Mr. Alexander. The main objection to it seems to be in the conversion of the *pound* to the *Victoria*, represented in farthings; however, much of this objection may be considered as removed, and by the aid of tables and a little experience, would not prove so formidable a difficulty as at first it appears, whilst it has the advantage over the pound-and-mil system of not interfering with the copper coinage of the country at present in circulation. On the whole, however, this plan does not appear to have been very favourably received.

There is also a modification of this proposal, which would employ a silver coin of 100 farthings, or 2s. 1d., as the chief money of account; this would be similar to the two-shilling unit, but without *inconvertible* cents. Perhaps the *dollar* system may be properly placed here; it takes the halfpenny, which is considered by many to be more important than the penny, for a basis by which we might ascend to 10 halfpence, or 5d.—a very useful coin,—and 100 halfpence, or 4s. 2d.; or our dollar might be divided into 100 cents of a halfpenny each, as in America, to the money of which country we should thus have some approximation. The advantages of such a system would be its popularity, and non-interference with the money now circulating amongst us; whilst we should have the experience of the United States in the change; concerning which Mr. W. Brown, M.P., in his evidence before the Committee*, stated that "Being in the United States in 1800, when the transition was going on from the pound, shillings, and pence system of accounts to the decimal dollars and cents, as the dollar and cent currency was issued from the mint, it gradually superseded and supplanted the pounds, shillings, and pence, so that you were hardly aware of a change taking place."

As, however, it is considered that the dollar would be a silver coin, the objection already quoted relative to a silver standard has been urged against it.

The next and the final plan we shall direct our attention to is that founded upon the penny, the preservation of which is the aim of its advocates, for reasons which may be gathered from their objections,† already noticed, to the plan promoted by the Decimal Association. The main feature of this system is the formation of an ascending decimal coinage by the creation of a new coin of account of the value of *tenpence*. From the pamphlets of Mr. Rathbone, Dr. J. E. Gray, Mr. Laurie, and Mr. Turner, the details of the tenpenny system, as it is called, may be learned.

Mr. Theodore Rathbone, immediately after the appearance of the Report of the Select Committee, in August, 1853, published his first pamphlet‡ on this subject, in which he proposes his plan in the following terms:—

"The course of proceeding would be simply, as the first great step, to make *pounds*, *francs*,§ and *pence*, instead of pounds, shillings, and pence, our monies of account—and to stamp, at first, as a rude temporary expedient, on the face, or rather the reverse, of every circulating coin its decimal value in tens and hundreds; these figures, be it observed, instantly furnishing to every eye, at once both the decimal value and the actual amount of pence and tenpences, with their multiples and decimals, every coin in existence represents. Thus in all the great multitude of our ordinary transactions, in all sums whatever up to the pound sterling, the dot dividing, or the column in account separating, the two first items,—pence and tenpences, tens and hundreds,—would present the ordinary figures of account, and, at the same time, the amount decimally stated in the most pure and perfect form of decimals. The figures would, in short, ever be to this extent one and the same. Half a guinea, for instance, would be twelve francs (or tenpences) and sixpence; that is, either a 12f. 6d., or 12.6 decimal, and the coins would at once speak for themselves—the half sovereign (12·0), the sixpence (0·6),—every coin being ever thus defined and indicated. The only new money or item in our accounts, the tenpence, or franc, would, whenever this coin were issued, be clearly expressed by the stamp thereon, its thus distinctly defined value (1·0); its tenth, our present penny (0·1)—twenty francs of course would be (20·0), and the halfpenny, the five-cent piece, or French sou (0·05), &c. The ultimate regular series of coins would probably be—for those very poor districts and classes of the population which some of the witnesses represent as suffering injury and injustice from the want of more exact and minute measures of value, centimes, or (as I would propose they should be called in this country), cents, in a series of one to five—(0·01), (0.02), (0·03), (0·04), (0·05), our present halfpenny;—(0·10) indicating the penny;—(0·50) the fivepence or half franc;—(1·0), the tenpence, or franc."

These views are further enforced by Mr. Rathbone in a subsequent paper,* read before the British Association in September last.

In nearly the same terms Dr. Gray† proposes his plan for the establishment of a decimal coinage in this country. "Its great feature is," he says, "that our accounts should hereafter be kept in pence and tenpences, or *albions*.

"1. The value of the penny to be retained unaltered, in which case there could be no loss or misunderstanding as to any existing coin.

"2. All the coins at present in circulation may remain in circulation, each passing for the number of pence they now represent, as 2, 3, 4, 6 pence; the shilling as 12 pence, the halfcrown as 30 pence, the crown as 60 pence, in silver; the half-sovereign as 12 albions or 120 pence, and the sovereign as 24 albions or 240 pence. Though no longer moneys of account, they would be perfectly understood, and would be most useful for all the current purposes of life, and as coins of circulation.

"3. Only two new coins will be required, viz., the *tenpence*, which may be called an *albion*, or *alb.*, and its half or fivepence; hereafter the crown piece (6 alb., or 60 pence), may be replaced by a 5-alb. or 50-pence coin, and we may have gold coins of 10 and 20 *albs.*, 100 and 200 pence."

Mr. James Laurie, in his pamphlet already referred to, remarking upon the necessity for preserving our existing copper coinage, as having "their fixed representatives in articles of food, and in a thousand other commodities, determined by a sort of conventional law, well understood by the public, and particularly by the poorer classes," observes, that for this purpose "the integer of the decimal should be one which would comprehend every existing coin, and occasion no sort of inconvenience or loss to the

* 1194.

† See also the evidence of Mr. Headlam, M.P., before the Committee on Decimal Coinage.

‡ An Examination of the Report and Evidence of the Committee of the House of Commons on Decimal Coinage, with reference to a Simpler, Sounder, and more Comprehensive Mode of Proceeding.

§ Or *tenpence*, the term now always employed by Mr. Rathbone.

* "A Comparative Statement of the different plans of Decimal Accounts and Coinage, which have been proposed by the witnesses examined before the Committee of the House of Commons and others. By Theodore W. Rathbone; with a compendium of the scheme of pounds, florins, cents, and mils, and the scheme of pounds, tenpennies, and pence, comparatively stated; an abstract of the discussion; and 'Observations of a Merchant' on the statements of the Chairman of the Committee, Mr. Brown, M.P., and Professor De Morgan, in the Proceedings of the Decimal Association.'" Altogether this is the most complete account of the question that has yet appeared.

† Decimal Coinage, what it ought and what it ought not to be.

public when the decimal currency came into use. In this respect the integer of £1 is a complete failure,—that object can be secured by an integer of 10d. only,—and by that integer alone divisible into cents. Were the tenpenny introduced, there is not an existing coin that could not readily be adapted to such an arrangement, and the coinage as it exists would continue to circulate until it was worn out, each coin representing ten *cents* for every penny of its value. This will at once be seen by the following table of equivalents:—

| | | | | |
|---|---|---|---|---|
| The Integer ......... | | 10d. | | 1·00 |
| A Sovereign ......... | £1 | 0 | 0 | 24.00 |
| Half do................ | | 10 | 0 | 12·00 |
| Crown ............... | | 5 | 0 | 6·00 |
| Half do................ | | 2 | 6 | 3·00 |
| Florin.................. | | 2 | 0 | 2·40 |
| Shilling ............... | | 1 | 0 | 1·20 |
| Sixpence ............ | | 0 | 6 | ·60 |
| Fourpenny............ | | 0 | 4 | ·40 |
| Threepenny ......... | | 0 | 3 | ·30 |
| Penny ............... | | 0 | 1 | ·10 |
| Halfpenny............ | | 0 | ½ | .05 |
| Farthing .......... | | 0 | ¼ | .02½ or .025." |

As in the the case of the pound-and-mil scheme, the proposal for the *tenpenny* does not appear to be new. In a leading article of the *Times* newspaper, of the 20th of July, 1816, the following paragraph occurs:—"Since the revolution, a simple system has been adopted in France, and the coins, both of gold and silver, have been, in comparison with our own currency, perfection itself. The integral unit in this system is a piece of silver, intrinsically worth about 9½d., or 9¾d., of our legal money. If, therefore, our government would coin shillings of the same intrinsic value (that is to say, containing 69½ grains of pure silver, besides the alloy), and would make these shillings current for *tenpence*, we should have the elements of a decimal system of calculation, with little derangement of our existing accounts, inasmuch as it would only be necessary to enact, that wherever pounds sterling have been mentioned in existing contracts, the term should be taken to mean 240 pence or 24 shillings of tenpence each." At this period the feeling is said to have been friendly to the proposal, while that which divides the pound into 1000 mils, was not received with much favour.*

Recently, commenting upon Dr. J. E. Gray's pamphlet, the journal just referred to observes: "There can be little doubt, even from the experience of the past five years, that if the matter is really to depend on any organic change affecting the copper circulation, the discussion raised and the obstacles suggested will be such that no recommendations of mathematicians, however constantly reiterated, or parliamentary reports or articles in the newspapers, will succeed within any moderate space in bringing the Government to assume the trouble and responsibility of such a measure. If the desire in favour of a decimal coinage is as great as those who trust in the rough intelligence of the masses believe it to be, the argument is not unreasonably urged that they will soon voluntarily bring it into operation if simple means are offered them, while if, on the contrary, the change would be intrinsically unpopular, no compulsory measure, especially of a kind to disturb all previous ideas, could be anticipated without embarrassment. Supposing a tenpenny piece to be introduced, it must certainly be the fault of the public alone if all their calculating habits do not soon flow into the decimal direction, and, at all events, few will deny that while the philosophers are discussing more general changes, it may be well to let so simple an experiment make its way."† And subsequently, "The question seems only whether, by the simple introduction of a tenpenny piece, the people shall be instantly furnished with the means of adopting a decimal currency at their pleasure, which shall, at the same time, give them clear perceptions of the currencies of the principal countries of the world, or whether, by long philosophical efforts, the attempt shall still be made—although year after year passes without any apparent advance—to bring them at some distant but undefined day, to banish the penny in favour of the mil, and while thus gaining some of the advantages of the decimal system, to separate themselves hopelessly from any general affinity with the currencies of the nations with whom their chief intercourse is carried on."*

Against this proposal for a decimal coinage, it is argued that the employment of the number 24 in account to represent what we have been so long accustomed to call 1, would lead to very great inconvenience and confusion.

As a specimen of the fears of this class of objectors, take the following:—"£500,000 represented in dollars would stand thus, D2,000,000::00; and in francs thus, F10,000,000::0::0, say ten millions of francs. Let an Englishman picture to himself long pages in the books of the State departments of revenue and taxes, or of finances of any kind, or in mercantile books, covered with these clouds of figures from top to bottom, and then he will have some faint idea of the labour of the head and hand in France and in the United States of North America, through having their unit fixed at so very low a value as a dollar and a franc; and as to paying any very large sums in specie in those countries, it would occupy almost the life of a man to count such small coins. These are cogent reasons for continuing the sovereign or pound sterling as our highest denomination, independently of the facility of counting the coin, the expedition of adding up large sums, the beauty of the coin itself, and the greater respectability of the value."†

A further objection is taken to the tenpenny plan, on the assumed ground that it would lead to the establishment of a silver monetary standard instead of a gold one, as at present in use among us. These two objections may be regarded as the main arguments in opposition to the system now under consideration. To the first of these it may be replied that a little use would soon familiarise the minds of people with the larger numerical representations of sums now expressed in pounds; besides, Mr. Rathbone's plan would sanction the continued use of that coin for any length of time the public might be disposed to demand. Mr. Maslin's fears would certainly excite a smile from our neighbours, who, of course, are not altogether in the difficult position he represents them to be. To the second objection raised it will be sufficient, in reply, to quote the words of Dr. Gray:—

"*No change should be made in the present gold standard.*"—This rule is chiefly founded on a matter of policy, because otherwise the advocates of a decimal coinage will necessarily complicate the question by introducing disputes as to whether a gold, a gold and silver, or a silver standard is most advisable. Fortunately, this may easily be prevented by making whatever silver coin may be taken as the silver coin of account correspond with a certain fraction or portion of the sovereign. It is the more necessary to insist upon this rule, because some of the advocates of the mathematical system, and even so exact and cautious a person as Sir John Herschel, seem to think that if a florin were taken as the unit, "it assumes a silver monetary standard, whereas, for good or for evil, for better or for worse, we are married to a gold one;" and it is a general objection put forward against any other than a pound unit, that it would alter the standard of value."‡

Mr. Rathbone also observes, on the subject of a universal standard of value:—"This important question, however, the author must here again repeat, is not in any way

* See a letter from Dr. J. E. Gray, in the *Journal of the Society of Arts*, March 30, 1855.

† *Times*, April 21st, 1854, City Article.

* *Ibid*, September 20.

† A new Decimal System of Money, Weights, Measures, and Time; by Decimus Maslin, Esq.; page 23.

‡ Decimal Coinage, p. 26.

whatever mixed up with that of the present scheme. So long as gold is the standard of value in this country, the *franc* or *cent-cent* would be a twenty-fourth or twenty-fifth, as determined, of the pound sterling, if silver ever became so, the pound would be twenty-four or twenty-five, as fixed, of these tenpenny coins."*

I have thus attempted to bring before you the various plans that have been proposed for introducing a decimal system of coinage and accountancy in this country. In a mere outline of each, such as I have produced, and in so short a space as a single lecture, it must be evident that I fail in doing justice to plans which are all more or less ably treated by their respective advocates, to whose published views I would refer you for complete information. I have avoided as much as possible all reference to my own views on this matter; of course, I have views of my own; it will not be proper longer to conceal what those are. In doing so, I do not arrogate to my proposal any superiority over others, but desire in all candour to submit it with the others to your impartial consideration. I may as well say that it is a phase of the tenpenny plan that I give the preference to, and which is given at length in a paper I had the honour to read before the Statistical Society of London in June last, and which was subsequently published in their Journal.†

For some years past I have been a humble advocate for a decimal coinage. As to the plan to be adopted, I did not think any was more desirable than that which seeks to subdivide the £1 sterling into 1000 parts—a plan supported by men ranking high in science and mercantile matters; a plan that would render perfect that very simple method for the transposition at sight of shillings and pence to three decimal places of a £, so common in use among actuaries and others; a plan which seems to require a shaving only from every farthing, restored as an additional coin in the sixpence, which would count 25 instead of 24. The result of a somewhat careful consideration of the subject, has, however, shown me that it is not a question of accountancy only, but one in which numerous important interests are concerned—interests that would be best consulted and advanced by a decimal system founded upon the *penny*. The conclusions I then arrived at were:—

1. That the new system should be one free from any liability to give rise to injustice or confusion among the poor and illiterate classes of the community, thereby creating a prejudice against its use.
2. That it should not necessitate the withdrawal of the most useful and popular coins already in circulation, and with which, from habit, everyone is familiar.
3. That it should possess the greatest possible clearness in expressing its coins in the old money, and *vice versâ*.
4. That there should be but few coins of account, and those of a convenient size; and, if possible of different metals.
5. That it should be an experiment which might be withdrawn without difficulty if found inconvenient in practice.
6. That the unit of account should be a gold coin of moderate value. And,
7. That its lower denominations of account should range in value as nearly as may be with the units of currency of such foreign states as we have most important relations with.

In accordance with these requirements, I advocated the tenpenny plan just explained, with the modification of making the unit of account a gold coin‡ of the value of 10 tenpences, the effect of which would be to advance the unit of account nearer its present value, and thus aid in getting rid of the maudlin feeling which some have relative to reckoning in tenpennies, and the fears of others about a silver monetary standard. This *Imperial unit*,* or *Imperial*, as I have termed it, might then be put forth as the olive branch by which to reconcile the two chief contending elements of this question, the penny and the pound, between which it seems now acknowledged this *questio vexata* rests. The penny would remain intact, and the pound, also unaltered and uninterfered with as *a coin of currency*, numerically represented by 2·4. Quoting from my own paper on this subject, it will be seen how this plan fulfils the seven conditions previously laid down:—

"1stly. No confusion or mistrust would arise among the lower classes of the people, since the new coins could be represented in the old, while the penny would remain unaltered in name and value.

2ndly. The old coins might continue in circulation for any length of time that might be found necessary.

3rdly. The two systems are obviously convertible with great simplicity, and *all* the old coins easily represented by the new, and the reverse, thus—

| Coins of the Present System. | Value in pence. | Value in Proposed System. Imp. | tenp. | p. | | Imp. |
|---|---|---|---|---|---|---|
| The penny | 1 | 0 | 0 | 1 | or | ·01 |
| The three-penny piece | 3 | 0 | 0 | 3 | ,, | ·03 |
| The four-penny piece | 4 | 0 | 0 | 4 | ,, | ·04 |
| The sixpence | 6 | 0 | 0 | 6 | ,, | ·06 |
| The shilling | 12 | 0 | 1 | 2 | ,, | ·12 |
| The florin | 24 | 0 | 2 | 4 | ,, | ·24 |
| The half-crown | 30 | 0 | 3 | 0 | ,, | ·30 |
| The crown | 60 | 0 | 6 | 0 | ,, | ·60 |
| The half-sovereign | 120 | 1 | 2 | 0 | ,, | 1·20 |
| The sovereign | 240 | 2 | 4 | 0 | ,, | 2.40 |

4thly. There would be but three coins of account, whereas the Committee names four,† so that two places of decimals would represent *tenpennies* and *pence*, or simply *pence*, if preferred, and thus the absence of a third column of figures would materially lessen the labour of addition. Also, the new coins would be of different metals, and of a convenient and, at the same time, a different size, thus precluding all chance of mistake in their use. The *imperial* would be a little smaller than the present half-sovereign, and the *tenpenny* somewhat less than a shilling piece.

The 5th and 6th requirements are also equally fulfilled. And—

Lastly. It will be observed that great facilities would be afforded to travellers and others in more easily effecting exchange operations. The *half-imperial* would represent the United States *dollar*, and the *hard dollar* of Spain and the South American States; the *tenpenny* would equally approximate to the French and Belgian *francs*, and other foreign coins of the same value; while the Dutch *guilder*, and the *florin* of Zollverein, &c., would be

* Examination of the Report, p. 40.

† September, 1854.

‡ It would not be necessary to coin all our gold in this form,—2 or 5 imperials might be issued for ordinary use.

* Elsewhere I have stated that when the old system of money had ceased to be used, it might be well to restore the familiar names of pounds, shillings, and pence, in accordance with Mr. Tate's suggestion in the *Times* of December 11th, 1853, who proposed "4 farthings = 1 penny; 10 pence = 1 shilling; 10 shillings = 1 pound." Mr. J. H. Turner, of Cambridge, in his pamphlet entitled "The Penny Considered as the Foundation of a Decimal Currency," agreeing with this idea, says—"I propose that a silver coin of ten pence shall be, and shall be called, *a shilling new currency*, and that a gold coin of one hundred pence shall be, and be called, *a pound new currency*."

† It would, I think, be better to ignore halfpence and farthings in account, as is frequently done at present, but they should still be current for the use of the poorer classes; nevertheless, if found desirable, the farthing might be withdrawn and the penny divided into ten *mites*.

indicated by *two tenpennies*. For this and other reasons it would doubtless be found convenient to coin such pieces as—

| | s. | d. |
|---|---|---|
| The *half-imperial*, or *dollar*—value in present money | 4 | 2 |
| ,, *forty-penny piece* | 3 | 4 |
| ,, *twenty-penny piece*, or *guilder* | 1 | 8 |
| ,, *five-penny piece* | 0 | 5 |

Those could be struck in silver, and would eventually supply the place of those at present in circulation.

A *Victoria*, equal to *ten imperials*, or 1000*d*., answering to the *double eagle* of the United States, would likewise be found useful, and might be made a handsome commemorative gold coin, considerably smaller than the present crown piece."

The plan, then, which I respectfully advocate, may be popularly termed that of THE DOUBLE DOLLAR WITH THE DOUBLE CENT.

If a decimal system of coinage is to be established in this country, I contend it should be at the expense of the present chief coin of account. Those who would be affected by such a change are much better able to cope with that difficulty than the poorer portion of the community with the greater and more confusing change in the copper currency. As to the difficulty of estimating large sums under a smaller unit than at present, I apprehend no one is really seriously alarmed on that point. A simple operation would transpose present money to the new system, and *vice versa*.

As examples:—

1. Express £145 in the new money.

```
      145 × 24
      ----
      290
       580
      ----
Ans.  3480 tenpennies.
Or     348 imperials.
```

2. Express £87 15s. 9d. in new money.

```
                       87
                      ---
                      174
                       348
15s. 9d. = 189d.       189
                     -----
        Ans.  2106·9  tenpennies.
        Or     210·69 imperials.
```

Conversely:—

3. Reduce 348 *imperials* (or 3480 *tenpennies*) to present money.

```
          1/2 | 348
          1/6 | 174
  Subtract    |  29
               ----
       Ans.  £145
```

4. Reduce 210·69 *imperials* (or 2106·9 *tenpennies*) to present currency.

```
          1/2 | 210
              | ---
          1/6 | 105
  Subtract    |  17  10
               --------
                 87  10
  Add 69d.            5   9
               ------------
     Ans.      £87  15s. 9d.
```

These reductions might be considerably facilitated by the use of tables.

Whilst it must be acknowledged that at first sight, at least, these operations present a somewhat uninviting aspect, they are by no means difficult, and are, it will be observed, opposed to the class of persons least likely to be puzzled by them. When the new money came to be established, such processes would cease to be requisite.

Gentlemen, I now leave this matter with you, for that careful investigation its importance merits. Right glad shall I be if my poor exposition on this occasion shall prove the means of inducing the schoolmasters of Great Britain to take the part in this discussion for which they are so peculiarly qualified.

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*** The Secretary begs to state that it is proposed to give in the next number of this *Journal*, a list of the authorities on the decimal coinage question. This list is in a great measure prepared, and its publication is only postponed with the view of making it as complete as possible. A proof will be sent to any gentleman on application, and the Secretary will be glad to receive any additions or suggestions relative thereto.

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## BRITISH IRON MANUFACTURE.

### Remarks on the Report of the Select Committee of the House of Commons on the Petition of Coningsby Cort, eldest Son of the late Mr. Henry Cort.

By Richard Cort.

#### General Summary.

(Concluded from page 623, of No. 140.)

The readers of the *Journal of the Society of Arts* having the Report of the Committee of the House of Commons with my annotations upon it before them, paragraph by paragraph, will now be able to judge whether my father's services for *saving thirty millions sterling to the country*, were duly appreciated in 1812 or not. But even, assuming that the Committee had taken a different view of my brother's petition, and the family had received a large reward, still, that reward could only have reference to the national benefits realised up to that time, from 1788 to 1811, 23 years, while it will be seen that since then 43 additional years have elapsed. One of the principal reasons, indeed, for publishing such a narrative of these discoveries, after continuing for more than half a century in oblivion, is the fact, that the national benefits have grown up during that period to so prodigious an amount, as compared with the first 23 years, ending 1811, that they now constitute quite a *new case*, many times stronger on national grounds, for 66 years instead of 23 years; therefore, however, the case in 1812 may have been ignored or misapprehended in 1812, it can present no reasonable bar to any *new case* for nearly treble the whole period in 1855.

I am also anxious while I survive, now more than 71, to record the whole merits in the Journal of this Society, many of whose members are vitally interested in British iron manufacture, and are well qualified to judge how far the inventions of puddling and rolling bar iron during the last 66 years, have proved a *mine of iron above ground* more valuable than gold or silver for the naval and military defence of Great Britain, for the safety of our fleets, and the lives of our seamen; as well as for the daily wants of the whole human race at home, and in more than twenty other countries where British puddled and rolled iron have been used for more than half a century.

In order fully to understand and appreciate the *real case* in 1812, the view of the iron trade before and since the inventions of puddling and rolling must not be confined merely to the difference of import and export of bar iron in 1782 and 1811; for as the demand in pig iron could not be so great without puddling and rolling as with them, the real value of both inventions can only be fairly appreciated by comparing the total make of pig iron, and the state of the iron trade generally, before and after the universal adoption of puddling and rolling.

The total make of pig iron with the cheaper pit coal was not reported to be a single ton in 1782, while the total make of pig iron with the dearer charcoal fuel

had dwindled down from 300 blast furnaces to 59, and the produce from 180,000 tons annually to 17,350 tons only, for the supply of all the daily wants of the whole population of Great Britain.

The use of timber for charcoal fuel had been prohibited by various Acts of Parliament for making iron in many of the principal counties contiguous to navigable streams, particularly Essex, Kent, Surrey, and others. Every ton of pig iron required four loads of timber for charcoal fuel, and every ton of bar iron three additional loads of timber, so that even the minimum make of 17,352 tons of pig iron, required 69,400 loads of timber, at more than double the cost as compared with pit coal.

More than 30 years previous to 1782, pit coal had been tried by various parties and substituted for charcoal in the blast furnaces, particularly by the Carron Iron Company in Scotland, who had an inexhaustible supply of that fuel in the immediate vicinity of their iron works, but always unsuccessfully, owing to the very imperfect operation of blowing by large bellows moved by a water wheel. The scanty supply of air, and its want of density was such, that the produce of the blast furnace did not exceed 10 or 12 tons weekly, and in summer frequently considerably less, so that the average annual make of each furnace was less than 500 tons, which was not sufficient to afford adequate profit.

Nor could *refineries* be multiplied without a great additional means of blast, which could not be effected without powerful steam-engines, the expense of which could not be afforded while the produce of the blast furnaces scarcely averaged 500 tons annually, and while the hammered bar iron did not exceed ten tons weekly, and in quality, too, inferior for exportation; so that, in fact, *British Iron Manufacture*, previous to puddling and rolling, had actually become almost a nonentity.

At this critical juncture, when the nation was dependent on Russia and Sweden for not less than 70,000 tons of bar iron annually, at a cost in British money of nearly 2½ millions sterling year after year, my father's inventions of puddling and rolling opened quite a new field for British Iron Manufacture, by encouraging a large increase in the make of pig iron with the cheaper pit coal, instead of the dearer charcoal. For as soon as it was seen that out of common ship ballast, the coarsest kind of cast iron, my father had succeeded in rendering iron malleable in a reverberatory, or air furnace, heated by the *flame* only of pit coal, shewn by his trials in all the royal dockyards, without the aid of coke, blast, bellows or cylinder, being the process termed puddling, and that by his other invention of grooved rollers, the slow operation of the hammer could be superseded by making in one week *ten times* as much of the best quality (and now *twenty times*), as could be made under the hammer of inferior quality, the whole of the iron masters were sufficiently alive to their own interests not to feel that these discoveries, with all the requisite capital to work them, would insure to themselves the princely fortunes which they have since realised.

Hence the Carron Iron Company was among the first, in 1786, to invite my father to commence the new operations of puddling and rolling at their own works, where every facility was offered for the purpose, with an ample field of pit coal at his command. In 1788 this company had four blast furnaces at work with pit coal, which produced 4000 tons of pig iron, being more than double the average annual produce of the charcoal furnaces previous to 1782. Then followed the Colebrook Dale Company, who had been trying a process for puddling called "Buzzing," but had abandoned it as hopeless of profit before my father patented his improved method in 1783; soon after which the Colebrook Dale Company were the first to adopt the rolling process. The late Mr. Richard Crawshay, and Mr. James Cockshutt, next determined, in 1787, on the erection of new works at Cyfartha, to carry out both inventions on a great scale. The Blaenavon Iron Company, the Dowlais Iron Company, by the late Sir John Guest, and the Penydarran Iron Company, by Mr. Samuel Homfray, had all erected colossal works for the use of puddling and rolling, before the close of 1789, besides others in Staffordshire and Yorkshire, many of the iron masters having signed agreements to pay different royalties for working under the patents.

Mr. Malkin, in his publication on the Antiquities of Monmouthshire, in 1803, states, that in 1788 no bar iron was made in the whole county; whereas from 1802 to 1811, the total quantity of puddled and rolled iron sent down the Monmouthshire canal by a few companies was not less than 218,509 tons —*See* Scrivenor's work, p. 127. In 1788 the total make of charcoal pig iron was reduced from 17,350 tons to 13,100 tons. The total make of pig iron with pit coal was increased in Scotland alone to 7,000 tons, while the whole make in Great Britain had increased to 50,950 tons (*See* Scrivenor, page 88), or nearly three times the whole make of the kingdom with charcoal fuel in 1782. In 1811, the whole make of pig iron was 350,000 tons, being nearly seven times as much as the whole make of Great Britain in 1788; while the blast furnaces, instead of producing less than 500 tons annually, were producing at the works of Crawshay and Co., in South Wales, with pit coal, more than 2,600 tons annually, and the average produce in Great Britain from 162 furnaces was 1546 tons annually.—*See* Scrivenor, p. 98. The total quantity of pig iron made from 1788 to 1811 may be estimated at not less than four millions of tons, partly by returns made, and partly by estimating the make for the intervening periods, being nearly 80 times as much as the whole make in Great Britain in 1788, while the total make of puddled and rolled iron, in the same period is estimated at 2,500,000 tons, including probably 1,500,000 tons of bar, bolt, and wrought iron.—See pp. 140 and 622.

No. 1.

Estimate *showing the total pecuniary Value of the National Benefits derived from Puddling and Rolling, from* 1788 *to* 1811, *for* 23 *years, from* 4,000,000 *tons of Pig Iron, making* 2,500,000 *tons of Puddled and Rolled Iron, including* 1,500,000 *tons of Bar, Bolt, and Rod Iron, out of materials previously useless, and by British Labour.*

Iron Trade.

| | |
|---|---|
| By total amount saved on 1,500,000 tons of puddled and rolled bar, bolt, and rod iron, from 1788 to 1811, as compared with previous operations, making from 100 to 200 tons of rolled bar iron in one week, of the best quality, instead of 10 tons in the same time under the hammer, in quality too inferior for exportation, averaging, 30s. per ton . . . . . | £2,250,000 |
| Deduct amount subscribed in 1811, at most | 1,000 |
| | £2,249,000 |
| By total amount saved by royalties not paid on 500,000 tons of puddled, rolled, and wrought iron, from 1788 to 1798, when the patents were locked up for the debt of a public defaulter, but not for any debt for money borrowed by the patentee of the Crown, averaging 7s. 6d. per ton . | 187,500 |

Mineral Owners.

| | |
|---|---|
| By total amount saved from royalty or rent for pit coal, ironstone, and limestone, equal to 35,000,000 tons, averaging 9d. per ton . . . . . . . . | 1,312,500 |
| Total saved by the Iron Trade and Mineral Owners, ending 1811 . . . . . | £3,749,000 |

This is exclusive of the profit on the *increased* quantity of pig iron made, owing entirely to the increased quantity of malleable and bar iron by puddling and rolling.—This

amount of £3,749,000 sterling, is but a very small part of the whole national benefits realised under:—

Import.

| | |
|---|---|
| By total amount saved by *decreased* import of bar iron from 1788 to 1811, being so much less paid to foreign countries in 23 years, from returns and estimates for 681,444 tons, at a low average rate of £15 per ton . . . . . . | £10,221,660 |

Export.

| | |
|---|---|
| By total amount saved by *increased* export of puddled and rolled iron, from 1788 to 1811, being so much more received from foreign countries in 23 years, for 467,268 tons of British iron, exported at a low average rate of £8 per ton . . . | £3,738,144 |
| Total saved by difference of import and export of bar iron in 23 years . . | £13,959,804 |

N.B.—The price of the best Swedish iron from 1788 to 1811 varied from £40 to £37 6s. 8d. per ton; British bar iron from £28 to £20 per ton.

Home Trade.

| | |
|---|---|
| By total amount saved from 1788 to 1811, on 2,032,732 tons of puddled and rolled iron for naval and military service, for railway, steam navigation, ship-building, house-building, agriculture, domestic use, mining, and all the other wants of the population for 23 years ending 1811, at a low average rate of £8 per ton . . (Making the whole quantity including exports, 2,500,000 tons.) | £16,261,856 |
| Total estimated amount saved by the country out of materials previously useless, and by British labour . . . | £30,221,660 |
| Total saved by the Iron Trade and Mineral Owners . . . . . . . . | 3,749,000 |
| Total estimated aggregate saving from 1788 to 1811 . . . . . . . | £33,970,660 |

Suppose it were possible to reduce the amount actually saved to £20,000,000 sterling, that alone was sufficient to redeem the whole amount paid to free her Majesty's subjects from slavery in the West Indies, and would have deserved at least a parliamentary reward.

The real case, however, in 1812 was so damaged by previous averments, denials, and imaginary defects that the House of Commons made no order even to pay the £250 to cover the expenses of the petition, although the committee had recommended the national bounty to be so far extended. The Lords of the Treasury, nevertheless, in 1816, were so satisfied that great injustice had been done to the case for want of the letters in evidence from the late Mr. Raby, Mr. Cockshutt, and Thomas Llewellyn, received after the report was made, that although they did not feel justified in acting contrary to the vote of the House of Commons as to the expenses, or even the clerks' fees, the whole not exceeding £250, they were pleased to re-open the question of compensation, by granting to two of my sisters pensions of £19 per annum each, which they continue to receive.

Having thus shown some grounds for estimating the whole pecuniary value of the national benefits, in 1812, to exceed considerably *thirty millions sterling*, the real case in 1812 may be closed by stating that—the country saved, out of materials previously useless, and by British labour, on the first 1,000 tons of puddled and rolled bar iron used for naval purposes, long before 1794, not less than £30,000, being sufficient to repay the whole grant to Harrison, in 1764, for his chronometer, as a means of ascertaining the longitude at sea, and also the grant to Dr. Jenner, for his discovery of vaccination, besides leaving £10,000, which might have been, with no less justice, awarded to the discoverer of puddling and rolling of bar iron, being not only quite as valuable for navigation, but for saving the lives of her Majesty's subjects in another way, besides adding prodigiously to the wealth, the independence, and commerce, of the nation.

We have now only to show what are the merits of the *new* case, constituting not merely the national benefits for 23 years, but for the whole 66 years, from 1788 to 1854, which will be best understood first, by contrasting the state of the trade for three years ending in 1782 and 1854, and then estimating the pecuniary value of all the national benefits for the whole period.

The total make of pig iron made with pit coal for three years, ending 1782, is not reported to be a single ton, whereas in three years ending 1854 it was more than eight millions of tons.

The total make of bar iron made with pit coal for three years ending 1782, is not reported to be a single ton, whereas in three years ending 1788, the total make was probably not less than 90,000 tons, while in 1854 it may be estimated at five millions of tons, or 4,910,000 tons more than three years ending 1788.

The total quantity of British hammered bar iron exported in three years ending in 1782, did not exceed 1000 tons, whereas the total quantity of puddled, rolled, and wrought iron exported in three years ending 1854, by the last return to parliament was not less than 2,570,216 tons, and if one-third be added for waste in conversion, the real quantity of puddled, rolled, and wrought iron exported was equal to 3,426,954 tons, being 3425 times more than it was in three years ending in 1782, besides 867,150 tons of pig iron, other sorts, 215,713 tons, total exported, 4,509,817 tons. The total make of pig iron from 1788 to 1854, 66 years, may be estimated at not less than 40 millions of tons,* and the total make of puddled, rolled, and wrought iron, 25 millions of tons, including probably 15 millions of tons of bar, bolt, or rod iron.

In 1788 there was not a single ton of bar iron made in the county of Monmouthshire, whereas, from 1802 to 1840, thirty-two companies in thirty-nine years sent down the Monmouthshire Canal 2,909,558 tons, and in addition to this quantity, only ten companies, in twenty-four years, sent down the Glamorganshire Canal, from 1817 to 1840, 2,007,527 tons, making together 4,917,085 tons of puddled and rolled iron, including more than 2,000,000 tons of bar iron. (See Scrivenor's work, p. 224, 257.)

Statement, *showing the total quantity of pig iron made in four principal districts, from* 1788 *to* 1852.

| — | 1788 | 1839 | 1847 | 1852 |
|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. |
| South Wales | 8,200 | 453,880 | 706,680 | 635,000 |
| Staffordshire and Shropshire | 30,000 | 445,353 | 474,240 | 935,000 |
| Scotland | 7,000 | 196,960 | 539,968 | 775,000 |
| Total | 45,200 | 1,096,193 | 1,720,888 | 2,345,000 |

Thus it will be seen that, the total make of pig iron in 1852, was more than fifty times greater than in 1788, owing to the increased demand for it by puddling and rolling, while the average produce of the furnaces increased from 875 tons annually in 1788, to 3,209 tons in 1847, being the average of 623 furnaces, and 4,123 tons in 1852, being the average of 655 furnaces, being the total number of furnaces in and out of blast. (See Scrivenor, pp., 88, 295, and 302.)

The following Estimate will best show the pecuniary

* The total quantity, estimated partly by returns and partly by estimating the quantity for the intervening periods for want of returns is 50 millions, and allowing *one-fifth* for any possible over calculation, the general estimate is founded on 40 millions only.

value of the national benefit by puddling and rolling for the last sixty-six years.

Estimate *showing the total pecuniary Value of all the National Benefits from* 1788 *to* 1854, *being sixty-six years, from forty millions of tons of Pig Iron, producing twenty-five millions of tons of Puddled and rolled Iron of all sorts, out of materials previously useless, and by British Labour.*

| | |
|---|---|
| **Iron Trade.** | |
| By total amount saved on 15,000,000 tons of puddled and rolled iron, including bar, rod, bolt, and plate iron, from 1788 to 1854 (66 years), at a low average profit of 30s. per ton . . . . . | £22,500,000 |
| By total amount of gratuity not paid on 500,000 tons of puddled and rolled iron, including bar, bolt, rod, and plate iron, from 1788 to 1798, when the patents were locked up for the debt of a public defaulter, at 7s. 6d. per ton . . . | 187,500 |
| Total amount saved . . . . . . | £22,687,500 |
| Deduct total amount subscribed in 1811, at most . . . . . . . . | 1,000 |
| | £22,686,506 |
| **Steel Trade.** | |
| By total amount saved on 45,000 tons of puddled and rolled iron used for the cheap cutlery instead of Swedish iron, and progressing at the rate of 15,000 tons annually, say . . . . | 500,000 |
| **Mineral Owners.** | |
| By total amount saved by royalty or rent for pit coal, ironstone, and limestone, to make 33,333,333 tons of puddled and rolled iron, including one-third for waste 320,000,000 tons, averaging 9d. per ton | 12,000,000 |
| Total saved . . . . . . . | £35,186,506 |
| **Import.** | |
| By total amount saved by *decreased* import from 1788 to 1854, for 66 years, being so much money *less* paid to foreign countries for 1,600,000 tons of bar iron, at the low average rate of £15 per ton . . | £24,000,000 |
| **Export.** | |
| By total amount saved by *increased* export of puddled and rolled iron, from 1788 to 1854, for 66 years, including bar, bolt, rod, plate, and other wrought iron, being so much money *more* received from foreign countries for 8,000,000 tons of British iron, at the low average rate of £8 per ton . . . . . . . . | 64,000,000 |
| Total saved by difference of import and export of foreign and British iron . . | |
| This is exclusive of the increased profit from pig iron by increased quantity made, owing entirely to the increased quantity of malleable and bar iron made by the puddling and rolling processes, which would amply compensate for any error by over-calculation or otherwise. | |
| **Home Trade.** | |
| By total amount saved by 17,000,000 tons of British puddled and rolled iron, including bar, bolt, rod, plate, and all other sorts of wrought iron from 1788 to 1854 (66 years), for naval and military service, railways, steam navigation, ship-building, house-building, domestic use, agriculture, mining, &c., at the average rate of £8 per ton | 136,000,000 |
| Total estimated aggregate saving to the country in 66 years . . . . . | £259,186,506 |

The whole of these calculations are based partly on official returns, and partly on the best estimate that could be made in the absence of other data. Those who are practically engaged in the *Iron Trade*, will be best able to detect any error from over or under calculation. But enough will result, whatever the correction may be, to show that while as Shakespeare says—

"The evil that some men do lives after them."

the good alone in my father's case survives, and is progressing year after year more and more prodigiously.

Lord Brougham (31st July 1855) drew the attention of the House of Lords to a report which he believed was not unfounded, of the withdrawal of the grant of £1000 per annum, which had been for the last four or five years voted by parliament to the Royal Society for the Promotion of Science. The most eminent men concurred in saying, that the utmost possible good had been achieved by the outlay of this very moderate sum in the advancement of science. Parliament had voted wisely nearly £80,000 for the promotion of the arts and the diffusion of science. A learned friend of his lordship, writing from Paris, observed, "that the French and other Continental nations had made the most extraordinary progress in steam engines and machinery, and was mortified to see what a poor figure we cut at the Great Exhibition in the department of philosophical instruments, *all the prizes having been won by foreign, not English inventors!*" This was attributed to the neglect and discouragement experienced by those who contribute in any shape to the public good in this country by their inventions or scientific pursuits.

Among the authorities who have borne honourable testimony to the merits of my father's inventions for puddling and rolling, besides those elsewhere named in 1789, are Sir John Dalrymple, Dr. Watson, the Bishop of Landaff, the Rev. Archdeacon Cox, in his History of Monmouthshire, Dr. Ure, in his Dictionary of Arts and Sciences, and the editors of the Encyclopædia Britannica in 1824, who after giving a full description of both inventions illustrated by drawings of the works and machinery, remark, "It is painful to know that incalculable as have been, and are likely to be, the national advantages derived from the puddling and rolling processes, which have given England the command of all the markets of the world, Mr. Cort, the inventor, after expending an ample fortune in bringing the system to perfection, died, and a respectable family survives without having received any public acknowledgment or adequate compensation for his losses."

Still more recently Mr. Charles Sanderson, manufacturer at Sheffield, in his admirable Essay on steel, read to the Society on the 9th May, 1855, and for which he received the prize medal, observes—"It is well known that the process of puddling and rolling was the invention of Mr. Cort, of Gosport; it was introduced in 1784, before which period the charcoal finery alone was used. This invention opened a new and extensive field for the industry of the nation; coal became the medium of the manufacture of wrought iron instead of charcoal, and the process has expanded the production of this kingdom from 17,000 tons in 1782, to 3,000,000 tons in 1854. The facility with which malleable iron can be produced with coal has caused the erection of magnificent and colossal iron-works, finding profitable employment for a great number of men, and producing throughout the ramifications of its manufacture, and its subsequent uses, an amount of wealth almost incalculable. This is somewhat foreign to the subject, excepting that, by the use of this invention, the steel iron market is annually supplied with 15,000 tons; and to me it is a pleasure, as it is a pride, to bring forward to public notice the inventions of a man which have produced such astonishing results in our works, our railways, and steam navigation."

Mr. David Mushet, jun., in his remarks on Mr. Sanderson's Essay, observes, "Mr. Sanderson says well, it is a pleasure as it is a pride to refer publicly to the merits

of such inventors as Mr. Cort, yet it is said, that proud as we justly are of their achievements, a feeling of shame clouds the recollection of those merits. Cort expended a large fortune in perfecting the puddling and rolling process; he left it a legacy to wealthy recipients, who give his memory praises which cost nothing to bestow, while his descendants have received no further acknowledgment or reward."

The late Mr. David Mushet, of Coleford, in the county of Gloucester, iron manufacturer, who died in 1847, was the well-known author of many valuable publications on iron and steel, and celebrated for his knowledge and skill in the valuation of the mineral districts. In 1801 he discovered, in crossing the river Calder, in the parish of Monkland, a new vein of ironstone, called the Black Band, and ever since known in Scotland as "Mushet's Black Band." This discovery alone, in all the iron districts in Great Britain, has added greatly to the profit of the ironmasters. Mr. Mushet also discovered the means of making bar and other iron out of the refuse or slag from smelting copper ore. Patents were granted to himself and Mr. William Crawshay, in 1818, for this invention. Mr. David Mushet, jun., inherits not only a considerable portion of his father's property, but his mind and talent in the art of making iron, and the science of metallurgy and mineralogy, as many valuable publications from his pen attest.

The make of pig iron in Scotland in 1788 was only 7,000 tons, whereas, in three years ending 1853 it was considerably more that *two millions of tons*, the whole of which may be attributed to three discoveries, "Mushet's Black Band" ironstone, "Neilson's hot blast," and lastly, though not least, *puddling and rolling*, without which the total make of pig iron, and consumption of pit coal and ironstone, would have been comparatively trifling.

Mr. Scrivenor, also, in his able "History of the Iron Trade," after giving the best part of a chapter on Mr. Cort's inventions, and the petition to the House of Commons, observes, page 19, "Neither Mr. Cort nor his family derived any advantage from these most important and valuable discoveries, which have given to this country the markets of the world. To give some idea of the importance of Mr. Cort's invention of the rollers, it may be as well here to mention that, previous to their introduction, the smallest size drawn under the hammer was three-quarters square—all below that size were cut in the splitting mill, and it required the hammer to be kept constantly at work to draw 20 cwt. of average sizes in twelve hours, while, with the rollers, they can manufacture in the same time, with one pair of rollers, about fifteen tons, which, in a work in full operation, are kept constantly employed day and night, during six days of the week; of the small sizes they roll about five tons in the twelve hours."

The whole case for 1855 cannot, perhaps, conclude better than by publishing the following extract, by permission, from the letter of Mr. Charles Sanderson, dated 24th April, 1855.

"The seizure of your father's works, trade, and all his property, with the locking up of his patent rights for ten years for the debt of a public defaulter, without benefitting either the State or himself, was a cruel sacrifice, considering also the immense amount of wealth these great inventions, puddling and rolling, have brought to the country. I think the present parties in office should in some measure seek to repair the past, by making a suitable allowance for you at your time of life. I hope for the encouragement of men of science that the government will listen to your claims, as no distance of time should be allowed to blot out national services, which *time* alone could best fully establish, not so much for the acquisition of the money, but as a just compensation for the ill-requited merits of your father, I have carefully looked over the printed statement of facts and proofs, and find your calculations on the whole correct as regards difference of import and export of foreign and British iron. You have a right to call for national acknowledgement, and I should be glad to learn how I could assist you to obtain it."

## Home Correspondence.

### SOCIETY'S VISIT TO PARIS.

Allenheads Haydon Bridge,
July 28, 1855.

Sir,—The period of *eleven* days appears *much too short* to answer the purposes of those who really intend to study carefully the contents of the Paris Exhibition, or any important section of them.

Special Tickets might be arranged so as to include at least the whole of September, an extension of time which would be fully justified under the circumstances.

Considerable part of from four to six days would be occupied in travelling to London, thence to and from Paris, and returning to any part of the provinces in the midland, northern, or western parts of the United Kingdom; and it requires nearly three days even to walk through the miles of galleries in the Palace and its various adjuncts. Many would probably go who have not been, or may never again be in Paris, and little time would, therefore, be afforded to see any of its wonders, and when it is considered that the expense of travelling is to many the most serious part of the undertaking, it seems in every respect desirable to allow ample time not only to remain in Paris, but to examine some of the interesting towns (especially Rouen) on the way to or from. I have spent several days in the Exhibition, and purpose going again, from the very circumstance of not having been able to see more than a very small portion of its contents.

I observe a letter in this week's *Journal*, p. 623. The outline there given of what is to be *seen* strongly confirms my argument; and though the various places may be hastily glanced at in a few days, examination and instruction are out of the question. I strongly recommend M. Baillot as an intelligent and useful agent.

It would be most useful to workmen if a printed sheet or small book of information were prepared suitable for the occasion, showing French and English *money* and *weights*. One good effect of such a publication would be to familiarise the public mind to decimal weights and money, and this is the more important as it is very doubtful that in either one or the other any improvement can be made on the French system. This, if adopted by England, would probably be followed in many European states.

It may interest many, and especially active young persons, to whom time is not so much an object as cost, to know that *for less than five pounds*, they may obtain when in Paris a ticket which entirely clears all cost of railways and steamboats from Paris to Amiens, Lille, Brussels, Aix-la-Chapelle, Leige, Cologne, Bonn, Coblenz, Mayence, Weisbaden, Frankfort, Heidelberg, Baden-Baden, Strasburg, Nancy, and so back to Paris,—a route which may be comfortably made in a fortnight, but for which the railway authorities wisely allow a month. Having taken this little round when last in Paris, I can strongly recommend the excellence of the arrangement.

I am, Sir, yours truly,
THOS. SOPWITH.

### PARIS EXHIBITION—LIVING IN PARIS.

Sir,—As the Council of the Society of Arts are about making arrangements for a visit to Paris, I take the liberty of offering a few remarks, which I hope will not be deemed impertinent.

A most intimate knowledge of Paris and of its environs, acquired during a residence of more than twenty years in that city, and by frequent visits since I have resided in

England, enable me to make a few suggestions, which, perhaps, may not be unworthy of notice. The suggestions of your correspondent, Mr. Reid, of Greenwich, are truly valuable, yet in my opinion they leave room for ameliorations, which may render them more useful, not only to artizans, but also to persons in easier circumstances, who may be attracted to Paris by the splendid exhibition, which is so worthy of admiration.

With respect to the remuneration of guides, Mr. Reid mentions *ten francs* a day, with restaurant expenses, &c., Now I beg to state that honest and intelligent men may be engaged on much less onerous conditions. They may be found on application at most of the hotels, or at Messrs. Galignani's No. 18, Rue Vivienne, near the Bourse, and sometimes at the money changers. While speaking of money, I would advise persons going to Paris not to change their English money (except a sovereign or so) until they arrive there; it will be more advantageous. The rate of exchange is, at present, 25 francs for the pound sterling. Changers may be found in abundance on the Boulevard des Italiens, in the Rue de la Paix, and in the Palais Royal. There is a very fair-dealing one at the corner of the Rue de la Paix and the Boulevard des Italiens.

Your correspondent, Mr. Reid, recommends private lodgings in preference to hotels, and he is right in so doing, because at the hotels they expect you to take your meals, which economists will find rather an expensive mode of living. Private rooms are to be found in what are called *Maisons Meublées*, at about two francs a day, in respectable houses, on the third and fourth floors; they charge, however, 10 sous, or half a franc per diem, for service (servants), to whom you are not expected to give anything when you leave.

Foreigners ought to remark a distinction between *Maisons Meublées* and *Maisons Garnies*; the latter are certainly the more economical, but not the more respectable of the two classes; they abound in the Pays Latin, or Quartier Latin, or Student's Quarter; but although you may there be treading the most classic ground of Paris, it would be too great a stretch of toleration to recommend it as the most holy, any more than the purlieus of the Palais Royal.

Mr. Reid mentions also the Barrières of Clichy and of Montmartre; he might have added that they are rather out of the way places, and to be reached only by going up a hill about twice as long and twice as steep as Holborn-hill,—not very inviting, after running about all day lionising. It is true there are omnibuses to drag you up, but what says dame economy?

With regard to living, Mr. Reid's suggestions are worthy of attention, but I may be allowed to add that good dinners, consisting of a basin of soup, two plates of meat, or one of meat and one of vegetables, half a bottle of wine, bread and a dessert, may be had for 1 franc 8 sous, and 2 sous waiter, making a franc and a half, or fifteen pence, at several restaurateurs in the Palais Royal, and particularly at the Restaurant du Havre, No. 123, in the arcade or gallery, in the Garden of the Palais Royal, *eastern* side.

I must also remark that, generally speaking, dinners are served in much better style at the French restaurateurs than at those professing to be English, which latter partake more of the cook-shop. This I have frequently perceived, and very recently, at one of the houses mentioned by Mr. Reid near the Bourse. Economy persuaded me to try a dinner there one day, but prudence and a love of cleanliness forbade me to repeat my visit. Wine-and-water is, I think, a more wholesome beverage than beer, at Paris—the French beer being rather windy.

Now with regard to the routes; that by Newhaven and Dieppe certainly offers great inducements in an economical point of view, but the sea part of the journey being so long, is a great drawback for those who prefer two hours, or an hour-and-a-half, sea-sickness, to six or eight hours of that delectable feeling, in which the only consolation is—that my lord Duke or my lady Duchess are reduced to a level with plain Mr. and Mrs. Smith.

The journey by Folkestone and Boulogne is more direct than that by Dover and Calais; it can be done in thirteen hours, and if the South Eastern Company will reduce their fares, I think many persons will prefer that route, as the sea voyage is done in two hours, and sometimes in less.

On arriving at the station at Paris, omnibuses will be found ready to take you to any quarter of the town; besides which, lodgings are to be had at several houses opposite the station, which is not more than ten minutes' walk from the Boulevards. Travellers will remark, on the railways in France, posts indicating the distances, which are calculated in *kilometres*, each being about 5-8ths of an English mile, so that by multiplying the number of *kilometres* by 5 and dividing the product by 8, you will find the number of miles. For example—from Boulogne to Paris is 272 kilometres, which, multiplied by 5, gives 1,360; divide that by 8, and you will have 170 for miles.

With respect to the Exhibition, the arrangements are admirable. I have visited it several times within the last fortnight, both on the cheap and on the dear days, and have remarked with pleasure that the only difference observable between the four-sous and the five-franc days was, in the costliness (not cleanliness) of toilette. Decorum prevailed as much on one day as on the others.

A few words on Parisian omnibuses may not be unacceptable. There is a convenience attending them which does not exist in London; it is, that in whatever quarter you may be, you may find an omnibus that will take you to whatever quarter you may wish to go. You have only to tell the conductor where you desire to go, and if his omnibus is not going there, he will, without any additional charge, put you into another which crosses his line. This is called correspondence.

Now, at the risk of being "written down" in the Puffiad, I will venture to recommend a little book which will be found very useful to those who go to Paris *via* Calais or Boulogne. It is called, *Manuel Classique de Conversations Françaises et Anglaises*, containing itineraries, in form of dialogues, describing the various places which are seen from the line. It is to be procured either at Nutt's, near St. Clement's-church; or at Dulau's, in Soho-square.

Apologising for this long epistle, I am, sir, yours truly,

PERCY SADLER,

One of the Committee of the Hackney Institution.

High-street, Homerton, July 31, 1855.

## MEETING FOR THE ENSUIFG WEEK.

Fri. Royal Botanic, 1 p.m., Anniversary.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 20th July, 1855.*

Par. No.
140. Civil Service—Supplementary Estimate, Class 4.
412. Poor Law, &c. (Ireland)—Copy of Correspondence.
414. Ordnance—Supplementary Estimate, &c.
417. Ballast Heavers—Copies of Letters.
Charity Commission—Supplemental Report.
Railways—Report of the Railway Department, Board of Trade.
Public General Acts—Cap. 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, and 58.

*Delivered on 27th July, 1855.*

403. Powers vested in the Companies for the Improvement of Land—Map.
63. Trade and Navigation Accounts (30th June, 1855).
140. Civil Services, Estimates—Class 7.
269. Bills—Customs Laws, Consolidation (amended).
270. Bills—Customs Tariff Acts Amendment and Consolidation (amended).
271. Bills—Crime and Outrage (Ireland) Act Continuance.
272. Bills—Religious Worship (as amended by the Lords).
273. Bills—Dwelling Houses (Scotland) (as amended by the Lords).

*Delivered on 28th and 30th July, 1855.*

140. Civil Services Estimates—General Abstract.

370. Yeomanry Corps—Return (a Corrected Copy).
384. Mr. Brownrigg—Copy of Correspondence, &c.
401. London Writs—Second Report from the Committee.
418. Caledonian Canal—Fiftieth Report of Commissioners.
419. Capital Punishment (Scotland)—Return.
422. Commissariat—Supplementary Estimate.
427. Sale of Beer, &c. Act—Second Report from the Committee.
274. Bills—Dwellings for Labouring Classes.
252. Bills—Vaccination.
275. Bills—Burials.
276. Bills—Turnpike Acts Continuance (No. 2).
277. Bills—Militia Ballots Suspension.
278. Bills—Sale of Beer, &c.
Shipping Dues (Scotland, the Channel Islands, &c.)—Report of the Commissioners.

*Delivered on 31st July*, 1855.

426. Army Commissions—Return.
433. National Gallery—Copy of a Treasury Minute.
251. Bill—Court of Chancery (Ireland).

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, July 27th*, 1855.]

*Dated 31st March*, 1855.

723. W. H. Balmain, St. Helen's—Recovering oxide of manganese from chlorine.

*Dated 4th May*, 1855.

997. J P. de Frontin, Agen, France—New material for paper.

*Dated 9th July*, 1855.

1530. R. Roberts and G. Coppock, Heaton Norris—Looms.
1531. H. E. Flynn, Ranelagh, Dublin—Preventing fire from overheating of flues.
1532. J. Prophet, Broughty Ferry—Confectionery.
1533. J. Tetlow, Oldham—Spinning machinery.
1535. A. V. Newton, 66, Chancery-lane—Fire and burglar proof glass. (A communication.)
1536. J. and A. B. Seithen, Regent's-square—Cork cutting machinery.

*Dated 10th July*, 1855.

1539. J. Palmer, Oldham—Carding machinery.
1541. R. A. Brooman, 166, Fleet-street—Securing wheels upon axles. (A communication.)
1543. C. J. C. Elkington, Hall-street, City-road—Depositing alloys of metals.

*Dated 11th July*, 1855.

1544. H. Pratt, Worcester—Mills. (Partly a communication.)
1545. J. H. Johnson, 47, Lincoln's-inn-fields—Facilitating performance of music on organs, pianos, &c. (A communication.)
1546. J. H. Johnson, 47, Lincoln's-inn-fields—Permanent way of railways. (A communication.)
1547. J. H. Nalder, Alvescott, Oxford—Dressing grain.
1548. J. Wilson, Manningham, near Bradford—Rolling or piece boards.
1549. E. Hart, Nottingham—Lace.
1550. J. Coulson, Penzance—Ventilating mines.
1551. J. Jeffreys, Kingston-hill—Sun blinds.
1553. J. Jeffreys, Kingston-hill—Steam boilers.
1554. J. Adams, Aldwincle, Northampton—Time indicator.
1555. C. F. Bielefeld, Wellington-street, Strand—Saddle-trees.
1556. W. Williams, Bedford—Bricks, pipes, and tiles.

*Dated 12th July*, 1855.

1558. J. Robinson and W. Wedding, Manchester—Machinery for cutting paper, &c.
1560. F. H. Edwards, Newcastle-upon-Tyne—Motive power.
1562. J. Caldow and J. B. A. M'Kennel, Dumfries—Cutting vegetable substances.

*Dated 13th July*, 1855.

1566. J. H. Tuck, Pall-mall—Condensing or exhausting atmospheric air. (A communication.)
1568. T. Redmayne, Rotherham—Stove grates.
1570. S. C. Lister, Bradford—Weaving.
1572. R. Cochran, Glasgow—Preparation of clay for potter's use.
1574. E. Gillett, Bruxelles—Fixing artificial teeth.
1576. R. A. Brooman, 166, Fleet-street—Pumps. (A communication.)
1578. L. Koch, New York—Making pulp from wood, &c.
1580. H. Grafton, Rolles-buildings, Fetter-lane—Fire lighters.
1582. C. L. Neale, 1, Chapel-place, Cavendish-square—Neuralgic specific.

INVENTION WITH COMPLETE SPECIFICATIONS FILED.

1658. J. Tildesley, Willenhall—Curry-combs.—21st July, 1855.

### WEEKLY LIST OF PATENTS SEALED.

*Sealed July 27th*, 1855.

254. Patrick Moir Crane, Athy, Kildare—Improvements in the manufacture of products from peat.
269. Ebenezer Hartnall, 1, St. Mary-axe—Improvements in preserving animal and vegetable substances for food.
293. George Briggs, Wigmore-street—Improved spring for carriages.
317. William Balk, Ipswich—Improvements in machinery for crushing grain and other substances.
321. George Rennie, Holland-street — Improvements in marine steam-engines.
355. Samuel Barlow Wright, Parkfields, Stone, Staffordshire—Improvements in the manufacture of encaustic tiles.
415. Hamilton Martin and Joseph Smethurst, Guide Bridge Iron Works, near Manchester—Improvements in the construction of fences or casings for shafts, pulleys, and other parts of machinery.
445. Henry Constantine Jennings, 8, Great Tower-street—Improvement in the manufacture of soap.
779. William Tuer, William Hodgson, Robert Hall, and Samuel Hall, Bury—Improvements in looms for weaving.
1045. George Taylor, Liverpool—Improvements in steam-engine governors.
1079. François Alphonse Theroulde, 15, Place Vendome, Paris—Improvements in preserving animal substances.
1123. Edmund Morewood and George Rogers, Enfield—Improvement in coating wrought iron.
1129. Henry Hough Watson, Little Bolton, and James Oliver, Over Hulton—Improvements in the manufacture of fuel.
1159. James Eden, Lytham—Improved mode of drying fabrics.
1163. Alfred Vincent Newton, 66, Chancery-lane—Improvements in beehives.
1207. Thomas Waterhouse, Claremont-place, Sheffield—Improvements in the means of actuating forge and other hammers, which improvements are also applicable to pile-driving and other like purposes.
1223. Daniel Dunn, 9, King's-road, Pentonville—Improvements in steam-boilers.

*Sealed July 31st*, 1855.

245. Alexander Prince, 4, Trafalgar-square, Charing-cross—Improvements in fire arms.
256. Robert James Mary'on, 37, York-road, Lambeth—Improvement or improvements in the construction of and manufacture of bullets, or shot, or projectiles.
258. Edmund Clegg and James Leach, Shore Mill, near Littleborough—Improvements in temples for looms.
270. John Imray, 64, Bridge-road, Lambeth—Improvements in measuring instruments.
272. Pierre Joseph Carré, Asnières, Seine—Improvements in ornamenting fabrics with metal leaf.
278. Frederick Gray, Birmingham—Improvements in candlesticks.
298. Adolphe Girard, Pertuis, Vaucluse, France—Improvements in extinguishing fires.
390. Charles Low, Bodowen, Dolgelly, N. Wales—Improvements in the extraction of gold from its ores.
446. Thomas Cook, Lieut. R.N., Addiscombe—Improvements in working punkas and apparatus for agitating air in churches, hospitals, and other buildings.
474. William Johnson, 47, Lincoln's-inn-fields—Improvements in cleansing and preparing fibrous materials. (A communication.)
492. James Wood, 30, Barbican—Improvements in ornamenting woven fabrics for bookbinders and others.
610. Vincent Scully and Bennett Johns Heywood, Dublin—Improved mode of regulating the supply of gas to gas burners.
618. William Smith, Little Woolstone, Fenny Stratford—Improvements in ploughing or trenching and subsoiling land.
642. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in hydraulic motive power engines. (A communication.)
1044. Duncan Morrison, Bordesley Works, Birmingham—Improvements in the manufacture of metallic bedsteads, sofas, and other articles to sit or recline on.
1094. John Lackmann, Hamburgh—Improvement in the manufacture of sheet iron.
1153. George Collier, Halifax—Improvements in looms for weaving carpets and other fabrics.
1304. John Andrus Reynolds, M.D., Elmira, New York—Improved machinery for discharging vollies of shot.
1310. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in the manufacture of iron shovels.
1316. Etienne Jules Lafond, and Count Louis Alfred de Chatauvillard, Belleville, near Paris—Improvements in apparatus for lighting.
1326. Henry Bernoulli Barlow, Manchester—Improvements in certain parts of machines used in slubbing and roving cotton and other fibrous materials.

### WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3740 | July 27. | Improved Camp Cloak or Coat, which also forms a Tent suitable for Military or other purposes ........................ | John Singleton Copley Hill, and Clement Coe.......... | Manchester. Leeds. |

Journal of the Society of Arts.

*FRIDAY, AUGUST* 10, 1855.

## SOCIETY'S VISIT TO PARIS.

The Secretary to the Society is now in Paris, engaged in making arrangements for the visit of the Members and their friends. The Imperial Commission cordially reciprocate the kindly feeling which has induced the Society of Arts to visit the Exposition under their charge, and will do all in their power to render the visit agreeable and profitable.

Since the circular dated the 1st instant was issued to the Members, the London and South-Western Railway Company have intimated that in the course of a few days Return Tickets will be issued from London to Paris, *via* Southampton and Havre,—available for 15 days,—for 48s. first class, or 32s. second class. It should be remarked that the Paris Service on this line is limited to four days in the week, viz. :—Mondays, Wednesdays, Fridays, and Saturdays.

## FAILURE OF THE INDIAN SILK-WORM IN MALTA.

The following copy of a despatch, from his Excellency the Governor of Malta, has been received from the Minister of War ;—

Palace, Valetta, 7th July, 1855.

My Lord, —I very much regret to have to report to your Lordship, for the information of the Society of Arts, the complete failure of the Indian silk-worm, the *Bombyx Cynthia*, this year in Malta.

2. Throughout the year 1854 their numbers increased so rapidly that no doubt was entertained of the success of acclimatising this silk-worm in the South of Europe. In December, 1854, I had them living both in the house and in the open air, in wind and rain. But about that time many began to die. In January, 1855, they generally died soon after they were hatched, notwithstanding that the utmost care was taken of them.

3. On examining the eggs with a powerful lens, I could see myriads of worms formed in them with the shell just broken, but the animal apparently had not the power in most cases to extricate itself. When it could do so, I conclude it must have been too weak to live.

4. A room in the house was kept dry at night, at a temperature of about 65° of Farenheit, a temperature which during the same month of 1854 appeared to suit them perfectly well. Every reasonable experiment suggested was tried, yet only seven worms were saved. These produced eggs, but they never hatched.

5. From this I infer that the climate of Malta will not suit them. In Italy they promised to thrive, and succeeded the first year ; but I understand that this year they have failed also in Italy. I have not recently heard whether others sent to Algeria are or are not prospering.

6 It may be useful to state how the *Bombyx Cynthia* was successfully transported from Malta to the West Indies after many attempts to bring it from India to Europe had failed.

7. Having first obtained the authority of the Directors of the Peninsular and Oriental and of the West India Royal Mail Steam Packet Companies, about thirty fresh cocoons were placed in bird cages and suspended in the cabins of the surgeons of the steam ships. This was done that males and females might be kept together when the chrysalides became moths. In the moth state they required no food. On the voyage they laid their eggs, and these eggs began to hatch on their arrival at the Island of Grenada, in the West Indies,

8. They were multiplying fast when I last heard from Grenada, but that being now several months ago, I cannot say whether they continue to thrive there.

I have, &c.,

(Signed) WM. REID, Governor.

## LIST OF BOOKS AND PAMPHLETS ON THE DECIMAL-COINAGE QUESTION.

In the preparation of this list assistance has een received from the following gentl emen :—Messrs. Edgar A. Bowring, W. Brown, M.P., Prof. De Morgan, J. A. Franklin, Dr. J. E. Gray, W. Miller, F. J. Minasi, R. R. R. Moore, General Sir Charles Pasley, T. W. Rathbone, H. Reid, E. Ryley, J. Yates, F.R.S., &c., &c.

*** Proposals for a Decimal Coinage, arranged upon the present pound Sterling, or on some unit having a decimal relation to it, are marked by the letter (A) after the title ;

Plans founded upon the Penny, Halfpenny, or Farthing, are marked (B) ; and

Other plans (C).

From 1784 to 1852, Arranged Chronologically.

*Jefferson, Th. : Notes on the Establishment of a Money Unit of a Coinage for the United States, 1784, in *Randolph*, Mem. and Correspondence, 1829, p. 133. C.

Jefferson : Report on Money, Weights, and Measures ; Philadelphia, 1790. C.

Report on Weights and Measures ; folio, London, 1814.

* "Calculator" : Observations on the Report of Weights and Measures ; 8vo., London, 1814. B.

*Eliot's Letters on the Political and Financial situation of the Country ; 8vo., London, 1814. C.

*"Mercator" : Sketch for a New Division and Subdivision of Monies, Weights, and Coins ; 8vo., London, 1814. A.

*Goodwyn, H. : Account of a Plan for a New Silver Coinage, for introducing the Decimal principle ; 4to., London, 1816. B.

*Goodwyn, H. : A Plan for a New General System of Weights, as a Supplement to the Plan for the New Silver Coinage ; 4to., London, 1816. B.

*"Libra :" Two Letters to the Editor of the *Times*, on Mr. Croker's plan of Decimal Coinage ; London, 1816. B.

*Plan of Decimal Weights and Measures submitted to the Dutch States General by the King of Holland ; London, 1816. C.

*Proposals for a New Money System ; London, 1816. B.

*Remarks on the Proposal for a New Money System ; London, 1816. B.

*The British Metre and its Derivatives, being a sketch of a Proposed Reformation of the British Measures, Weights, and Coins ; 8vo., London, 1820. A.

Adams, J. Q. : Reports to Congress on Weights and Measures ; Washington, U.S., 1821.

*Babbage, Charles : Economy of Manufactures ; 8vo., London, 1832. A.

*Pasley, Lieut.-General Sir Charles, K.C.B. : Observations on the Expediency and Practicability of Simplifying and Improving the Measures, Weights, and Money used in this Country ; London, 1834. (An Abstract of the foregoing was lithographed and distributed in 1831.) A.

Cory, J. P.: Proposal for the introduction of the Decimal Division of Money: Paper read before the Numismatic Society, May 24, 1838; *Numismatic Chronicle*, vol. i., 1839. B.
*Watt, J.: A System of Tables on British Money, Weights, and Measures; 1837. B.
*De Morgan: Decimal Coinage; Companion to the Almanack for 1841. A.
*Maslen, Decimus: A new Decimal System of Money, Weights, Measures, and Time; 8vo., London, 1841. A.
*Report of the Commissioners for Restoration of the Standards of Weights and Measures; 1841; (Redelivered 1855.) A.
Taylor, Henry: Observations on the Current Coinage of Great Britain; 1846. From *Banker's Magazine*. A.
*Taylor, H.: Simple Arithmetic as Connected with the National Coinage, Weights, and Measures; London, 1847. A.
Remarks on Decimal System of Keeping Accounts; by the late Mayor of Bewdley; Bewdley, 1847.
*Debate in the House of Commons, April 27, 1847. Hansard's Debates.
*De Morgan: Decimal Coinage; Companion to the Almanack for 1848. A.
*Taylor, H.: The Decimal System applied to the Coinage, Weights, and Measures, of Great Britain; 4th edition, London, 1851. A.
Anon: Decimal Coinage; *Chambers' Journal*, March 13, 1852. A.
*Liverpool Chamber of Commerce: Address to the President of the Board of Trade; 1852. A.
*Liverpool Chamber of Commerce: Report of Special Committee; 1852. A.

1853, Arranged Alphabetically.

*Alexander, James: Suggestions for a Simple System of Decimal Notation, and Currency after the Portuguese Model. Paper read before the Royal Scottish Society of Arts, December 12th, 1853; 8vo., London, Houlston and Stoneman. B.
*Cooper, J. Collingwood: Decimals and Decimal Coinage; 12mo., London, Simpkin and Marshall, 1853. A.
*Franklin, J. A.: The Decimal System Facilitated and Adapted Intermediately to Routine Methods of Account, Money, and the precious Metals, with Tables, &c.; 4to., London, Letts & Co., 1853. A.
Galbraith, Rev. J. A.: On a Decimal Currency. Paper read before the Dublin Statistical Society, May, 1853; Dublin, Hodges and Smith. A.
*Gray, Dr. J. E.: Observations to Report on Decimal Coinage; London, 1853. From *Times*. B.
*H. B.: Table for a Decimal System of Accounts; folio, London, Smith and Elder, 1853. A.
Hogg, James: Decimal Coinage, Weights, and Measures; Hogg's Instructor; Edinburgh, November, 1853.
*Jack, Professor: On Uniform Weights, Measures, and Moneys. Paper read before the Society of Arts, Feb. 23, 1853. *Journal of the Society of Arts*, Vol. I., page 157. A.
*Laurie, J.: Customs Tariff and Currency Reforms, with Decimal Currency Tables; Manchester Commercial Association Memorial, 4to., 1853. A.
*Mears: Decimal Coinage Tables; London, Adams, 1853. A.
*Milward, A.: A Letter to the Chancellor of the Exchequer, advocating the issue of a Five-farthing Piece; London, Bell, 1853. A.
*Rathbone, Theo. W.: An Examination of the Report and Evidence of the Committee of the House of Commons on Decimal Coinage, with Reference to a Simpler, Sounder, and more Comprehensive Mode of Proceeding; London, Ridgway, 1853. (2nd and 3rd Edition, with a preface and postscript, 1854.) B.
*Report of the Select Committee of the House of Commons on Decimal Coinage; folio, London, 1853. A.
*Rozzell: Practical Suggestions for Facilitating the Adoption of a Decimal Currency; 8vo., 1853. A.
Ryley, E.: Decimal Coinage. A brief comparison of the existing system of Coins and Money of Account, of that proposed by Decimal Coinage Committee, and of another system: 8vo., London, Metcalf, 1853. A.
*The New Decimal Money; from the *Phonetic Journal*, 1853.

1854, Arranged Alphabetically.

*Aintliche: Reduction des Zuger Currentgeldes, in das Neue Schwitzergeld; 1854.
*Alexander, James: Decimal Ready Reckoner, 1854; a card with slides.
*Aslits' Decimal Coinage, with a proposal for Decimalising our Weights and Measures; 12mo., London, 1854. A.
*Bewley: Decimal Interest Tables; 1854.
*Bishop, S. H.: Decimal Coinage and Accounts; London, 1854. A.
*Bowring Sir J.: The Decimal System in Numbers, Coins, and Accounts, especially with reference to the Decimalization of the Currency and Accountancy of the United Kingdom; London, Ingram and Cooke, 1854. A.
*Brown, W., M.P.: Letter to Francis Shand, Esq.; 2nd edition, London, Ridgway, 1854. A.
*Calder, Rev. Fred.: The proposed Decimal Coinage; 12mo., London, Whittaker and Co., 1854. A.
*Davidson, Alex. Brand: The New Decimal Coinage; Aberdeen, 1854. A.
*De Morgan: Decimal Coinage; Companion to the Almanack for 1854. A.
*Decimal Association: Proceedings, with an introduction by Professor De Morgan; 8vo., London, Rickerby, 1854. A.
*Eclectic Review: Review of the Report of the Select Committee of the House of Commons; November, 1854. A.
E.R.A.: Suggestions for a complete Decimal System, reprinted from the *Patriot;* 1854.
Ferrari: Calcolo Decidozzinale; Turin, 1854.
*Franklin, J. A.: Letter to Mr. W. Brown, M.P., on the Impracticability of the Franc or the Tenpenny unit. Read before the Statistical Section of the British Association at Liverpool; September, 1854. A.
Gibbon: Report on Utility of Uniform System in Measures, Weights, Fineness, and Decimal Accounts; Charlestown, U.S., 1854.
*Godwin, Edward: A Manual of Decimal Monetary Calculations; No. 1, London, 1854. A.
*Gray, Dr. J. E.: Decimal Coinage; What it ought, and what it not to be. By one of the Million; London, Ridgway, 1854. B.
*Gray, Dr. J. E.: Comparative Statement of the Value of the Pound and Penny Systems of Decimal Coinage; 1854. 2nd and 3rd edition, 1854. B.
Hoare: Mensuration made easy, or the Decimal System and its application to the daily employments of the Artizan and Mechanic; 1854.
*Laurie, James: Manual of Foreign Exchanges; 12mo., London, Hall, Virtue, and Co., 1854. B.
*Laurie, James: A Practical Analysis of the Comparative Merits of the One Pound and Tenpence as the Ruling Integer of a Decimal Currency for the United Kingdom. With Tables of Merchandise; 8vo., London, Hall, Virtue, and Co., 1854. B.
*Mears: The Decimal Calculator; London, Adams, 1854. A.
*Miller, W.: Decimalization of Coins and Accounts. Paper read before the Society of Arts, May 5th, 1854. *Journal of the Society of Arts*, Vol. II., page 414. A.
*Miller W.: Letter to Mr. W. Brown, M.P. Read before the Statistical Section of the British Association at Liverpool, September 25th, 1854. A.
*Minasi F. J.: A Word in Behalf of the Poor Man's Penny; London, Alliston, 1854. B.

*Minasi, F. J.: On a Decimal Coinage for the United Kingdom; Paper read before the Statistical Society of London, June 19th, 1854; Journal of the Statistical Society for September, 1854. B.

*Monro, A.: Letter to the Chancellor of the Exchequer; Glasgow, 1854. (2nd Edition, 1855.) A.

Pitman, Isaac: A Brief Account of the New Decimal Money, with Report of Dr. Bowring's Address on a Decimal Currency, at Manchester; London, Pitman, 1854. A.

*"Retired Merchant:" A Short and Easy Method of changing the present currency into the Decimal System; London, Ridgway, 1854. A.

*Rathbone, Theo. W.: Comparative Statement of the Different Plans of Decimal Accounts and Coinage which have been proposed by the Witnesses examined before the Committee of the House of Commons, and others; paper prepared for the Statistical Section of the British Association, September 25, 1854; with a Compendium of the Scheme of Pounds, Florins, Cents, and Mils, and the Scheme of Pounds, Tenpennies, and Pence, Comparatively Stated, with Abstract of the Discussions; "Observations of a Merchant," on the statements of the Chairman of the Committee, Mr. W. Brown, M.P., and Professor De Morgan, in the "Proceedings of the Decimal Association;" Correspondence with the Chancellor of the Exchequer; London, Ridgway. A.

*Richardson, Samuel: Decimal System in Coins, Accounts, Weights, and Measures; Liverpool, 1854. A.

Strachan, James: A Short Exposition of the Proposed Decimal Coinage System; Aberdeen, Gray, 1854. A.

*Smith, J. B., M.P.: Should Decimal Coinage be adopted without a Decimal System of Weights and Measures? Manchester, 1854.

Smith, B.. Arithmetic for use of Schools; 8vo., London.

Tallant and Allen: Decimal Money Tables; 1854.

*Tate, T.: The new Coinage considered in relation to our School Arithmetics; reprinted from the Educational Exhibition, 8vo., London, Longman and Co., 1854. A.

Tegetmeier: Arithmetical Tables, including those of the Decimal Coinage; 1854.

*Thomson, W. T.: Decimal Numeration and Decimal Coinage. Paper read before the Institute of Actuaries, January 30, 1854; Edinburgh, Blackwood. A.

*Yates, J.: On the French System of Measures, Weights, and Coins, and its Adaptation to General Use. Paper read before the Institution of CivilEngineers, Feb. 28, 1854; London, Ridgway. C.

*Yates, J.: On a Method of Substituting Francs and Centimes for the Present English Metallic Currency. Paper read before the Statistical Section of the British Association at Liverpool, Sept. 25, 1854. *Assurance Magazine* for Jan., 1855. C.

1855, Arranged Alphabetically.

*Anon: First Steps towards a Universal System of Decimal Coinage; London, 1855. C.

*Anon: Remarks upon a Decimal System of Accounts and the Coinage; 8vo., Glasgow, 1855.

*Anon: Reasons against the Pound being adopted as the Integer of a System of Decimal Coinage; reprinted from the *Times* City Article, May 3, 1855. B.

*Annuaire pour l'An 1855; presenté du Roi par le Bureau de Longitudes; 12mo.; Paris.

*Arbuthnot: Observations on Mr. T. W. Rathbone's Pamphlet on Decimal Coinage; reprinted from the "Decimal System," 1855. A.

Banfield, T. C.: A Letter to Mr. W. Brown, M.P., on the Advantages of his Proposed System of Decimal Coinage; 8vo., London, Hardwicke, 1855. A.

*Bishop, S. H.: Decimal Coinage Tables; London, Tallant and Allen, 1855. A.

*Borradaile, H.: Plan for adapting the Currency of India to a Decimal System of Accounts; London, Smith and Elder, 1855. C.

*Brown, W., M.P.: Answers to Fallacies; Balance of Trade Exchanges, and Common Coins; London, Rickerby, 1855. A.

Brown, W. M.P.: International Moneys; London, Rickerby, 1855. A.

*Crauford, J.: Memorandum on the Currency of the Straits Settlement; 4to., London, 1855. C.

*Debate in House of Commons, June 12, 1855. Hansard.

*De Morgan: Reply to Statements in Favour of a Tenpenny Unit in the *Times* City Article of May 3rd; London, Rickerby, 1855. A.

*De Morgan: Reply to Mr. Lowe's Speech in the House of Commons, June 12th, 1855. (Reprint of the Decimal Coinage Debate, by the Decimal Coinage Association.) A.

*Decimal Association: Address, with Petitions and Brief Explanations of Decimal System; March, 1855. A.

*Decimal Association: Address to the Chancellor of the Exchequer; 1855. A.

Fitch, J. G.: A Chapter on Decimal Money in Cornwell and Fitch's "Science of Arithmetic." London; Simpkin and Marshall, 1855.

*Franklin, J. A.: On the Expediency of at once Decimalising English Moneys and Weights. Paper read before the Society of Arts, Feb. 14, 1855; *Journal of the Society of Arts*, Vol. III., page 211. A.

*Franklin, J. A.: Decimal Money and Accounts as a Banker's Question; reprinted from the *Bankers' Circular*, May 12, 1855. A.

*Goddard: Four Letters on a Decimal Currency based upon the Crown; *Birmingham Journal*, May and June, 1855. A.

*Good, S. A.: Principles of a Decimal Coinage; *Journal of the Society of Arts*, May, 1855. A.

Good, S. A.: Synopsis of the Chief Proposals for a Complete Decimal Currency; also a Proposal for a Decimal Notation without altering the Present Coinage; suggestad by the Parliamentary Discussion of June 12th, 1855. Printed for private circulation.

*Gray, Dr. J. E.: On the Small Unit and the Comparative merits of the Three principal Decimal Systems. London, 1855. From the *Spectator*. B.

*Hare, J. Middleton, jun.: Letter to the Chancellor of the Exchequer; London, Ward and Co.; 1855. A.

Hoare: Decimal System for the Million; 1855.

*Jellicoe: An Examination of the Objections urged against the plan of Decimal Coinage proposed by the Royal Commissioners and by the Select Committee of the House of Commons. Paper read before the Institute of Actuaries, 26th March, 1855; *Assurance Magazine* for July. A.

*Minasi, F. J.: On the Basis of a Decimal System of Money for the United Kingdom. Paper read before the Society of Arts, Feb. 14, 1855; *Journal of the Society of Arts*, Vol. III., page 219. B.

*Minasi, F. J.: Lecture on Decimal Coinage, delivered before the Metropolitan Society of Schoolmasters, at Westminster, April 21, 1855. Printed in the *Journal of the Society of Arts*, Nos. 139, 140, and 141. B.

*Oliphant, G. H. H.: Proposed System of International Decimal Coinage; London, 1855. C.

*Paulson, K. J. W.: Decimalism, Part 1; London, Longman and Co., 1855. A.

*Rathbone, Theo. W.: Objections to Mr. Brown's Schemes, and Proposed Substitution of a more Simple and Practicable Plan; folio, 1855. B.

*Rathbone, Theo. W.: Letter addressed to the Honourable the Commons of the United Kingdom; Allerton Priory, 1855. B.

*Rationale of our present subdivision of the Pound Sterling, with Strictures on a Decimal Coinage. 8vo., London, Houlston and Stoneman, 1855.

*Reid, Hugo: On Decimal Coinage. Paper read before the Society of Arts, February 14, 1855. *Journal of the Society of Arts*, Vol. III., page 222. A.

*Sigma: Observations relative to the possibility of having an International Uniformity of Money; reprinted from the *Liverpool Mercury*; June 8th, 1855. B.
Stainton, J. J.: A Familiar Conversation upon Decimal Coinage, written especially for the Lower Orders; London, Cox, 1855. A.
*Turner, James H.: The Penny considered as the Foundation of a Decimal Currency; Cambridge, Macmillan and Co., 1855. B.
*Vining, C.: A System of Decimal Coinage and Currency, without Fractions; 8vo., London, Hamilton, Adams, and Co., 1855. B.
*Walford, C.: Decimal Coinage Familiarly Explained, with Tables; London, Pitman, 1855. A.
Young, Prof.: On the Decimal Coinage founded on the Farthing; Belfast, 1855. B.

*** The works marked thus (*) are in the collection of Dr. Gray, of the British Museum, who has also a very large and complete series of the Reports of Parliamentary Debates, Articles, Letters, &c., extracted from the different metropolitan and local journals from 1814 to this period. He would be obliged to any gentleman who would inform him of any work not in the above list, and for copies of any paper on the subject, as he is preparing a history of the discussions.

## Home Correspondence.

### THE WORKING CLASSES AND MECHANICS' INSTITUTIONS.

Sir,—I believe that the *non*-success of *some* Mechanics' Institutions may be attributed to the causes stated under the above heading in your *Journal* of yesterday. My experience of mankind has proved that poverty generally bends and gives precedence to wealth, and that therefore, when wealthy men introduce themselves, or are introduced, into the management of societies established for the benefit of the working classes, there is a considerable yielding of authority to them, which in numerous instances they neither require nor expect, and which is quite unnecessary on the part of the working man to give; this in time becomes a serious evil, and both the wealthy man and the working man become antagonistic, and retire from the society with disgust, which has either the effect of breaking it up altogether, or of seriously impairing its efficiency.

I once knew an Institution where working men formed three-fourths of the Committee, and yet it was *notorious* that one gentleman could carry every proposition which he introduced. The effects just stated, I am told, have been the consequence,—the Institution is now either a "very sick man," or is entirely defunct. I hold the working men who formed so large a majority responsible for so pusilanimously betraying their own manhood and the interests of the Institution.

Why "a sensible honest working man" should feel afraid or "uncomfortable" in the company of a man of wealth, simply because he is wealthy, is, I believe, owing to a defect in his early training, and is a problem which will only be successfully solved in the "good time coming;" then only *ignorance* and *vice* will hang their heads in shame in the presence of *educated intellect* and *virtue*.

As these thoughts have been suggested by reading the letter of Mr. Skinner, I shall perhaps be pardoned if I make a remark or two on the following sentences from his letter, before I proceed with other causes of the want of success of Mechanics' Institutions.

Mr. S. states that, "It is vain to suggest to the man of wealth and education, that he should endeavour to feel himself comfortable in the company of rags, dirt, and ignorance. Let Mr. Rymer ask himself if he would like, dressed in his superfine, to elbow his way through among dusty coats."

I am of opinion that a great want of the harmony which ought to exist among the members of these Institutions, arises in many cases from the jealousy of the working man against the good intentions of his richer neighbour; the spirit of the quotation bears me out in this assertion; here the man of "fine cloth" is made to elbow his way through among dusty coats, to look upon ignorance and rags with contempt, and I think, *very properly*, upon "dirt" with disgust; because a man is a working man this is no reason why he should appear at these places slovenly or "dirty;" and if the presence of respectable persons attending these unions have no other effect than to make such persons improve those habits, a great moral good is achieved; but, sir, I am happy in being able to add my testimony to the cleanly and generally orderly habits of the working classes at all the Institutions which I have visited and been connected with. In these gatherings I may have met with rags; I have met with ignorance, but I have never seen what may be termed a "dirty" person attending them, but in numberless instances they have been *scrupulously* clean.

But, to proceed, another cause of the want of success in these Institutions is their unavoidable secular character; and because they do not possess any strictly religious element, they are looked upon, both by ministers and the religious world in some localities, with a stronger feeling than in others, as seminaries of infidelity, and consequently the influence of these parties is strenuously opposed to them. It may be, and doubtless is true, that a few of the members in certain cases may hold those erroneous views, but there are, I believe, *few* committees to be found in this country who would sanction the dissemination of such pernicious doctrines; and whether or not, this is not a sufficient cause for the absence of ministerial influence, but is, on the other hand, a loud call for more active cooperation.

I have known Institutes, however, which could have enjoyed the membership and council of ministers, but for the custom of holding dancing parties and balls, which of course neither ministers nor professing Christians can sanction; this, I think, a very serious ingredient when introduced into any institution set apart for educational purposes; discord in a greater or lesser degree is certain to arise where these exercises are permitted.

In some other Institutions it is the custom, and a very excellent one if properly conducted, of setting apart some portion of the week for the discussion of topics voted by a majority of the members; but, excepting they are skilfully managed, and a respectful bearing cultivated, they degenerate into serious elements of discord, but where they are presided over by an intelligent mind, who is capable of detecting fallacious reasoning, and of giving a proper and healthy direction to their thoughts and arguments, then I can conceive them to be of immense benefit, but in the absence of these, I have known them to be of the most damaging character to the Institution.

Another serious drawback to their proper success in some cases is, the want of classes, and in others, the want of properly qualified teachers to conduct them when established, but the most serious difficulty that many Institutions have to contend with is, their inability to provide separate accommodation and teachers for young men and lads; this is of so serious a nature, that it is with great difficulty that young men can be induced to attend, and when they do, they are so afraid of their ignorance being seen by the junior members, that it is extremely difficult to teach them, nay, in some cases, utterly impossible; this feeling I conceive to be quite natural, and I am sorry that in so large a proportion of Institutions the necessity exists for it.

In one of the largest Institutions in Liverpool, where highly-qualified teachers are engaged, and which affords advantages few besides can offer, the classes are mixed; the consequence is, none but mere boys and youths attend.

Mr. Skinner is quite right as to the necessity of working men feeling and really having an interest in the management of such Institutions; but it is useless to disguise the fact that Mechanics' Institutions cannot be so successfully conducted without the aid of the purse and the social status of the wealthy man; and, as a *rule*, I am of opinion that those Institutions are the most flourishing, and do the greatest amount of real good to the neighbourhood where such is the fact. The more frequently the rich and poor can meet together, and that in so social a manner as at these Institutions, the more readily will they understand one another, seeing new beauties in each other's character, and eradicating many prejudices and much evil feeling.

I consider, for an Institution to be successful, it must be *definite* in its object, honest in its professions, and prospective in all its movements. If it be a society for the education of the masses, let it be so by every available means—by lectures, concerts, classes, reading-rooms, news-rooms, and good libraries—all of these if possible, or as many of them as are really practicable. If, on the other hand, it be a society for dancing and balls, let it be so, and allow the young people to dance until they are tired; but what I believe many Institutions have failed in is, by aiming at too much and doing but little, and that not well, and by introducing doubtful relaxations, losing thereby both character and status in the neighbourhood.

I am, Sir, yours very respectfully,
JOHN HILL.

Educational Institution, Bootle, July 21, 1855.

## GUNNERY.

SIR,—I crave your indulgence, and that of your readers, for I again address you on Gunnery, a subject with which I can be but little acquainted. My information is taken from papers left by the late Sir Samuel Bentham.

Amongst other improvements, he advised lining guns with different metals, to preserve the bore from rust; this might be done either by casting in, by braizing, or by soldering the metal; or by the insertion of a tube pressed in, *in vacuo*. Your correspondent, a Civil Engineer, proposes lining a gun with steel, but Sir Samuel suggested *cast steel* as the material for the gun itself, provided the price of that metal should not be too great. He had found by actual trial that, strength for strength, steel was not more costly than forged iron.

For the long period of 35 years, Sir Samuel vainly endeavoured to induce the Admiralty to institute a series of experiments on naval ordnance; but now that public attention is directed to the subject, it may be useful to Government, and to private persons employed in making experiments on firearms, to mention those he had in view, so far as can be collected from his papers. It may give confidence in his opinions to state that the flotilla he created at Cherson defeated in three separate actions a superior one supported by twelve ships-of-the-line, of which no less than nine were taken, sunk, or burnt. His flotilla was armed with guns of different descriptions—mortars, long guns, &c., from three-pounders to 18 inch howitzers.

The experiments indicated are as follows, and it will be apparent that most of them are applicable to the land as well as to the naval service.

What is the most efficient length of a gun?—It should be sufficient to afford space for the decomposition of the whole charge of powder before the shot quits the bore, but not so great as to produce unnecessary friction to the ball. What that length ought to be, has not yet been ascertained, though it may be known approximatively. For this experiment provide a gun of the greatest length in use, in proportion to bore, note the distance of range of the missile, then shorten the piece by two inches at a time, ascertaining the range on each successive trial. In this way will be determined the greatest distance to which a missile can be carried, and the comparative range according to the different lengths of the piece of artillery.

What is the thickness of metal necessary to prevent the bursting of a gun?—Take a piece of the greatest thickness in use, prove it, then diminish its thickness by degrees till it bursts. To that thickness should be always added a sufficiency of metal to ensure perfect safety, but this addition should be based on good grounds, instead of being arbitrary as at present. It is also desirable to ascertain whether the same thickness of metal be requisite along the whole length of the bore.

What is the smallest size of shot that can be thrown with good effect from a large gun?—It is important to know this, as the same aggregate weight of missile can be discharged with less trouble and labour from one large gun than from several small ones.

The great variety of ordnance now in use shows the need of the above experiments since the different lengths and weight of artillery "cannot *all* be right."

Can wrought iron ordnance be furnished, strength for strength, at the same price as cast iron?—This is more a question of expense than of experiment.

Experiments on balls.—Sir Howard Douglas has shown that those of an *ovoid* form pass more easily through air than globular ones, but his experiments do not determine the precise form that is least obstructed by the atmosphere. The continuance of the flight of a shot, in the desired direction, depends on the position of its centre of gravity as well as on its form. There is another point to be considered, namely, what it has to destroy. The same form of missile will not batter a stone wall that would easily pierce a ship's side. A single bullet might effect the latter purpose, but would not be so destructive of men, sails, or rigging, as the same weight of shot divided into many parts. Many varieties of shot producing various effects are in use, but a sufficient assortment is rarely furnished, especially to vessels of war.

The charge of powder that different guns will bear has not yet been accurately determined, and to the small quantity allowed for a carronade may principally be attributed the disuse of that species of ordnance; for it was found in long continued actions that the carronade would bear a much larger charge of powder; indeed, on one occasion at least, enough to discharge *three* balls at once without damaging the piece.

The form and dimensions most suitable for the *chamber* of a gun require experiment.—Should a space be allowed between the cartridge and the missile, or should they touch? What part of the cartridge should be first ignited, whether close to the missile, in the middle, or at the end nearest the breech of the gun.

Windage is well known to be highly prejudicial; to prevent it, the balls might be cast with a groove round them, this groove being filled either with a strip of soft metal, or with bands of some such thing as woollen; wads would then be no longer necessary, and the saving would probably compensate for the extra expense of the ring. There might be some amount of care required for loading a gun, but not so much as in loading a rifle.

Sir Samuel indicated many precautions that he thought essential in making gunnery experiments. Each one might be repeated five times to ensure certainty of result; the piece of ordnance should always be brought to the same temperature; the bore should be perfectly cleansed; the shot should be of the same diameter, weight, and specific gravity; other precautions which are always adopted in the present advanced state of science and accuracy of experiment, need not be mentioned.

The great variety of gun carriages in use indicates that hitherto they have not been constructed on any fixed principle. They should be fastened strongly enough to resist the shocks occasioned by explosion; they should not rest on rollers or wheels, so that no deviation from the aim taken should be caused by motion of the carriage. To facilitate the training of a gun, it should, when

needed, be supported on handspikes with rollers on their lower ends. Rolling handspikes were brought into general use by Sir S. Bentham early in this century.* Moreover, if the platform be not of hard materials, it is gullied by wheels or rollers, as is frequently seen in the decks of vessels.

Your correspondents, Mr. Bridges Adams and Cosmos, may probably point out many other experiments in gunnery, besides those indicated in these notes, as they are so well acquainted with the subject, and enter into the *rationale* of it.

Cosmos appears to aim at perfection in ordnance. General Bentham aimed at the practicable. The former advocates large and heavy guns, even of greater size than those which throw stone shot at the entrance of the Dardanelles; General Bentham was well aware that a long gun carried further than a short one, and that the weight diminished the recoil, but he considered also, that however deep the public purse may be, still it is too shallow to afford any other outfit than such as would, on the average, most annoy the enemy at the least possible outlay of men or money. Though convinced of the superior efficacy of long guns, yet when permitted by the Admiralty to build and arm half-a-dozen vessels according to his views, he armed them with carronades and other short artillery, considering that most of the missiles thrown to a great distance, fail to hit the object aimed at, and that, therefore, naval actions must generally be at close quarters. The success of his sloops and schooners in actual warfare proved the soundness of his views. They took numerous prizes, although armed with nothing better than carronades, and having but slender complements of inferior men. As shell would be thrown with greater effect from a long gun than from a mortar, it might be desirable to provide large pieces of ordnance for battering a fortress.

What Cosmos says of the inertia of a gun seems to militate against Captain Roberts's mode of fitting mortars, for it is evident that the inertia is diminished by the recoil, whereas in the old method it had no other recoil than that of the vessel itself through the water, this being estimated by Mr. Fairbairn as next to nothing.

The same correspondent further observes that "It is not by taking things for granted on by-gone knowledge that the new and essential can be attained." Opinions of from 25 to 70 years old would not, then, be useful at the present day; but the circumstance of our long peace renders still available the ideas of a person who, from his official position, was enabled to witness the effects of the last war on our fleets and on private trade. His views as to warfare, although not appreciated at the time, are now found to be correct, and are being, in many instances, adopted. Government scouted the idea of shallow vessels —they now find the need of them; they used no other ordnance than long guns—they now cause ships' boats to be heavily armed with short ones. In the Sea of Azoff, our victories have been gained, not by ships-of-the-line, but by vessels of the lightest draught of water. The *Lady Nancy*, a mere raft, constructed in a single night, has proved of the greatest service.

It is quite true that experiments carried on at Woolwich by such men as Sir Howard Douglas, would be far preferable to those tried in Manchester. They can no where be carried on so satisfactorily as on Government premises, so as to combine economy with certainty of good results. As to economy, preparations for one set of experiments would frequently be useful for another series. It would be difficult in Manchester to find a suitable range of ground for experimenting; no such difficulty would exist at Woolwich.—I am, Sir, very truly your's,

M. S. BENTHAM.

A letter sent to the Admiralty being on Gunnery, a copy of it is annexed:—

*To the Secretary to the Admiralty.*

Sir,—As the enemy appears to make much use of the rifle, it would seem more desirable than ever to protect our seamen from its shot; I, therefore take the liberty of requesting you to lay before the Lords Commissioners of the Admiralty a plan devised by the late Sir Samuel Bentham, which after much consideration, he conceived to be the most practicable of several modes that had occurred to him for effecting the purpose.

Sir Samuel's expedient was as follows:—

That in fitting ordnance there should be attached to their carriage, by means of a ball and socket joint, a shield closing the whole port of a ship excepting the mouth of the gun and an aperture sufficiently large for taking aim.

I am, Sir, your obedient servant,
(Signed) M. S. BENTHAM.

## ON THE CHEMICAL PURIFICATION OF TOWNS AND CITIES.

Sir,—Liebig and others have made known to us analytically, a process in nature, long known empirically to most cultivators of the earth, viz., that the excretions of animals are the food of plants, while many kinds of plants are the food of animals, being, in fact, a kind of natural alembics for reconverting the excretions to serve again as animal food.

When large numbers of human beings aggregate together these conditions are lost sight of. The natural processes of absorption in the hunting or nomadic condition of man are altogether changed, and what should be the food of vegetables becomes simply a nuisance and a waste, till the enormity of the nuisance amongst more civilised communities generates various means of causing the carrying powers of nature to get rid of it, and without which, in the absence of better knowledge, large cities would be, and are, centres of constantly recurring plague. Thus we find that cities with large rivers—large proportioned to the numbers of their inhabitants—are, notwithstanding many disadvantages of low alluvial bottoms, far healthier than cities without rivers; and thus we find that camps without drainage are generally centres of disease.

Rome, in its palmy days of dense population, would have been uninhabitable without its *cloaca maxima*, and that would have been useless without its Tiber. How far the unhealthiness of southern towns may be due to the absence of tide in the Mediterranean, is a problem worth inquiring into. Rivers may be carriers, but the Mediterranean sea is not; and whoever has lived in Marseilles, and frequented the harbour during the hot months, has had painfully called to his mind the reflection, that for centuries have the excretions of the town being pouring into a tideless salt-water pond, forming a mass of filth analogous to our own Thames, and, like it, stirred up incessantly by paddle steamers, and, worse still, by the screw steamers, that stir up lower deeps, delving in a pit of Acheron of the foulest blackness, a fetid blackness, compared with which the Stygian blackness of the Aire and Irwell is as the meads of Enna. And the Bay of Cadiz, exposed to the Atlantic tides, is in a similar condition. Constantinople and the cities of the East, wherever the tideless sea stretches, are the perennial abodes of plague and cholera, save where, as at Nice, the inhabitants avoid pestilence and barrenness at the same time by the economical appropriation of the excretions not suffered to accumulate in too large masses. The conditions of pestilence vary with climate and locality. With a hot sun, dry air, and porous soil, desiccation takes place immediately; with warmth and moisture, putridity is generated rapidly, and even the desiccated substance is capable of being again changed into a noxious condition. If ever the time shall come that the Eastern towns fall into the hands of people of energy, the under-sea deposits of places like Marseilles will be dredged in the winter season, and the rich harvest

* This invention is attributed, erroneously, to the French Engineer, Paixhans.

of coprolute will become a world-wide discovery more extended than guano. What the guano islands have been to sea birds, rivers and sea creeks have been to the inhabitants of the bordering cities, and the time may come that Anglo-Saxon contractors will compete with each other for the guano diggings of the long-shore regions of the Thames. And when these are dug out, they will rush to obtain the concessions of the deposits of rich Venice and richer Amsterdam.

For many years Brighton, Hastings, Sandgate, Margate, and similar places, possessed pure air. Numbers thickened with the temptation, and now, who can walk on their respective beaches without being disgusted, if not poisoned, with that which is "in a wrong place!" The sea cannot be made a carrier of that which nature has ordained for other uses. If the sewer pipes be carried to low-water margin their contents are strewed along the beach. If they be carried into the sea beyond, they are stopped with shingle. Even if we try to suspend them, "like Mohammed's coffin, between heaven and earth," by slinging them to buoys with elastic joints, even then they will pollute the water, and bathing can only be practised to tideward of their mouths. The salt sea was not intended by nature to be a pickling tub for the refuse of slatternly Health of Towns Commissioners, a mud bin for the reception of wasted household material.

Careless and idle housemaids are proverbially fond of sweeping dirt into dark corners, and letting it lie there. It was once my evil fortune to make a passage in a vessel, part of whose hold was improvised into cabins for steerage passengers by forming a deck with loose planks, the joints of which were open, like the station platforms on the Dover Railway, since imitated in the Crystal Palaces. The women soon found that it was much easier to throw water and sweep dust down the cracks than to carry them up the hatchway, and throw them overboard; and thus began a feud with the mate, who was incessantly on the watch to stop them from, as he phrased it, "losing" dirt and water in the hold. But it was unavailing, all his time was taken up like a policeman, and he resorted to an Act—and not a Parliament—deed, not word—caulking the planks, and cutting of the inboard drainage.

In the earliest river settlements, the inhabitants of the dwellings found the stream so convenient a carrier that they threw all their "dirt" into it. As dwellings thickened and receded from the river, the inhabitants dug holes called "cess" or collective pools, to save themselves a daily journey to the river. Water overflowed the cess-pools, and it became essential to score the surface of the ground to help it in its course to the river. Becoming an olfactory nuisance in time, these scores, or surface drains, were covered over, and became sewers. Increase of cesspools with the increase of population choked the sewers, and—in London at least—Acts of Parliament were passed prohibiting any communication between privies and sewers.

Water-closets were then invented, water carriage by the open river indicating the convenience of water carriage in drains; and during all this time it seems not to have occurred to mind that the excretion nuisance was not really got rid of by simple removal to another place. It grew and increased mightily, pervaded our houses and our streets, and worked up through gully holes. And then the Board of Health proclaimed aloud that it was all for want of water enough. And water was added, and the drains and sewers were cleansed, and then came the discovery that all this time we had simply been converting the river itself into one huge sewer, a nuisance open to everyone's eyes and nostrils.

Another outcry now comes, that no drainage is to be permitted into the river, but that all sewage shall be carried in closed sewers along the banks of the river, and be deposited in the marshes of Kent and Essex. But this is simply removing the pestilence to a certain distance, to be borne back to us on the breath of the wind when setting towards us, or poisoning some other portion of the population in other directions.

The next remedy is to deodorise and dry the total collection in these same marshes; and here, at last, we arrive at something tangible.

Owing to our bad construction of houses, and to our preference for small pipes, buried in walls and elsewhere for purposes of secrecy, and our use of water as a lazy though not gratuitous carrier, we convert every cubic foot of excretions into many cubic feet of poisonous liquid. We may get it to the Essex marshes in that mode, but we have then to evaporate the water, previous to drying and deodorising.

Why, then, should we not begin at the beginning, and keep away water from it altogether. The answer is that the vicious practice of putting all our excretions into dark places and narrow corners has necessitated the use of water to make cleaning accessible. Capable housewives always look to the dark places about their houses; the light portions are sure to be right.

The cess-pool, in its original intention, was right. It was the collection for the day or week, and had it been confined to that, chemistry would long since have dealt with it, on account of the frequent recurrence of a trouble. In Manchester, where I believe there are scarcely any water-closets, the practice is to throw the daily ashes among the soil in layers, and thus partly absorb it, and frequently remove it without additional liquid, in a condition satisfactory to the farmer.

Our old cesspools, like those of Paris, were made to gather the collections of years. Commonly they were made of permeable brick, and that which might be convenient on a farm became insufferable in a city. The construction of sewers of porous brick also tended to choke them, and they were christened by the name of "elongated cess-pools." To remedy this difficulty vigorous attempts were made to supply the place of brick sewers by glazed earthen pipes of small diameter, and needing comparatively little water. Now, supposing the absence of all contingencies of stoppage by housemaids' brushes and other matters, there was one insurmountable difficulty in these drains being placed under ground and out of sight, and, consequently, inaccessible save by workmen.

In all cases of drainage, the first consideration is that the drains should be accessible to, and capable of being cleaned by, the servant of the house, and, therefore, they should be in sight.

But, it will be said, that this precludes the use of close and trapped drains.

This does not follow. It would be easy to place earthen or other drains in a trunk of brickwork, and to have water traps to the drain-pipe at frequent intervals, so as to make the whole course accessible to an elastic rod or brush. But this brings us to the consideration of the different waste materials we have to deal with.

First.—The indirect materials used for the body—washing water, cooking water, refuse food, animal and vegetable.

Secondly.—The direct excretions of the body.

Thirdly.—Ashes and dust, the refuse of fuel.

There is no reason why soapy water and greasy water should not run down ordinary drains, unless they be useful to sell, in which case they would not be a nuisance to carry away. Putrid vegetable water should be dealt with chemically before running into the drains.

The direct excretions of the body cannot be properly dealt with in our present fashion of houses, neither can refuse food, animal or vegetable. Cabbage leaves and refuse must go into the dust-hole along with the refuse fuel, and the result is frequently obnoxious, owing to the want of proper disinfectants.

As chemistry has been successful in converting filthy potatoe oil and coal tar into delicate perfumes, it is no doubt chemically possible to convert all the waste material of a household into innoxious and not unpleasant substances. Two considerations are requisite;—first,

that it be cheaply done; secondly, that it may not diminish the value of the materials as a manure, by locking up, as it were, the ingredients so firmly, as to render them insoluble in the ground for the purposes of vegetation.

In this mode, and by no other mode, by chemical conversion, and not by mere mechanical transport, must the ultimate purification of cities be brought about. If this conversion is deemed practicable and profitable on the larger scale, it will be found much more convenient on the small scale, converting the matter before it leaves the houses, and not subsequently.

To accomplish this is the business of the chemists. If the same skill and energy be put to work that has accomplished the conversion of other noxious substances into perfumes, we shall not long be at a loss. For towns with ample water supplies, we may put this off; but for inland towns without water there is no other remedy. We need a chemical neutral, cheap in itself, or at any rate of such a quality that it will possess an equivalent value when put on land.

I think that if the Society of Arts bestirs itself to impress this on its members, we shall soon be as well supplied with disinfectants, at a cheap rate, as with colour-boxes and microscopes.

The next question is, how to use them, and to ensure their use.

To use the disinfectants we need portable cess-pools, without the access of water on the ordinary plan of closet, in which cesspool or vessel the disinfectant may lie. It should be a vessel on wheels, at a level with the yard of the house, and beneath the opening of closet or closets, with ample space, so that falling matter may certainly pass clear of the walls. The disinfectant should be in a liquid form, thoroughly to mingle with the offensive matter. These cesspools should be furnished by companies, who would take them away with their contents, to discharge into covered railway waggons or barges, and replace them with empties. In this mode the material, undiluted with water, would be transported cheaply, and be as readily saleable as guano.

To ensure the use of the disinfectants, the material might be a servant's perquisite, and there is no reason why the receptacle for family excretions should not be as cleanly and orderly as the receptacles for family increment in the shape of food, as the beer cellar or wine cellar, and in addition it should be thoroughly light.

With these arrangements—perfect chemical neutralisation—instead of the pretence of the thing—sewers would not be needed save for rain and impure water.

But, it will be answered, this will need houses to be built on purpose, or very extensive alterations! No doubt; but there is a simple way of making the plan self-acting. Put the sewer's rate on such houses as communicate with them by water-closets, and free those properly fitted to disinfect and carry away the excretions. Districts undrainable in the ordinary sense, might thus be rendered comparatively wholesome, and builders of new streets might be permitted to erect dwellings, without incurring the expense of underground drains.

So long as we shall persist in the practice of making drains for filth beneath the surface, and hiding obnoxious substances in dark corners, so long shall we be afflicted with insidious nuisances. Putrid odours are not the less fœtid when they ascend through gully-holes at intervals. Destroying the putrefactic germ by air and light, and chemical action, is a more logical process than trying to "lose" it in the river.

Let, then, the Society of Arts "poke their noses"—as Earl Granville has it—into this matter, and my life on it they will set the chemists earnestly to work, and in a short time the pages of their Journal will teem with communications, giving the public the choice of many cheap disinfectants, besides peat charcoal and chloride or sulphate of zinc; perhaps, also, a model or two of improved house arrangements, with portable cesspools, that may lighten our present darkness. If we run up the cost of our present system of closets, and drains, and sewers, and their non-efficiency, we shall find the disinfectant process and transport by railway the least outlay and the largest economy with the best result.

I am, sir, your constant reader,

W. BRIDGES ADAMS.

1, Adam-street, Adelphi, August 9, 1855.

## THE RAW PRODUCE OF BRITISH HONDURAS.

Belize, British Honduras, June 15th, 1855.

Sir,—I am happy to say that twelve tons of cahoun nuts have been shipped on board the *Elphinstone*, a vessel belonging to Messrs. Hyde and Co., of London, which sails to-day for that port. A like number will be sent in another vessel in a very short time, and I have also forwarded to Mr. Wilson a large box of those nuts, and six bottles of cahoun oil. There is now a certainty of this article being fairly tested, and the fact ascertained, whether or not it is likely to become a valuable addition to our commerce. I am, myself, sanguine that the experiment about to be tried will be attended with the most satisfactory results. Should the oil obtained from the nuts now sent be found to be very superior to cocoa-nut oil, the next questions will be—1st. What kind of machinery will be the best adapted for the manufacture of it with expedition and economy; and, 2ndly, whether will it be better to export the nuts to England to be there manufactured, or to have the necessary machines sent here for the purpose of expressing the oil in this country. With respect to the first question, I have no doubt there are many scientific members of your Society who will, with great pleasure, turn their attention to the subject, and offer their suggestions. Should any be so disposed, Messrs. Hyde and Co., 2, Great St. Helen's, Bishopsgate-street, would gladly avail themselves of their counsel, and furnish them with the nuts requisite to enable them to form an opinion. The second question will require much serious consideration. A great deal may be said in favour of either alternative. If the oil were manufactured on the spot, there would be, I think, a saving in freight, not only on account of the oil being less bulky than the nuts—for the oil obtained from a ton of nuts would of course occupy a much smaller space than that quantity of nuts in their natural state,—but also on account of the great number of nuts which the manufacturer would be compelled to reject, either because they were not sufficiently full, or because they were too old. If the oil were manufactured in England, these bad nuts would pay freight equally with the good ones. It is true that, at present, the freight of the nuts is only one pound per ton, while the freight of the oil is three pounds. But this inequality arises from the fact that the nuts can now be sent to England as broken stowage between the logs of mahogany. But I apprehend that the day is not far off when mahogany will cease to be the staple commodity of this country, and cahoun nuts and cocoa nuts will have to be shipped as regular cargo. On the other hand, if the nuts were exported to England, there would be the advantage of having the most complete machinery, engineers to repair it when out of order, and cheap labour, besides the aid of those whose attention has long been directed to the manufacture of oils. Upon the whole, I think the advantages preponderate on the side of home manufacture.

A doubt has been raised whether there are sufficient nuts to supply the British market to a large extent. I have already said, and the crown surveyor, Mr. Faber, who is a very scientific and intelligent man, and has visited most parts of Honduras, has also declared, that there are sufficient nuts to supply the British and other markets to an unlimited extent. Those who profess to doubt the plentifulness of these nuts, admit that there are millions of cahoun trees, but they say that not one-half of them bear fruit. Now this is *partly* right and *altogether* wrong. It is correct to say that a very great number of the trees now

growing do not bear fruit, but it is quite erroneous to say that they are not capable of bearing. The fact is, the trees are so numerous, they grow so quickly, they are so closely packed—so much so, that it might be said with no great impropriety that they are not able to breathe—that, from this circumstance alone, very many of them do not bear fruit. There is, in truth, in many instances, what may be termed a barren exuberance. As the trees are constantly shedding their nuts, and there being no one to gather them, it follows as a matter of course that young trees are ever springing up on all sides, until the whole country round becomes a vast leafy wilderness, "an endless contiguity of shade." If the cahoun trees were male and female, like most of the palm tribe, many of course would not bear; but there would then be a known cause for this default. But they are not male and female, and there *can* be no other cause but the one which I have mentioned. I have sent you a small sketch of a cahoun ridge, executed by Mr. Faber. It is a correct representation as far as it goes, but I will endeavour to procure a more complete drawing to be made.

I observe in your catalogue that amongst the desiderata of your society are samples of ornamental woods suitable for furniture. This country contains a vast variety of woods, both of an ornamental description, peculiarly adapted to cabinet ware, and of a solid and durable nature, fitted for ships, buildings, railway sleepers, and a number of other purposes. I will procure a list of all the woods which are known to exist in this country, and, if possible, specimens of them, and forward them to the Society. But the wood which has hitherto occupied the attention of the settlers, not only to the exclusion of all other wood (except logwood), but of all other considerations, is mahogany. King Log has hitherto ruled with despotic sway. But his reign is nearly over, and the benignant nut, I trust, will succeed to the throne, and, casting his oil upon the troubled waters, will cause a commencement of prosperous and *palmy* days.

When mahogany was first introduced into Europe, is not known with any degree of certainty. It is by some supposed it was first discovered in the island of Trinidad, by the carpenter of one of Sir Walter Raleigh's vessels. The story goes, that the ship requiring some repairs, this officer went on shore to look for some wood for the purpose, which, having found, he cut and brought on board. When he came to work it up, he was surprised at its hardness and beauty. This story deserves little credit. The circumstance could not be transmitted to us without its having been known to many persons at the time, and if the wood were so beautiful, it is not probable that, in the reign of Elizabeth, when there were so many enterprising navigators, and such a raging thirst for the riches of the New World, such a valuable tree would have been left to blossom and decay unmolested in its native forest. We do not hear of mahogany having been made use of in England until the beginning of the present century. It is said that a Dr. Gibbons, of London, had a brother who was master of a vessel trading to the West Indies. This worthy skipper, hearing that his brother was building a new house in King-street, Covent-garden, very fraternally sent him a quantity of wood, which he had brought in his ship as ballast. This wood was so hard that the carpenters could not work it up, and it was thrown aside as useless. But one day Mrs. Gibbons, who it appears was a thrifty dame, and did not approve of burning candles at both ends, resolved to have a box made, in which those illuminators might be safely kept, and every fragment thereof carefully preserved, and she selected a piece of this rejected wood for the purpose—which turned out to be mahogany. When it was made it was so beautiful, and the Doctor was so enchanted with it, that he determined to have a bureau made of the same material, in which *he* might keep his money. When the bureau was finished, it was shown to the Duchess of Buckingham, who was equally charmed, and she also determined to have a case made in which *she* might keep her jewels.' By these quick gradations, from the candle-box of a citizen's wife to the casket of a peeress, mahogany became known in England. But this story has a fabulous air with it, for it is hardly likely that the captain of a West India trader, laden with sugar and rum, and also much spice, would take a quantity of *wood* into his ship for *ballast*.

The manner of cutting mahogany, trucking it, squaring it, and floating it down the river to the sea, are well described in an old almanac. The account is rather long, but it is very interesting; I will not apologise for giving you the following copy of it:—

"The season for cutting the mahogany usually commences about the month of August. The gangs of labourers employed in this work consist of from twenty to fifty each, but few exceed the latter number. They are composed of slaves and free persons, without any comparative distinction of rank; and it very frequently occurs, that the conductor of such work, here styled the captain, is a slave. Each gang has also one person belonging to it termed the huntsman. He is generally selected from the most intelligent of his fellows, and his chief occupation is to search the woods, or, as it is called in this country, the bush, to find labour for the whole. Accordingly, about the beginning of August, the huntsman is despatched on his important mission, and if his owner be employed on his own ground, this is seldom a work of much delay or difficulty. He cuts his way through the thickest of the woods to some elevated situation, and climbs the tallest tree he finds, from which he minutely surveys the surrounding country. At this season the leaves of the mahogany trees are invariably of a yellow reddish hue, and an eye accustomed to this kind of exercise, can, at a great distance, discern the places where the wood is most abundant. He now descends, and to such places his steps are directed—and, without compass, or other guide than what observation has imprinted on his recollection, he never fails to reach the exact point to which he aims. On some occasions no ordinary stratagem is necessary to be resorted to by the huntsman, to prevent others from availing themselves of the advantage of his discoveries; for, if his steps be traced by those who may be engaged in the same pursuit, which is a very common thing, all his ingenuity must be exerted to beguile them from the true scent. In this, however, he is not always successful, being followed by those who are entirely aware of all the arts he may use, and whose eyes are so quick that the lightest turn of a leaf, or the faintest impression of the foot is unerringly perceived—even the dried leaves which may be strewed upon the ground, often help to conduct to the sacred spot—and it consequently happens that persons so engaged, must frequently undergo the disappointment of finding an advantage they had promised to themselves seized on by others. The hidden treasure being, however, discovered, the next operation is the felling of a sufficient number of trees to employ the gang during the season. The mahogany tree is commonly cut about ten or twelve feet from the ground, a stage being erected for the axe-man employed in levelling it; this, to an observer, would appear a labour of much danger, but an accident rarely happens to the people engaged in it. The trunk of the tree, from the dimensions of the wood it furnishes, is deemed the most valuable, but for purposes of ornament, the limbs, or branches, are generally preferred, the grain of them being much closer, and the veins more rich and variegated. A sufficient number of trees being now felled to occupy the gang during the season, they commence cutting the roads, which may fairly be estimated at two-thirds of the labour and expense of mahogany cutting. Each mahogany work forms in itself a small village on the banks of a river—the choice of situation being always regulated by the proximity of such river to the mahogany intended as the object of future operations. In the arranging of the habitations, much rural taste is often displayed, and it is highly gratifying to the curious to remark the different modes peculiar to the several nations or tribes of Africa,

as also the improvement introduced by European experience in the construction of the houses, among which the proprietor's residence, with store-houses, cattle-sheds, &c., invariably form a conspicuous figure—those of the different labourers being usually of more humble appearance, but all built of the same material, which the surrounding country affords in abundance. We have frequently seen houses of this kind completed in a single day, and with no other implement than the axe, consequently every workman is capable of performing the labour required to build his own dwelling. After completing this establishment, a main road is opened from it, in as near a direction as possible to the centre of the body of trees so felled, into which branch or wing roads are afterwards introduced, the ground through which the roads are to run, being yet a mass of dense forest, both of high trees and underwood. They commence by clearing away the latter with cutlasses, which, although in appearance a slender instrument, yet, from the dexterity with which it is used, answers the purpose admirably. This labour is usually performed by task-work, of one hundred yards each man per day, which expert workmen will complete in six hours. The underwood being now removed, the large trees are then cut down by the axe, as even with the ground as possible, the task being also at this work one hundred yards per day to each labourer, although this is more difficult and laborious, from the number of hard woods growing here, which, on failure of the axe, are removed by the application of fire.

"The trunks of these trees, although many of them are valuable for different purposes, such as bullet tree, iron-wood, redwood, sapodilla, &c., are thrown away as useless, unless they happen to be adjacent to some creek or small river, which may intersect the road; in that case they are applied to the constructing of bridges across the same, which are frequently of considerable size, and require great labour to make them of sufficient strength to bear such immense loads as are brought over them.

"The quantity and distance of road to be cut each season depends on the situation of the body of mahogany trees, which, if much dispersed or scattered, will increase the labour and extent of road-cutting; and it not unfrequently occurs, that miles of road, and many bridges, are made to a single tree, and that may ultimately yield but one log. The roads being cleared of all the brushwood, still require the labour of hoes, pick-axes, and sledge hammers, to level down the hillocks and to break the rocks, also such of the remaining stumps as might impede the wheels that are hereafter to pass over them.

"The roads being now all in a state of readiness, which may generally be effected by the month of December, the cross-cutting, as it is technically called, commences. This is merely dividing crosswise, by means of saws, each mahogany tree into logs, according to their length, and it often occurs, that while some are but long enough for one log, others, on the contrary, will admit of four or five being cut from the same trunk or stem, the chief guide for dividing the trees into logs being to equalise the loads the cattle have to draw, and prevent them being overburdened; consequently, as the tree increases in thickness, so the logs are reduced in length; this, however, does not altogether obviate the irregularity of the loads, and a supply of oxen are constantly kept in readiness to add to the usual number, according to the weight of the log; this becomes unavoidable, owing to the very great difference of size of the mahogany trees, the logs taken from one tree being about 300 feet, while those from the next may be as many thousands; but the largest log ever cut in Honduras was of the following dimensions:—Length, 17 feet; breadth, 57 inches; depth, 64 inches; measuring 5,168 superficial feet, or 15 tons weight. For bringing to view this extraordinary specimen of the production of nature, we are indebted to the persevering exertion and ingenuity of Charles Craig, Esq., an eminent and experienced mahogany cutter.

"The sawing being now completed, the logs are separated one from another, and placed in whatever position will admit of the largest square being formed, according to the shape which the end of each log presents, and is then reduced, by means of the axe, from the round or natural form, into the square, although some of the smaller logs are brought out in the round; yet, with the larger description, the making them square is essential not only to lessen their weight, but also to prevent their rolling on the truck or carriage.

"We now reach the month of March, when all the preparation before described is, or ought to be, completed—when the dry season, or time of drawing down the logs from the place of their growth commences, which process can only be carried on in the months of April and May, the ground during all the rest of the year being too soft to admit of a heavily laden truck passing over it without sinking, and, although the rains usually terminate about February, yet, from the ground being so soaked with rain, the roads are seldom firm enough for use till the first of April.

"The mahogany cutter's harvest may be at this time said to commence, as the result of his season's work depends on a continuance of the dry weather, for a single shower of rain would materially injure his roads. It is, therefore, necessary that not a moment should be lost in drawing out the wood to the river.

"The number of trucks worked is apportioned to the strength of the gang, and the distance, generally from six to ten miles. We will, for example, take a gang of forty men, capable of working six trucks, each of which requires seven pair of oxen and two drivers, sixteen to cut food for the cattle, and twelve to load or put the logs on the carriages, which latter usually take up a temporary residence somewhere near the main body of the wood, it being too far to go and return each day to the river side, or chief establishment. From the intense heat of the sun, the cattle would be unable to work during its influence, consequently, they are obliged to use the night time in lieu of the day, the sultry effects of which it becomes requisite to avoid. The loaders, as before-mentioned, being now at their station in the forest, the trucks set off from the barquedier about six o'clock in the evening, and arrive at their different places of loading about 11 or 12 o'clock at night. The loaders being at this time asleep, are warned of the approach of the trucks by the cracking of the whips carried by the cattle drivers, which are heard at a considerable distance. They arise, and commence placing the logs upon the trucks, which is done by means of a temporary platform, laid from the edge of the truck to a sufficient distance upon the ground, so as to make an inclined plane, upon which the log is gradually pushed up from each end alternately. Having completed their work of loading all the trucks, which may be done in three hours, they again retire to rest till about nine o'clock next morning. The drivers now set out on their return, but their progress is considerably retarded by the lading, and although well provided with torch-light, they are frequently impeded by small stumps that remain in the road, and which would be easily avoided in daylight; they, however, are in general all at the river side by 11 o'clock next morning, when, after throwing the logs into the river—having previously marked them on each end with the owners' initials—the cattle are fed, the drivers breakfast and retire to rest until about sunset, when they feed the cattle a second time and yoke in again. Thus goes on the routine of trucking during the season, the loaders being employed in the interim preparing the logs for the return of the trucks.

"Nothing can present a more extraordinary appearance than this process of trucking, or drawing down the mahogany to the river. The six trucks will occupy an extent of road of a quarter of a mile—the great number of oxen—the drivers half naked (clothes being inconvenient from the heat of the weather and clouds of dust), and each bearing a torch-light, the wildness of the forest

scenery, the rattling of chains, the sound of the whip, echoing through the woods, then all this activity and exertion so ill-corresponding with the silent hour of midnight, makes it wear more the appearance of some theatrical exhibition than what it really is—the pursuit of industry which has fallen to the lot of the Honduras wood-cutter. About the end of May the periodical rains again commence. The torrents of water discharged from the clouds are so great as to render the roads impassible in the course of a few hours, when all trucking ceases; the cattle are turned into the pasture, and the trucking gear, tools, &c., are housed.

"The rain now pours down incessantly till about the middle of June, when the rivers swell to an immense height; the logs then float down a distance of 200 miles, being followed by the gang in pitpans (a kind of flat bottomed canoe), to disengage them from the branches of the over-hanging trees until they are stopped by a boom placed in some situation convenient to the mouth of the river. Each gang then separates its own cutting, by the marks on the ends of the logs, and form them into large rafts, in which state they are brought down to the wharves of the proprietors, were they are taken out of the water, and undergo a second process of the axe, to make the surface smooth: the ends, which frequently get split and rent, by being dashed against rocks in the river, by the power of the current, are also staved off, when they are ready for shipping."

In the extract above quoted, mention is made of a canoe called a pitpan. In Honduras there are three descriptions of boats. One is called a dorey; this is a sort of a canoe, which is cut out of one log of wood (sometimes mahogany, sometimes cedar); this boat is considered to be very safe, and is well adapted to the waters in which it is intended to float; it is sometimes very small, but the negroes and the Caribs, especially the latter, are very dexterous in the management of it; it is invariably impelled by means of paddles—oars, indeed, would be useless in the narrow streams which the wood-cutters are frequently obliged to navigate. Another species of boat is called a creah; this is a raised dorey, that is, the portion which consists of the hollow log is built upon, partially decked, and rigged for sailing; they cut through the water with great rapidity, but they are very dangerous, being apt to be capsized by a sudden puff of wind upon the quarter, from the narrowness of the beam in comparison with their length and height. The pitpan is a long, flat-bottomed boat, deep and wide in the middle, but shallow at the ends, which are square; some of them are fitted with a wooden awning, which, however, can be removed at pleasure; it is also made of one log of wood, generally mahogany. The pitpan can only be used in the rivers—it would be swamped immediately in a heavy sea. At Christmas there are pitpan races between the negroes and the Caribs, and one pitpan not unfrequently contains fifty or sixty paddlers. It is a singular spectacle —this pitpan race. The enormous length of the boat—the great number of paddlers, with their dark bodies naked to the waist—their broad brawny chests and muscular backs and arms—their shrill, dissonant, ferocious cries, their wild gestures, sometimes plying the paddle with inconceivable vigour, which sends the canoe with the swiftness of an arrow throw the water, causing it to leave in its wake a thick milk-white foam—sometimes hurling it into the air, and dexterously catching it as it falls, and sometimes dashing up the spray, which for a moment makes them nearly invisible—present altogether a scene as different from those which are usually witnessed in civilised countries as can well be imagined.

I hope to be able to send you a model of a pitpan by the next packet.

I have now forwarded to you a sample of the snake root. This is thought by some persons to be the guaco, but it is not. It is, however, much confided in as a remedy for the bite of a snake. An infusion, or tincture of this root, is exceedingly bitter, and I have no doubt it would prove an excellent tonic.

The chew stick is, I believe, common to the whole of the West Indies; the negroes use it for polishing their teeth, and it must be admitted that its effect upon Sambo's incisors is quite wonderful. That highly respectable descendant of Ham generally possesses a set of masticators so white, so sharp, so glittering, that though perhaps his great progenitor, if he were to appear, might escape them, few modern hams would have the least chance. But the chew stick of Honduras—I do not know whether it is the same as that which is found in other parts of the West Indies—possesses other virtues besides that of beautifying the teeth,—it is a very powerful fermentative. It has a bitter flavour, but not more so than the hop, and it is considered to be a very good tonic. Who has not heard of Betsy Austin? she who was erst of Barbadoes—that is, coast—the natives of which brag that they are "neither crabs nor creoles, but true Barbadions born." She has been celebrated in prose and in verse, in fiction, and in authentic history quite as fabulous. But no poet has ever sung Betsy Potts. If England had her Robin Hood, Scotland had her own Rob Roy; if Barbadoes could boast of Betsy Austin, Belize can boast of Betsy Potts. What pert middy, what captain bold, what greasy, unkempt skipper, has not been indebted to Betsy Potts. From champagne and hock, to British gin and bitter beer, from paté de fois gras, and potage à la Jullien, to salt beef and pickled herrings, she could supply them. But she has not been appreciated as she deserved.

> "A primrose by the river's brim,
> A *yellow* primrose was to him,
> And it was nothing more."

Well—this same Miss Elizabeth Potts makes excellent ginger beer, and the only fermenting power which she uses is an infusion of the chew stick. About two feet of it is sufficient to ferment nine dozen bottles of ginger beer. Now, I am strongly of opinion that the chew stick would be a very good substitute for yeast, and in many respects would be far superior to it. It will keep for a great length of time; it is easily portable, and it would not be liable to deterioration in any climate. An experiment, I think, would be desirable. I have sent some chew stick, in order that it may be tried, if you think proper.

The wild cotton tree of this country grows to an immense size. The trunk of that tree is sometimes 20 feet in diameter. It is proportionately high, and the branches are far-spreading. It bears a light grey-coloured cotton, which is enclosed in a green pod, from four to six inches in length. This cotton is extremely soft and silky, but the staple is short. When the cotton is mature the pods burst, and their contents are blown by the wind in every direction. The ground in the neighbourhood of a cotton tree has sometimes the appearance of being covered with snow. Perhaps this cotton might be turned to some useful purpose. I have sent you two pods, in order that they may be examined by those who understand the various uses to which cotton may be applied.

There is a singular tree which grows very plentifully in Honduras, called by the Creoles the bobwood. The roots of this tree, which run along the surface of the ground for a considerable distance, are very light and spongy. The negroes, who are up the different rivers, make corks of them, and also use them for sharpening their razors. I have thought it right to send you a sample of this wood, in order that its applicability to any good purpose may be ascertained.

In one of the admirable letters of the *Times*' Special Correspondent in the Crimea, there is a statement that the shoes which were furnished to our troops were not only very uneasy to the foot, but were also very unserviceable, and that the soles, adhering to the mud, very unceremoniously parted company with the upper-leathers. It has struck me that a much better garment for the foot, in such a country as the Crimea is described to be, than the

ordinary shoe, with its thick, clumsy sole, and stiff unpliable upper-leather, would be the moccassin. The moccassin is worn by all the mahogany cutters, and it has this advantage over the common shoe—it is exceedingly soft and easy to the foot, and it is not liable to be pulled off by the adhesiveness of the soil—and the mud of the Crimea cannot be more adhesive than the clay in the mahogany works of Honduras.

The moccassin is made of undressed deer's skin, and it comes a little above the ancle when it is tied. It is not impervious to the wet, very much to the contrary, but it cleaves to the foot with a tenacity which no clay in the world could overcome. The North American Indian will go on a trail for 50 or 100 miles with a pair of moccassins on, without being in the slightest degree foot-sore. In order to clean it, no blacking is necessary; it is simply washed and hung on the hedge to dry. It might be pipe-clayed. And it might easily be made waterproof by smearing it with a solution of India rubber in spirits of turpentine. To soldiers on a march, with woollen socks on their feet, moccassins would be an inestimable treasure. I have sent you two pairs of these pedal habiliments, in order that you may have an opportunity of forming an opinion respecting them.

I have, &c.
R. TEMPLE.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette August 3rd*, 1855.]

*Dated 22nd June*, 1855.

1433. S. E. G. Simon, Paris—New material for paper.

*Dated 28th June*, 1855.

1474. Captain C. J. Symons, B.A., Hereford—Steam engines.

*Dated 3rd July*, 1855.

1498. W. Hammant, 1, Standfield-street, Stepney—Condensing smoke.

*Dated 9th July*, 1855.

1534. H. Crossley, Grove, Camberwell—Projectiles.

*Dated 10th July*, 1855.

1540. E. Kopp, Accrington—Mordants.

*Dated 12th July*, 1855.

1557. B. Greening, Manchester—Washing and mangling machinery.
1559. J. Bethell, 8, Parliament-street, Preserving provisions.
1561. E. D. Chattaway, Edinburgh—Railway buffing and coupling apparatus.
1563. E. Simons, Birmingham—Condensing smoke of, and increasing illumination from, gas flames.
1564. J. H. Weston, Cross-street, Newington Butts, and J. E. Lewis, Nicholas-street, New North road—Moderator lamps.
1565. R. D. Obissier, Bordeaux—Motive power.

*Dated 13th July*, 1855.

1569. J. Higgin, Manchester—Clearing and brightening dyed and printed fabrics.
1571. G. T. Bousfield, Sussex-place, Brixton—Boots and shoes. (A communication.)
1573. R. Hornsby, Grantham—Thrashing machines.
1575. M. Lawton and T. Schofield, Micklehurst—Spinning machinery.
1577. R. Yeates, Trafalgar place-west, Hackney-road—Lock and lever knives.
1579. R. Burns, Liverpool—Teethed gear.
1581. P. J. A. Gaudin, Skinner-street, Snow-hill—Baths for photographic purposes.
1583. L. C. J. Poliesse, jun., and C. A. J. Lengelée, Ham, France—Encaustic matters.

*Dated 14th July*, 1855.

1584. J. J. Derrieij, Paris—Lozenges, wafers, pastiles, &c.
1585. F. Hamilton, Bolton-le-Moors—Carding engines.
1586. T. Sadleir, Mulla, Tullamore—Heating liquids.
1587. F. Burke, Montserrat, West Indies—Preparing fibres of plantain, banana, aloe, &c.
1588. E. S. Atkinson, Knottingley—Condensing muriatic acid gas arising in the manufacture of sulphate of soda.
1589. J. F. Kealey, Oxford-street—Pulping vegetable substances.

*Dated 16th July*, 1855.

1590. W. H. Tayler, 19, South-row, St. Pancras—Screw cap and fittings. (A communication.)
1591. A. Reggazzoli, Milan—Impelling railway carriages up ascents. (A communication.)
1592. L. Gavioli, Modena—Musical instrument, called clavi-accord.
1693. J. B. Pascal, Lyons—Motive power.
1594. J. H. Tuck, Pall Mall—Blowing apparatus. (A communication.)
1595. J. Newman, Birmingham, and W. Whittle, Smethwick—Axles.
1596. W. E. Newton, 66, Chancery-lane—Vices. (A communication.)
1597. W. E. Newton, 66, Chancery-lane—Mechanism for operating shuttles of looms. (A communication.)

*Dated 17th July*, 1855.

1598. P. Laroche, Saventhem, Belgium—Rotary steam engine.
1601. S. Salaville, Paris—Airing and preserving grain, seed, apples, &c.
1602. W. Jenner, Southwark—Beverage.
1603. H. S. Boase, Claverhouse, Dundee—Drying organic substances.
1604. A. Burdess, Rugby—Oil feeders.
1905. E. Scragg, Buglawton, Congleton—Steam engines.
1606. H. Huthnance, Stratford—Combustion of coals.
1607. E. Barry, Soho square—Musical instruments played with a key-board, similar to that of a piano.

*Dated 18th July*, 1855.

1610. F. Hoyos, Paris—Roasting spits.
1611. T. Almgill, Busby, near Glasgow—Printing on calico, &c.
1612. J. Reilly, Dublin—Iron hoops for casks.
1613. C. Toye, 42, Gloucester street, Queen-square—Looms.
1614. W. Smith, Aston, Birmingham—Steel wire.
1615. T. Trapp, Mile end—Connecting and disconnecting shafts. (A communication.)
1616. J. Ellis, Heckmondwicke—Ammonia, charcoal, animal and vegetable naphtha.
1617. J. Pollard, Bexley-heath—Gas.
1618. W. Ball, Ilkeston, and J. Wilkins, Nottingham—Warp fabrics.
1619. J. King and J. Holdsworth, Rochdale—Woven cotton fabrics.
1620. A. E. L. Bellford, 32, Essex-street, Strand—Condensing vapours or smoke. (A communication.)
1621. A. E. L. Bellford, 32, Essex-street, Strand—Induction and eduction valves of steam engines. (A communication.)
1622. V. Scully and B. J. Heywood, Dublin—Cocks and taps.
1623. V. Scully and B. J. Heywood, Dublin—Locks, latches, and keys.

*Dated 19th July*, 1855.

1624. R. Martin, Reading, and J. C. Martin, 7, Pullen's-row, Islington—Obtaining pulp from wood.
1625. J. P. Clarke, Leicester—Metallic reels.
1926. S. B. Wright, Parkfield stone, and H. T. Green, Moreton, both in Staffordshire—Bricks and tiles.
1627. J. G. Laurie, Glasgow—Steam engines.
1628. P. Bertinetti, Paris—Projectile.
1629. D. and T. R. H. Fisken, Stockton-on-Tees—Tillage of land by machinery.
1630. E. A. Ferryman, Wadenhoe, near Oundle—Churn.
1631. J. Thompson and J. Mills, Manchester—Power looms.
1632. J. H. Woolbert, Brussels—Madder and application. (Partly a communication.)
1633. J. H. Johnson, 47, Lincoln's-inn-fields—Transmitting motive power, principally to horse mills. (A communication.)
1634. J. H. Johnson, 47, Lincoln's-inn-fields—Railway breaks. (A communication.)
1635. J. H. Johnson, 47, Lincoln's-inn-fields—Reeds for weaving. (A communication.)
1636. T. Broadbent, jun., Crawford-street—Filtering liquids.
1637. M. F. Isoard, Paris—Generating steam.

*Dated 20th July*, 1855.

1640. H. D. P. Cunningham, Gosport—Reefing sails.
1642. J. H. Johnson, 47, Lincoln's-inn-fields—Motive power. (A communication.)
1644. G. Conner, Liverpool—Brushes.
1646. C. Deschamps and C. Vilcoq, Paris—Free diving boats.

*Dated 21st July*, 1855.

1652. R. M'Laren and S. W. Pugh, Peckham—Artificial fuel and fire lighters.
1654. C. Goodyear, 25, Avenue-road, St. John's-wood—Printing surfaces. (Partly a communication.)
1656. A. Dugdale, Paris—Locomotive engines.
1660. W. E. Kenworthy and H. Greenwood, Leeds—Screw propellers.

*Dated 23rd July*, 1855.

1662. H. W. Ripley, Bradford—Finishing woven fabrics. (Partly a communication.)
1664. C. Goodyear, 25, Avenue-road, St. John's-wood—Moulded articles of compounds of india rubber. (A communication.)
1666. C. Goodyear, 25, Avenue-road, St. John's-wood—Combs.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3741 | August 4. | New Soap Cutting Machine | Isaac Shaw | 102, North-lane, Brighton. |
| 3742 | August 8. | The Improved Mule Portmanteau | Geo. Robert and John Bengough | 4, Tichborne-street, Piccadilly. |

Journal of the Society of Arts.

*FRIDAY, AUGUST* 17, 1855.

## MEETING OF COUNCIL.

Wednesday, 15th August, 1855.

The following Institutions have been taken into Union since the last announcement:—

397. Burton-upon-Trent, Literary Society.
398. Stafford, Mechanics' Institution.

## SOCIETY'S VISIT TO PARIS.

The Secretary, having returned from Paris, is enabled to announce that arrangements have been made for the presentation from the Society of addresses to His Imperial Majesty the Emperor of the French, and also the Prince Napoleon, the President of the Imperial Commission. The Imperial Commision will invite the members of the Society, during their stay, to an evening reception at the Palais de l'Industrie; and the public authorities have expressed themselves as most desirous of giving every facility to the Society for visiting public places in Paris and its neighbourhood, and also of doing everything in their power to render the Society's visit agreeable and profitable.

The Secretary has much pleasure in announcing that the French Consul has, in the most handsome manner, signified the intention of his Government to issue passports to the Members of the Society without any charge whatever.

The Secretary regrets that he has been unable to secure any reduction in the fares on the Boulogne and Folkestone, and Dover and Calais routes, as the South-Eastern Company had led him to expect, they alleging as a reason that the Directors of the Northern of France will not agree to any reduction in their fares. These fares, therefore, remain as hitherto, £4 10s. first-class, and £3 5s. for second-class return tickets to Paris and back.

The other routes available for visiting Paris, with their respective fares, are as follows:—

Brighton Railway (Newhaven, Dieppe, and Rouen Route).—Times of starting, every day to suit the tide. Return tickets to Paris and back, available for 15 days, £2 8s. first class, and £1 12s. second class. Single journey through tickets to Paris, £1 8s. first-class, and £1 second class.

South-Western Railway (Southampton, Havre, and Rouen Route).—Return tickets to Paris and back, available for 15 days, £2 8s. first-class, and £1 12s. second-class. Single journey through tickets to Paris, £1 8s. first-class, and £1 second-class. The single journey ticket is available for four days, enabling the bearer to break the journey at different places on the route. This service is performed four days in the week only, namely, Monday, Wednesday, Friday, and Saturday.

General Steam Navigation Company's Boats from London Bridge (Boulogne and Calais Route).—Return tickets to Paris and back, available for 15 days, £2 8s. chief cabin and first-class railway, £2 chief cabin and second-class railway, and £1 12s. fore cabin and second-class railway. Single journey ticket, £1 8s., chief cabin and first-class railway, £1 4s. chief cabin and second-class railway, and £1 fore-cabin and second-class railway. This service is performed four times in the week only, namely, Sunday, Tuesday, Wednesday, and Friday.

Tilbury Route.—Eastern Counties Railway, Fenchurch-street Terminus, to Tilbury, and thence by Commercial Company's boats to Boulogne, and by rail to Paris. Return tickets to Paris and back, £2 8s. first class, and £1 12s. second class, available for fifteen days. Single journey through tickets to Paris, £1 8s. first class, and £1 second class.

Dunkirk, Lille, and Paris.—General Screw Steam Shipping Company, from Irongate Wharf. To Dunkirk, 10s. first class, 7s. second class; Lille 13s., 11s., and 9s., according to class. Single journey through tickets to Paris, £1 8s. first class, and £1 second class.

The return tickets and through tickets by the General Steam Navigation Company's route cannot be obtained on board the boat, but must be taken at the Company's offices, 71, Lombard-street, or 37, Regent Circus, London, or 13, Rue de la Paix, Paris. Members will observe that there is very little saving in taking return tickets, over two single journey through tickets, and that by adopting the latter, the traveller has the option of going and returning by two different routes.

As many persons have been proposed as members, and owing to their being no meetings of the Society cannot be balloted for until the commencement of the Session in November next, it has been determined, in order to prevent disappointment, that all persons duly proposed shall at once be entitled to the general Privileges of a Member on payment of their first year's subscription.

The following list of hotels is given for the convenience of members proposing to visit Paris.

They have been divided into three classes, viz., 1st, Those in the more fashionable quarter; 2nd, Those in the neighbourhood of the Bourse and commercial houses; and, 3rd, Those on the south side of the river.

Members are strongly advised to write to Paris and secure their accommodation one week at least before their arrival in Paris.

### Hotels in the More Fashionable Quarter.

Hotel de l'Amirauté, Rue Neuve St. Augustin, 55.
Hotel Bedford (Lawson's), Rue de l'Arcade
Hotel Brighton, Rue de Rivoli.
Hotel Bristol, Place Vendôme, 5.
Hotel Canterbury, Rue de la Paix.
Hotel Choiseul, Rue St. Honoré.
Hotel Douvres, Rue de la Paix.
Hotel de l'Empire, Rue Neuve St. Augustin.
Hotel des Etrangers, Rue Vivienne, 3.
Hotel de France, Rue St. Honoré.
Maison de Goest, Rue Neuve St. Augustin, 46.
Hotel de Lille et d'Albion, Rue St. Honoré, 323.
Hotel Meurice, Rue de Rivoli, 42.
Hotel d'Orient, Rue Neuve St. Augustin.
Hotel d'Oxford et Cambridge, Rue d'Alger.
Hotel de Paris, Rue Richelieu, 99.
Hotel des Princes, Rue Richelieu, 97.
Hotel de Rastadt, Rue Neuve St. Augustin.
Hotel du Rhin, Place Vendôme, 4.
Hotel Rivoli, Rue de Rivoli, 24.
Hotel Sinet, Rue St. Honoré.
Hotel de la Terrasse, Rue de Rivoli.
Hotel Wagram, Rue de Rivoli, 28.
Hotel Westminster, Rue de la Paix.
Hotel Windsor, Rue de Rivoli, 38.

### Hotels in the Neighbourhood of the Bourse and Commercial Houses.

Grand Hotel d'Albion, Rue de Bouloi, 20.
Hotel d'Allemagne et Navarras, Rue de Bouloi, 13.
Hotel des Hautes Alpes, Rue Richelieu, 12.
Hotel des Ambassadeurs, Rue St. Anne, 73.
Hotel d'Athenes, Rue St. Roch, 39.
Hotel d'Angleterre, Rue des Filles St. Thomas, 10.
Grand Hotel d'Angleterre, Rue Montmartre, 56.
Hotel Bescancon, Rue de la Sourdière, 3.
Hotel Bibliothèque, Rue de Bibliothèque, 25.
Hotel Bouloi, Rue Bouloi, 5.
Hotel Bourdeaux, Rue Montmartre, 96.

Hotel Bretagne, Rue Croix des Petits Champs, 14.
Hotel Bretagne, Rue Richelieu, 23 bis.
Hotel Bruges, 34, Rue Valois, Palais Royal.
Hotel Bruxelles, Rue Richelieu, 43.
Hotel du Commerce, Rue Bouloi, 18.
Hotel de Normandie, Rue St. Honoré, 240.
Hotel Rome, Rue Montmartre, 136.
Hotel Rouen, Rue Croix des Petits Champs, 42.
Hotel St. Armand, Rue de Bouloi, 14.
Hotel St. Roch, Rue St. Roch, 13.
Hotel Sourdière, Rue Sourdière, 2.
Hotel de Tours, Place de la Bourse.
Hotel de Tyrol, Rue Montmartre, 162.
Hotel de Toulouse (vis à vis la Banque de France), Rue Baillif, 2.
Hotel de l'Univers et Etats Unis, Rue Croix des Petits Champs, 10.
Hotel de l'Univers, Rue Fontaine Molière, 21.
Hotel Voltaire, Rue Racine, 18.
Hotel de Vosges, Rue du Croissant, 6.
Hotel des Voyageurs, Rue Montmartre, 112.
Hotel de York (ci-devant Hotel Choiseul), Rue St. Anne, 61.

Hotels on the South Side of the River.

Hotel d'Angleterre, Rue Jacob, 22.
Hotel Beauvais, Rue St. Jacques, 185.
Hotel Bellevue, Rue Grenelle St. Germain, 56.
Hotel Berry, Rue de Seine St. Germain, 24.
Hotel Bou la Fontaine, Rue de Grenelle St. Germain, 16.
Hotel Bordeaux, Rue Jacob, 17.
Hotel Borysthène, Rue Vaugirard, 30.
Hotel Boulogne, Rue St. Germain l'Auxerrois.
Hotel Bourbonnes-les-Baure, Rue de l'Université, 9.
Hotel Bruxelles, Rue de Seine, 44.
Hotel Chemin de Fer de l'Oust, Boulevart Montparnasse, 43.
Hotel Clarence, Rue Grenelle St. Germain, 26.
Hotel Colonies, Rue St. Dominique St. Germain, 35.
Hotel Corneille (near the Garden of the Luxembourg Palace), Rue Corneille, 5.
Hotel Coté d'Or, Rue St. Dominique St. Germain, 3.
Hotel Deux Jumeaux, Rue St. Jacques, 15.
Hotel Empereur, Rue Grenelle St Honoré, 20.
Hotel Etrangers, Rue Racine, 2.
Hotel France, Rue Bonaparte, 50.
Hotel Grenelle, Rue Grenelle St. Honoré, 17.
Hotel Henri IV., Rue St. Jacques, 9.
Hotel Intendance, Rue de l'Université, 50.
Hotel Jacob, Rue Jacob, 44.
Hotel Lisbonne, Rue Vaugirard, 4.
Hotel Londres, Rue Buonaparte, 3.
Hotel Londres et de France, Rue Fosse St. Jacques, 20.
Hotel Louisiane, Rue Jacob, 5.
Hotel Louvre, Rue Fosse St. Germain l'Auxerrois, 38.
Hotel Luxembourg, Rue Vaugirard, 54.
Hotel Luxembourg, Rue St. Jacques, 69.
Hotel Maroc, Rue de Seine St. Germaine, 47.
Hotel Voltaire, Quai Voltaire.

## PARIS UNIVERSAL EXHIBITION.

A letter has recently been addressed to the Chambers of Commerce of the United Kingdom by the Board of Trade, calling the attention of those which are established in the various seats of British industry to the machinery for producing manufactures, and to the manufactures themselves, which are exhibited in the Paris Exhibition by France and other European countries; and of those Chambers which are situated in our great seaport towns, to the various kinds of imports, and especially those from the Colonies of the United Kingdom. At the same time, a suggestion is made that it would be advisable if the Chambers were to depute some of their members, possessing technical knowledge on the subject, to visit the Paris Exhibition, for the purpose of furnishing a detailed report of the result of their observations. It is believed that the progress of manufacturing production shown on this occasion, and its probable competitive influence on the markets of the world, will be found to be well worthy of the serious consideration of the producers of the United Kingdom, and should the suggestion be carried out with proper spirit, the Board of Trade expresses an opinion that a series of Reports on the industrial position and recent progress of Europe would be obtained far more practical and useful than any reports which the Board could hope to obtain itself through its own agency.

## ON THE SANITARY APPLICATIONS OF CHARCOAL, AND ON VENTILATION.

By J. Forbes Watson, A.M., M.D., Bombay Army.

Before considering a few of the more definite methods by which charcoal can be brought to bear as a sanitary agent, I would touch shortly upon its action, or the manner in which it deals with, and destroys, the various noxious gases which result from the decomposition of animal and vegetable matter.

The power of charcoal as a purifier of water and sweetener of tainted meat has been known, probably for ages, but it is to Dr. Stenhouse, of St. Bartholomew's Hospital, that we are indebted for the elucidation of the principle on which it acts, as well as for the idea of applying it to the filtration of impure atmospheric air; but to Mr. Turnbull, of Glasgow, belongs also the credit of having first demonstrated and directed attention to its wonderful power over decaying animal matter.

Charcoal, as is well known, has the power of absorbing various gases in large quantities, and, perhaps, few more readily than those which arise during the decay of dead animal and vegetable substances. But charcoal does something more than simply absorb, for it is evident that, if it possessed no other property, a point would shortly be reached, when, having become quite saturated, it would cease to act. Charcoal, then, has another power in addition to that of absorption, and for the illustration of this I would refer to the following striking experiment:—Certain dead animals were placed in an open box and covered with a layer of roughly-pounded wood charcoal, rather less than three inches in thickness, and all the decomposible portions disappeared more rapidly than if they had been buried in the ordinary way. Moreover, the boxes containing these dead animals were kept for many months in a room in which several persons were employed during the day, but still no disagreeable effluvia were detectable, and their health remained unaffected.

All decaying animal and vegetable matters give off, during decomposition, fœtid and deleterious gases, which, in the end, tell as fatally upon the human constitution as does the bite of a viper, or the most insidious poison known to the chemist, and the animals referred to in these experiments formed no exception to this rule—a fact which could be readily ascertained by removing a portion of the charcoal so as to get nearer to the putrid mass below. From this, therefore, it follows that not only does the charcoal hasten decomposition, but that those deadly gases that are constantly being given off, become, in their passage through the charcoal, converted into inodorous and comparatively harmless ones.

The explanation of this peculiar result is simple and very beautiful. Charcoal is an extremely porous substance, presenting through its mass an almost incredible amount of surface, and upon this depends its power of absorbing various gases in such large quantities. The oxygen of the air is the great vivifier of nature. The deadly emanations given off by decomposing matters are in what is called a "low state of oxidation," that is, they contain a comparatively small proportion of oxygen. Combine them with, or force them to take up, more of

this purifying element, and the point is gained—that which perhaps an instant before would have proved most hurtful if breathed, becomes now almost entirely resolved into harmless combinations.

Now charcoal contains within its pores a very large proportion of oxygen, amounting to rather more than eight times its bulk. As already shown, it absorbs the various putrid gases with avidity, and in this way they are brought into intimate contact with the condensed oxygen existing in the charcoal, and the result is as has been described.

Such, then, is the action of common charcoal in dealing with the fœtid gases of decomposition. It not only absorbs but destroys them; that done, it gives out the resulting comparatively harmless products; room is made for more oxygen from the air, and more of these bad gases from whatever source, and thus the process ceaselessly goes on. In this manner the charcoal is, so to speak, constantly purifying itself and under ordinary circumstances, with occasional exposure in front of a large fire, or to the sun's rays, its powers remain intact for an almost indefinite period. This secondary, or self-purifying action of charcoal is, however, a slow process, and, therefore, bulk comes to be an important element in calculating the amount of charcoal to be employed in particular cases, as will be shown afterwards.

To increase, then, the oxidizing power of the charcoal, so as to enable in some instances a smaller quantity to be used, is an object of considerable importance, and this for many purposes of the chemist has been effected. Platinum, in a finely divided state, has less power of absorption than charcoal, but it causes oxygen to combine with certain gases with infinitely greater avidity. Dr. Stenhouse, therefore, resolved to endeavour to deposit in the pores of the charcoal, a certain proportion of platinum, in the metallic form, and this he readily accomplished by boiling the charcoal in a solution of this metal in aqua-regia, evaporating to dryness, and afterwards subjecting it to the action of a red heat in a close vessel. The result exceeded his expectation, for he found that charcoal containing only two per cent. of platinum had its alterative or secondary power immensely increased, for some chemical purposes, although, I fear, that practically, the *permanency* of its action over morbid gases will be found to have become diminished by the addition of the platinum.

This conclusion I have reluctantly been obliged to come to from the following experiments:—Small but definite amounts of flesh in an advanced state of decay were covered with equal quantities of common wood charcoal, and of "platinized charcoal," the latter containing platinum in the proportions by weight of six, two, and one-fourth per cent. The jars containing these specimens were carefully and frequently examined. For the first two or three days no smell from either was detectable. After that period, however, a slight odour was perceived from the one with the common charcoal, thus showing that *at first* the addition of the platinum had probably increased the power of the substance. A small additional quantity of common charcoal was then added, and the jar containing this specimen has ever since remained almost constantly on my mantel-piece without causing the slightest inconvenience. The history of the other specimens, or those with the "platinized charcoal," is not so satisfactory. Although at starting, apparently possessed of greater power than the common variety, this in the course of four or five days, ceased to be the case, and it is remarkable that, in the end, the charcoal which contained the 6 per cent. or largest proportion of platinum was found to have the least power, although at first it seemed to have the greatest. From this it is evident that the platinum used in the above experiments had damaged to a certain extent that permanency of power which the charcoal itself usually possesses. It perhaps interfered in some way with the porosity of the charcoal, on which so much depends, but at the same time it is quite possible that its employment in still minuter quantities (or according to a different mode of preparation), may prove of advantage.

These experiments will be again repeated, and with regard to other points in what may be called the "science" of the whole of this most interesting subject, I may mention that a good deal has yet to be done.

The practical facts are, however, such as have been indicated, and these are amply sufficient to prove that in a sanitary point of view charcoal is not only the cheapest and most easily applied, but, perhaps, the most effective agent yet discovered.

Given, then, a substance with properties such as have been detailed, the question next comes to be how most efficiently to apply it?

The idea of the air filter, as already mentioned, originated with Dr. Stenhouse, but believing that something had still to be done with regard to its practical development, and foreseeing, moreover, that unless some striking demonstration was afforded to the public of the powers of this material, much valuable time was certain to be lost, I proposed to Dr. Stenhouse that we should conjointly carry out, on a somewhat extensive scale, a series of investigations into the modes of more practically bringing charcoal to bear as a sanitary agent than had yet been effected.

This was accordingly done, and last month the apartments in which these were carried on were thrown open to the public, so as to enable all who took an interest in the subject to judge for themselves,* and it now remains for me to detail the methods which have been adopted in these experiments, and to indicate the practical deductions which are to be drawn from them.

The first and most important application of charcoal as a sanitary agent to which I would refer, is one by which in a definite manner pure air can be insured to individuals in the mass. This is effected by means of a charcoal filter, through which the air is made to pass preliminarily to its diffusion within the building, &c., to be ventilated. More than six months ago charcoal had been applied for this purpose, both at the Mansion House and at Guildhall, but its power when dealing with a decidedly impure atmosphere had still to be demonstrated.

Ample proof, from many sources, had been afforded of the wonderful power of charcoal over a polluted air under *still* conditions, but the problem for solution continued to remain, whether a putrid atmosphere, passing at the rate of many hundred cubic feet per minute, would become purified; whether, in short, the charcoal would have time, so to speak, to secure and destroy the various impurities during their passage. The amount of charcoal to be employed had likewise to be settled, for it was quite clear that its powers must have a limit, and that only harm would arise to a good cause by assuming too much. For this purpose, the filter used in these experiments was so constructed as to allow the amount of charcoal employed to be varied according to circumstances.

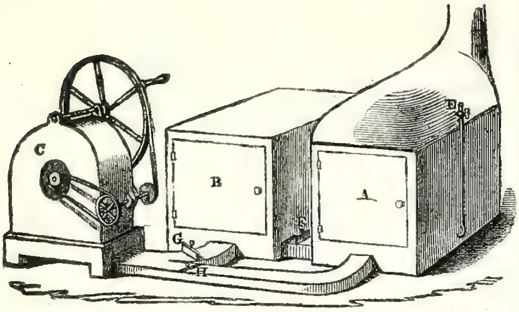
The charcoal air filter then, in the present instance, consists of a case in which are placed a series of layers of common wood charcoal, broken into angular fragments, varying from the size of a pea up to that of a large bean. These are contained in flattened cages, made of stout wire gauze, set in wooden frames, and the air to be purified is forced through by means of a revolving fan of the requisite power.

Of course, in all cases the size and shape of the filter—the thickness and extent of charcoal to be employed—the power of the fan, and so forth, must be adapted to circumstances, as, for example, the volume of air required for the ventilation of a given building—the facilities for moving the apparatus—the known malariousness of a district, &c.

* Further opportunity for this is about to be afforded by the removal of our apparatus to the Polytechnic

The filter used in the experiments referred to, and of which A in Fig. 1 is a representation, is of considerable

Fig. 1.



dimensions, sufficiently so, in fact, to ensure the purification of the air necessary for a building of very large size. Light portable ones, however, of simple construction, with small fans, throwing from two to three hundred cubic feet of air per minute, could be made, and these would be perfectly sufficient for the ventilation of hospital or other large tents, as well as for buildings of an ordinary size. The case for the air filters may be made of wood or other materials. The present one is constructed of zinc; it is three feet six inches in length; the same in height; and two feet in breadth; and the thickness of each of the filters, as seen in section in Fig. 3, amounts to three inches, giving, when the whole four are employed, a depth of 12 inches of charcoal fragments through which the air to be purified has to pass. These filters are made to slide air-tight into their places, and can be readily removed at pleasure.

The fan employed, C, Fig. 1, is calculated to throw, when worked by the hand, about six hundred cubic feet per minute, but from this amount 200 cubic feet will probably have to be subtracted, on account of the resistance offered by the charcoal, but this may be reduced to a fraction by increasing the extent of surface presented by the filters. In some cases, as in warm climates, it is, however, an object to secure a certain amount of pressure inside the filter, as, by this means, the temperature of the air in the apartment to be ventilated becomes lowered, and this affords a reason why, under such circumstances, the fan to be employed should be capable of forcing (or drawing, as the case may be,) the air through with considerable power. The one used in these experiments throws a large volume of air, but not with much force, but, even, with it the average of a number of thermometric observations showed that the temperature of the air in the adjoining apartment had suffered a diminution of 1½ degrees in consequence of its passage through the filter.

The filter constructed as described, it then remained to ascertain, in the first place, the extreme point to which the power of a certain quantity of charcoal could be pushed; to get, in short, some definite idea of the capabilities of the substance with which we were dealing. This was effected by placing in the bottom of the filter, as attempted to be shown in Fig. 3, a jar, or, in reality, two jars, containing several dead rats in an advanced state of putrefaction, a fact which could be readily ascertained by opening the door of the filter, or the stop cock at E in Fig. 1. The tube there shewn communicated with the bottom of the filter, in which these matters were, and the purity of the air after its passage through the charcoal could be readily demonstrated by means of the opening at A in Fig. 4, (this figure will be inserted in the next number,) as well as by a small aperture immediately at the top of the filter. In the experiment above referred to, the layers of charcoal amounted to nine inches in thickness, and the jars containing these dead animals were kept *constantly* inside the filter-case, and the air after its passage frequently and carefully tested. For nearly four days it stood this extreme trial, but at the end of that period it commenced to fail; the fœtid gases which had hitherto been secured and destroyed during their passage through the charcoal could now be detected.

Fig. 2.

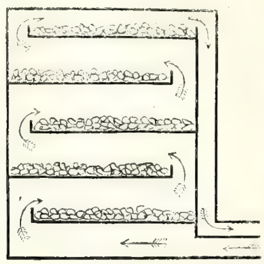
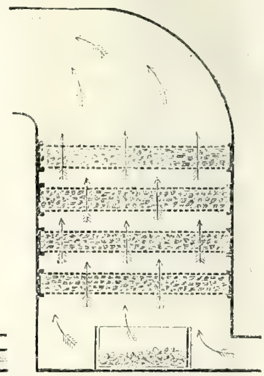


Fig. 3.



A limit to the power of the filter had in short been reached, and it now, therefore, remained, either to increase the bulk of the charcoal through which the air had to pass; to introduce a fresh supply; or to allow that already in the apparatus time to recover itself. The first and last of these alternatives were adopted. An extra layer of charcoal, three inches in thickness, was inserted, and those already in the filter freely exposed to the air, and the precaution was also taken of employing only one of the jars and removing it at night, and the whole then continued in satisfactory operation until the completion of our experiments, or for a period of about three weeks.

On several occasions a little fœtor in the filtered air could be detected, and at the expiration of a fortnight fresh charcoal was introduced, but the fault had not lain with it, as the annoyance entirely ceased on repadding the sides of the filters, so as to ensure more completely the passage of all the air through the charcoal; and I mention these particulars in order to suggest to others the precautions which are so essential in experiments of this nature.

With regard to the practical results to be deduced from these observations: the first I believe is, that in no case should the air-filter, or body of charcoal employed, be less than six inches in thickness, and although it would be hardly possible to conceive conditions which will more severely test its powers than those made use of in the foregoing experiments, still, in all cases, the error in point of bulk ought to be on the "safe side," for it at most only involves the use of a few inches more of charcoal, and, perhaps, a fan of rather more power; and having once laid down the amount of charcoal to be employed, it may be arranged in a single compartment so as to form one layer, as by this means the size of the case (when one is required) can be very much diminished. I should likewise recommend that a spare filter of the proper dimensions be kept in reserve, so as to enable the one in use to be replaced once a week, or oftener if necessary; and that not employed ought to be, in the interim, freely exposed to the action of the air and sun's rays, or to heat in front of a fire, and it would, perhaps, also be advisable to refill the filters with fresh charcoal every six months or so.

So much, then, for the "charcoal air-filter," an application the importance of which, I believe, can hardly be overrated.

In addition to the air-filter is, however, another contrivance, which I consider likely to prove of much advantage, especially in tropical countries.

During the course of a series of observations made in India, on the direct influence of climate on the human body, I found that after a period of continued rain—

as during the monsoon—the blood became deteriorated in a remarkable and striking manner; and that this was no accidental occurrence was proved from the fact that it was found, towards the end of the rainy season, to exist, without exception, in every case which I examined. The details of these observations will be published elsewhere, but I may shortly mention that the chief alteration alluded to was found to occur in the blood corpuscles, as ascertained by achromatic microscopes, under every possible precaution for securing truthful results. The change presented itself in two ways: in the first the red globules of the blood, which are usually pretty regular in size, were found to vary, and that to a considerable extent, some of them being not larger than the one-six thousandth of an inch in diameter, or nearly one-half less than ordinary; but the most striking feature was, that the great majority of them, instead of presenting their usual smooth appearance, were found studded with small highly-refracting granules, evidently from that, and other circumstances of a fatty nature. The blood-cells, in short, had undergone a change which some of my readers will recognise as constituting that peculiar morbid condition known, when affecting various tissues, under the name of "fatty degeneration."

The reason for this change under the circumstances referred to it is not difficult to divine. An excessive amount of moisture in the air interferes materially with the functions of those two great filters, the lungs and the skin, and the result is that the vital conditions of the blood itself become altered, and ultimately the general health impaired; and, although the inhabitants of temperate climates are not liable to be exposed for any very lengthened period to such influences, still, doubtless, to a certain extent, the same effects are produced in all countries during protracted wet weather.

Grant this, and it becomes, therefore, an object of importance to remove from the air a certain proportion of its moisture when excessive in quantity.

This can, to a considerable extent, be effected by passing the air, previously to entering the charcoal filter, over a series of trays containing quicklime. In Fig. 1, B represents a lime-box, of which Fig. 2 shows a section, which will sufficiently explain the arrangement adopted.

The case containing the limetrays is made of stout tin, and of the same dimensions as its neighbour, the air-filter, and at G H and F in Fig. 1 are stop-cocks of simple construction, which admit of the drying apparatus being used at pleasure. The trays containing the quicklime are five in number, three inches in depth, three feet three inches in length, and two feet in breadth, thus presenting a drying surface of upwards of 32 square feet in all.

The lime employed ought, of course, to be as fresh, or "quick," as possible; it should be in pieces about half the size of a man's hand, and the trays ought to be only three-fourths filled, in order to allow for the increase of bulk which attends the process of "slacking," during the passage of damp air, and which, from the nature of the arrangement, occurs with tolerable facility, especially if the fan be slowly driven, so as to allow the air to pass more gradually.

For this country an apparatus of the size here indicated would likely be quite sufficient, but, considering the very large amount of moisture which an Indian atmosphere contains during the monsoon, I am inclined to think that perhaps one of larger dimensions, with a couple of additional trays or so, may be required. This is, however, a matter of experience which cannot be settled at this distance.

In order to have, as far as possible, Indian conditions, I saturated, by means of steam, the air in the outside apartment, in which the fan, &c., were placed, and then carefully tested the effect produced by the lime-box, or desiccator, and these observations, as well as those formerly alluded to, were repeated by Mr. Richard Tuson, with results similar to my own.

In the outer room, the air, on testing it with Daniell's hygrometer, was found to be within rather less than one degree of saturation, whereas, after its passage through the apparatus, the dew point was found to have fallen between six and seven degrees, indicating that a considerable drying effect had been secured, although the entrance of the external air tended somewhat to complicate the results obtained.

I may mention that, the slight increase of temperature, caused by the lime-box, appeared to be fully compensated for during the passage of the air through the charcoal filter, and probably this could in all cases be more than counterbalanced by enveloping the apparatus in wet cloths, &c., and this leads me to make a few remarks on the cooling of the air in tropical countries,—a subject of very great moment, but one, towards the practical accomplishment of which, a great deal has yet to be done.

The low conducting power of the air offers a barrier to any great cooling effect being produced by the direct action of the cold generated during the vaporisation of water, but still some good can be effected by having the cases, tubes, &c., covered with wet cloths, and kept in a draught. The question, however, of sufficiently reducing the temperature of the air, in a tropical country, resolves itself into, how cheaply and efficiently to condense atmospheric air, so as to allow it to give off its latent heat previous to its admission and circulation within a given chamber? This, to a certain extent, has already been done, but the expenses, involved in carrying out the process, have hitherto rendered it practically unavailable.

The method adopted in India of cooling the air by means of "*tatties*," or wet mats, through which the air is made to pass, I consider, in the great majority of cases, to be decidedly objectionable, on account of the effects, on the system, which are induced by the moisture thus introduced into an apartment. It is, doubtless, agreeable to the feelings in the mean time, but the results eventually produced are, I believe, detrimental to health. The hot dry season in India is the most trying, as far as the sensations are concerned, but it has to be noted that, upon the whole, it is more healthy than any other period of the year; and from my own observations at Jacobabad, in the desert of Upper Sinde, I am inclined to think that the existence of, even, a certain proportion of moisture, in the air, is not so necessary as is generally believed, and at the worst, in the vast majority of cases, only involves the drinking of a pint, or more, of extra fluid.

During a series of experiments made towards the end of the cold season, in February and March of 1852, embracing a period of twenty-five days, I found that the average quantity of moisture, by weight, existing in the atmosphere, as ascertained by passing a definite volume through a tube containing chloride of calcium, the same as used in organic analysis, did not, over the whole of that period, amount to—*one grain* in the cubic foot of air; and on several occasions the atmosphere was perfectly moistureless! as was shown by the fact, that the apparatus, at the termination of the experiment, had not only not gained, but had actually lost, weight from the desiccation of the chloride of calcium itself produced by the dry air passing over it. During the whole of the cold season in Upper Sinde the air is extremely dry, but, nevertheless, a more agreeable climate than it *then* possesses does not perhaps exist anywhere.

(*To be continued.*)

## ON THE "DESCRIPTIVE MEASUREMENT" OF SHIPS AND STEAMERS, DEFINING THEIR TONNAGE, DISPLACEMENT, AND CAPACITY; AND A REVIEW OF THE BILLS RECENTLY BROUGHT BEFORE PARLIAMENT WITH REFERENCE TO THEIR SAFETY AND CAPABILITIES FOR MERCANTILE TRANSPORT SERVICE.

By Andrew Henderson, M.S.A. & Assoc. Inst. C.E.

On entering upon a subject which will lead to very extended remark from me, I shall first draw your attention to the actual position which the question occupies, together with the opinions which have been recently given on the subject by different scientific men, and I shall then offer some observations resulting from my own acquaintance with the subject.

On the 16th of May last, a paper was read at the Society of Arts by Mr. Atherton, Chief Engineer, Woolwich, on "The Capability for Mercantile Transport Service of Steam Ships, with reference to the Mutual Relations of their Tonnage, Displacement, Engine Power, Steaming Speed, Distance to be Run without Re-Coaling, Tons Weight of Cargo, and the Expense Incurred per Ton of Cargo Conveyed." This interesting paper was prefaced by a speech from the noble Chairman, the Right Hon. the Earl of Hardwicke, in which, among many observations remarkable for their point, there was none more applicable to the subject of this paper than the following:—"The subject to be submitted by Mr. Atherton appeared to him to be one more wanting to be considered than almost any other, a subject, it appeared to him, at this moment, if considered and brought into a proper focus, and into a properly tabulated and graduated form, which would render more service in point of revenue to the State, in point of revenue to the merchant, in point of fitting to the ship, than any other point which had been considered in reference to steam power. If from the meeting of to-night should emanate a system which might be secured and fastened upon the maritime power of this country, then indeed should he glory in having been their chairman."

To effect the objects alluded to in this speech, a Bill was brought into the House of Lords by the Earl of Hardwicke, entitled, "An Act to make further Regulations as to the Measurement and Registration of Merchant Steamers." In moving the second reading of this Bill, the noble Earl said that, "he was desirous that some addition should be made to the existing law as it affected measurement and registration." * * * "The internal measurement of a ship, by which the tonnage was calculated, was merely a statement of its capacity for holding a certain quantity of materials, but then the question arose, what these materials might be?" * * * "It was necessary that persons who wished to purchase the use of a ship or to obtain her services, should possess the means of ascertaining accurately what weight of materials she would carry." The noble earl then clearly showed that it was possible for the tonnage of a vessel to represent by measure an amount which her real power of carrying did not approach, while on the other hand, the tonnage of a ship by measurement might in reality be very much beneath her real carrying power. The third clause of this Bill proposed that the certificate of the builder and surveyor previous to registry, should specify the deep, light, and launching draught of water, and the corresponding external measurement expressed in cubic feet, the displacement in tons weight to be deduced therefrom.*

In opposition to this, the President of the Board of Trade urged, with reference to new measurement under the Merchant Shipping Bill of 1854, "that the objects of the Bill were to procure a test of the size of the ship for light, dock, and other dues." * * * "That of the two modes, first by displacement, to ascertain the weight carried, and, secondly, by measurement, to ascertain the available space, it was more important to ascertain the number of cubic feet in a vessel, and to accomplish that object the alterations were made, so as to give an accurate measurement of the capacity of a ship in cubic feet." "That this subject had been brought before government by a commission which heard evidence and recommended Moorsom's plan for adoption, adding that it had been submitted to all the local marine boards, Trinity boards, and to the Admiralty, the only dissentients to Moorsom's plan being one assistant-surveyor and one master-builder of H.M. dockyard." The noble president concluded by saying, that as not one single objection had been made to the present mode, a sufficient case had not been made out, and he opposed the second reading of the Bill. Lord Colchester, however, seconded the Earl of Hardwicke's proposal, that the subject might be referred to a select committee, but this was negatived by 28 to 21, in consequence of the opposition of the government.

It should be observed, that the technical difficulties and consequent misunderstanding to which the noble president of the Board of Trade alluded in the opening of his speech, are fully borne out by the inaccuracy into which he appears to have fallen, for he assumed that the government commission had recommended for adoption Mr. Moorsom's system of internal measurement, and that it was more important to ascertain the available space of a vessel than it was to know her displacement or the weight she could carry. The real facts are these. The committee of 1849, of which Lord John Hay was chairman, reported, "that the equitable basis on which charges, for dock, harbour, and other dues should be made, is the entire cubic contents of all vessels measured *externally*." In 1850, a Bill was brought in by Mr. Labouchere, the then President of the Board of Trade, carrying out this system of external measurement (as proposed by Mr. Parsons, a member of the committee,) by the use of diagrams and curves of areas, the eleventh clause providing a scale of displacement for ascertaining the weight of cargo received or discharged, such as was proposed in the Bill brought in by the Earl of Hardwicke. This last clause of the Bill of 1850 enacted that, "The owners of ships measured by Rule No. 1 may require from the Commissioners of Customs, upon payment of the expense of making such scale, a table of tonnage for ascertaining the weight of cargo to be received on board or discharged, to be attached to the certificate of registry." With reference to this, I proposed to the Board of Trade, in March, 1850, an amended Bill and plan, suggesting that as the Bill did not clearly define the mode in which the areas were to be measured, the curves formed, &c., that by substituting for the above part of the 11th clause, detailed rules or directions for the measurement of transverse areas, the formation of diagrams, of sections, and curves of areas, as well as the computation of tonnage and displacement, and enacting that these be recorded on the certificate of survey, signed by the builder, owner, surveyor, and registrar, all difficulties would be obviated and the scale of tonnage provided. Notwithstanding these suggestions, Mr. Labouchere's bill for *external* measurement was opposed by Mr. Moorsom, who advocated the continuance of the internal measurement then existing, merely substituting a more correct calculation. This plan of Mr. Moorsom's, adopted in the Bill of 1854, so far from having been recommended by the Tonnage Committee, is in principle and detail in direct opposition to it.

Both the Report of the Tonnage Committee, and the Bill of 1850, based the tonnage on the entire cubical contents of the ship, measured externally to the height of the upper deck, by the use of diagrams of sections and curves of areas, using the factor 27-hundredths of

* The fourth clause proposed the standard measure or unit of marine horse-power to be 100,000lbs. raised one foot high in a minute, *as being nearly in accordance with the actual amount of working power now usually called horse-power in marine engines.*

the bulk or displacement for a registered tonnage, approximating the old or builders' tonnage.

Objections were raised to external measurement by Mr. Gilmore, the owners of timber ships, and builders of iron ships, on the assumption that light or measurement cargo exceeded in tonnage the heavy or dead weight goods; and on the ground that iron vessels had much greater internal space than timber ships. A reference to Trade Returns, No. 51, of 1850, has shown that of the total exports and imports, amounting to 10,760,217 tons, there were 7,482,214 tons of heavy goods—only 31 per cent. being light or measurement cargo, the heavy or dead weight goods amounting to 69 per cent. of the trade. As the capacity of iron ships for light goods exceeds that of timber ships from ten to fifteen per cent., it is evident that a system combining both external and internal measurement would be most equitable.

In May, 1850, I submitted to the Board of Trade a plan and formula, showing that the mode of external measurement and computation of bulk and tonnage adopted in Rule No. 1 of the Bill of 1850, was equally applicable to ascertaining the internal capacity; and that by one measurement, taken either externally, as proposed by the Bill, or internally, as proposed by Mr. Moorsom, both the external bulk and internal space could be ascertained by means of diagrams and curves of areas; and to meet the irregularities of light goods and dead weight of iron and timber ships, *I then proposed and still advocate* the adoption of the mean of the external bulk and internal space in cubic feet as the bases of register tonnage.

The question remained in abeyance during the sessions 1851, 1852. Mr. Moorsom, however, published his plans from time to time, with the opinions of several naval architects, surveyors, and others, which were submitted to the local Marine Boards; that of London reporting that "*in the absence of any other proposed plan they recommended its adoption.*"

In November, 1852, I again forwarded copies of my plan to the Board of Trade, with the request that they might be similarly placed under the consideration of the several local Marine Boards, Government officers, and shipowners, suggesting, also, the organisation of a tonnage committee, consisting of members of those boards and of scientific institutions, &c. My plans were not submitted to the local Marine Boards, nor was any attention paid to the suggestion of extending the nautical department of the Board of Trade by a Board of Mercantile Marine, where each branch of the shipping trade wou d be represented by men of nautical and practical experience. The subject of tonnage measurement was subsequently brought before the Institution of Civil Engineers, when Mr. Moorsom was invited to take part in the discussion, but declined. On this occasion so much interest was absorbed by the large steamer now constructing in the Thames, that no conclusion was come to on the measurement question, after the lapse of a month, beyond the mere record on the archives of the Institution of an attempt to ascertain and define the capabilities and tonnage of ships and steamers in a tabulur form, as since proposed by Lord Hardwicke.

A reference to an abstract of the table annexed will greatly facilitate the explanation necessary to define the relative advantages of the different modes of measurement. Therein will be found the names of some thirty ships and steamers, their tonnage, displacement, draught, burthen, and resistance, as well as the average speed realised over many thousand miles, &c. The 7th column contains their tonnage by the old law, or builders' measurement, by which the shipping statistics were recorded up to 1835, in which year, after considering twelve plans, an Act was passed adopting an internal measurement, which was amended in 1845, from which time to May in the present year, the tonnage of ships was based on the internal measurement of the length, six breadths and three depths, the divisor 3,500 giving the register tonnage of sailing ships, the contents of the engine-room of steamers being deducted from the gross tonnage, as stated in the ninth column of the table, showing in the eighth column the register tonnage of steamers about two-fifths less than the gross tonnage, on which sailing ships are registered, and pay light, dock, harbour, and other dues.

The tenth column represents the external bulk in cubic feet recommended by the Tonnage Committee and Bill of 1850 as the basis of register tonnage, computed at 27 hundredths. The 11th column represents the internal space in cubic feet proposed by Mr. Moorsom as the basis of register tonnage, using the divisor 100, and adopted in the Shipping Act of 1854, on the grounds of expediency, that, by an easy process, "ships' capacities and liabilities to taxation might be approximated, while retaining the number denoting the tonnage of the empire."

The three lower lines of the table contain both the external bulk and the internal space of the ships *Monarch*, *Essex* and *Euphrates*, as taken from experimental measurements made externally by Mr. Moorsom for the Committee of 1849; the internal space being calculated from those measurements (less the thickness of side). These were published in his paper on Tonnage to show the practicability of computing the displacement from internal measurements, and thus prove the correctness of my statement—that by one measurement, either internally or externally, both the bulk and space can be correctly computed in cubic feet.

My proposal is to adopt the mean of these two quantities as the most equitable basis for register tonnage, which is exemplified in the 12th column, for seven vessels of different size and construction, The 13th column contains the proposed register tonnage deduced by the factor 30-100ths of the tonnage displacement of the mean bulk and space, producing a register tonnage a little below the old tonnage, or register of merchant shipping, denoting the tonnage of the empire, that is the old tonnage in the 7th column. To effect this it may be necessary to vary the factor for different classes of vessels. A comparison shows the factor 30-100ths produces the required tonnage for the large ships *Monarch* and *Essex*, but it exceeds the old tonnage 2½ per cent. in the *Euphrates*, a deep burthensome vessel, while with the *Kelpie*, a very shallow sharp clipper, the tonnage was reduced from 355 tons, old tonnage, to 254 tons proposed register, which was about the cargo the vessel did carry, either of dead weight or light goods.

These were all timber-built ships, but to test the applicability of this mode to iron and other ships, three lines give the external bulk of a screw steamer of 350 tons, old measurement, with separate calculations of the internal space of the same vessel built of timber, of timber and iron combined, and of iron, the latter having nearly 16 per cent. more space than the timber ships of the same bulk; by adopting the mean as the basis, a factor 30-100ths would give the timber-built ship a register tonnage of 247 tons, and an iron ship 263 tons, reducing the difference to 6½ per cent., equivalent to the additional capacity for light goods of the iron ship, as well as for burden or dead weight, arising from their hulls being lighter than timber ships—proving that iron ships ought to be registered more than timber ships. This will be exemplified by comparing the following bulk, space, cubic contents, and weight of hull of an iron ship with those of a timber ship, calculated from detailed plans and specifications of materia's. Those of a timber ship built according to Lloyd's rules, weighing 185 tons, rigged and fitted for sea, to same vessel built of iron, weighing 148 tons.

The cubic contents of an iron-built ship as follows:—

| | | | |
|---|---|---|---|
| External bulk . . | 34,612 | cubic feet. | |
| Internal space . . | 26,776 | do. | ratio to bulk 773 |
| Cubic contents of hull | 7,836 | do. | ratio to space 291 |

The hull of the iron ship occupying only three-tenths of the internal space; that of the timber-built ship one-half.

TABULAR COMPARATIVE ANALYSIS OF SHIPS AND STEAMERS, THE OLD, LATE, NEW, AND PROPOSED MEASUREMENT FOR TONNAGE, THEIR DRAUGHT, DISPLACEMENT, WEIGHT, BURTHEN, RESISTANCE, AND SPEED REALISED.

| Vessels' Name, Builder, and Date. | Dimensions. Length. | Dimensions. Breadth. | Dimensions. Depth. | Ratio of Length to Breadth. | Ratio of Depth to Breadth. | Old or Builders' Tonnage, based on the Breadth & Length of Keel only, the Depth being assumed to be half the Breadth. | Register of Steamers and Ships by Internal Measurement, from 1845 to May 1855. Tonnage. Register Exclusive of Engine Room. | Register of Steamers and Ships by Internal Measurement, from 1845 to May 1855. Tonnage. Gross Tonnage. | Measurement of Tonnage Proposed. By Tonnage Committee Bill, 1850. External Bulk to Medium Height of Upper Deck. | By Measurement Act, 1854. Internal Space, exclusive of beam, decks, &c. | By A. Henderson, adopting both internal & external measurement. Mean of External Bulk and internal space. | By A. Henderson. Factor ·30, ·31, or ·32 hundredths of Mean, in cubic feet, Divisor 35, for Register Tonnage. | Load Draught Forward. | Displacement. | Weight of Hull. | Weight of Engine, Boilers, & Water. | Area of Cross or Middle Section. | Average Speed at Sea. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Feet. Inches. | Feet. Inches. | Feet. Inches. | | | Tons. | Tons. | Tons. | Cubic feet, Factor 27. | Cubic feet. divisor 100. | Cubic feet. | × F. Tons. | Ft. In. | Tons. | Tons. | Tons. | Feet | Knots |
| Noah's Ark .......... B.C. 2,348 years. | 450 0 | 75 0 | 45 0 | 6.0 | 0·6 | 11,905 | | | | | | | | | | | | |
| Ptolemaus Philopater .......... B.C. 190 years. | 420 0 | 56 0 | ... | 7·6 | ... | 6,445 | | | | | | | | | | | | |
| Baron of Renfrew .......... C. Wood ...... 1825 | 304 0 | 61 0 | 34 0 | 5·10 | ... | 5,294 | | | | | | | ... | ... | ... | ... | ... | ... |
| Great Western .......... Pattison .......... 1838 | 207 3 W | 35 2 | ... | 5·86 | ... | 1,242 | 1,154 | 1,755 | .. | ... | ... | ... ... | 17 0 | 2,393 | 926 | 400 | 480 | 8·82 |
| Acadia, Halifax Line .......... Wood .......... 1839 | 207 6½ | 34 2 E | 22 2 H | 6·07 | ·64 | 1,156 | ... | ... | ... | ... | ... | ... ... | 17 0 | 2,186 | 766 | 420 | 482 | 8·50 |
| Thames, West Indies .......... Pitcher .......... 1841 | 215 0 | 36 0 | 30 W | 5·98 | ·85 | 1,330 | 1,240 | 1,889 | ... | ... | ... | ... ... | 17 0 | 2,363 | 923 | 400 | 475 | ... |
| Comprehensive, designed by ... A. Henderson, 1839 | 240 0 | 42 0 | 34 0 | 5·71 | ·80 | 2,015 | ... | ... | 259,961 | 226,660 | 243,620 | 30 = 2,085 | 19 6 | 3,335 | 1,300 | | 608 | ... |
| P. & O. Co. Precursor, Calcutta Line .......... Napier .......... 1842 | 225 W | 37 W | 24 H | 6·08 | ·65 | 1,476 | 1,133 | 1,817 | 164,702 | ... | ... | ... ... | 17 0 | 2,505 | 925 | 520 | ... | 7·733 |
| P. & O. Co. Haddington, Calcutta Line .......... Bailey .......... 1844 | 219 6 W | 35 W | 31 6 W | 6·27 | ·90 | 13,03 | 1,107 | 1,648 | ... | ... | ... | ... ... | 17 0 | 2,300 | 1,200 | 360 | 525 | 8·154 |
| P. & O. Co. Bentinck, Calcutta Line .......... Wilson .......... 1843 | 217 0 | 36 0 | ... | 6·03 | ... | ... | 941 | 1,974 | ... | ... | ... | ... ... | ... | ... | ... | ... | ... | 7·988 |
| Ajdaha .......... Indian Navy ... Ritherdon ...... 1846 | P 220 Ex. | 37 E | 23 0 | 5·94 | ·62 | 1,440$\frac{34}{94}$ | ... | ... | ... | ... | ... | ... ... | ... | ... | ... | ... | ... | 8·568 |
| Acbar .......... ditto ... Ritherdon ...... 1841 | P 206 5 Ex. | 34 E | 21 6 | 6·71 | ·63 | 1,143$\frac{74}{94}$ | ... | .. | ... | ... | .. | ... ... | ... | ... | ... | ... | ... | 8·538 |
| Locust, H.M.'s str. Malta line ... Symonds ...... 1840 | 117 6 W | 22 8 W | 13 8 W | 5·14 | ·65 | 282 | ... | ... | ... | ... | ... | ... ... | 9 10 | 416 | 186 | 100 | 182 | ... |
| Merlin do. do Symonds ...... 1831 | 171 8 W | 33 W | 17 8 W | 5·20 | ·53 | 889 | ... | ... | ... | ... | ... | ... ... | 11 7 | 1,073 | 393 | 329 | 296 | ... |
| India, East Indies .......... Scott .......... 1840 | P 189 0 | 28 10 | 26 W | 6·55 | ·89 | 767 | 501 | 1,206 | ... | ... | ... | ... ... | 15 0 | 1,260 | 560 | 300 | 380 | 7·72 |
| Lady Mary Wood .......... ...... 1842 | 160 6 | 25 5 | ... | 6·30 | ... | ... | 297 | 554 | ... | ... | ... | ... ... | ... | ... | ... | | ... | 7·78 |
| Achilles .......... China Line ... ..... 1840 | 205 0 | 27 0 | ... | 7·59 | ... | ... | 587 | 922 | ... | ... | ... | ... ... | ... | ... | ... | ... | ... | 8·242 |
| Pekin (Iron) ...... do ...... 1846 | 214 7 | 29 7 | ... | 7·25 | ... | ... | 759 | 1,182 | ... | ... | ... | ... ... | ... | ... | ... | ... | ... | 7·733 |
| Malta .......... do ...... 1846 | 205 9 | 33 5 | ... | 6·14 | .. | ... | 777 | 1,218 | ... | ... | ... | ... ... | ... | ... | ... | ... | ... | 7·402 |
| Hindostan .......... Calcutta Line ...... 1842 | 217 6 | 35 8 | ... | 6·07 | ... | ... | 971 | 2,017 | ... | ... | ... | ... ... | ... | ... | ... | ... | ... | 9·195 |
| Oriental .......... do Wilson altered 1848 | 220 0 | 33 5 | ... | 6·58 | ... | ... | 1,103 | 1,785 | ... | ... | ... | ... ... | ... | ... | ... | ... | ... | 8·468 |
| Hibernia, Holyhead Mail ...... Vernon .......... 1848 | 190 P | 26 9 E | 13 9 | 7·10 | ·51 | 662 | 369 | 579 | ... | ... | ... | ... ... | 11 2 | 950 | 380 | 320 | 256 | ... |
| Oronoco, West Indies .......... Pilcher .......... 1851 | 267 4 W | 41 10 W | 33 8 | 6·38 | ·70 | 2,245 | 1,892 | 2,901 | ... | ... | ... | ... ... | 19 8 | 3,798 | 1,490 | 700 | 682 | ... |
| Arabia .......... | 285 0 | 40 9 | 27 7 | 7·00 | ·68 | 2,402 | 1,359 | 2,393 | ... | ... | ... | ... ... | | | | | | |
| Arctic American Mail Steamer .......... | 282 0 | 45 0 | 32 0 | 6·27 | ·72 | 2,856 | ... | ... | ... | ... | .. | ... ... | 20 0 | ... | 1,525 | | | |
| Susquehanna ditto .......... | 257 0 | 45 0 | 26 6 | 5·71 | ·59 | 2,477 | ... | ... | ... | ... | ... | ... ... | ... | ... | 2,170 | 726 | | |
| Great Britain, Screw Steamer .... Patterson ... 1844 | 289 0 | 50 0 | 32 0 | 5·78 | ... | 3,444 | 1,460 | 2,936 | 457,332 | E. | ... | ... ... | 17 0 | 3,280 | ... | ... | 690 | |
| Himalaya ditto .......... 1853 | 341 0 | 46 0 | 32 6 | 7·41 | | 3,528 | 2,327 | 3,508 | 457,333 | E. | ... | ... ... | | | | | | |
| Bengal ditto ... Tod & Macgregor 1853 | 300 6 | 39 6 | 30 0 | 7·3 | ·79 | 2,180 | 1,176 | 2,185 | 235,116 | ... | ... | ... ... | | | | | | |
| Argo, Gen. Screw Steam Co., Mare & Co. ...... 1853 | 245 0 | 39 6 | ... | 6·20 | | 1,840 | 1,236 | 1,815 | ... | ... | ... | ... ... | | | | | | |
| Victoria, Australian, do. ... J. Scott Russell ... 1853 | 251 4 | 38 1 | 27 0 | 6·85 | ·71 | 1,834 | ... | ... | ... | 177,253 | ... | ... 1852 | 16 5 | 3,000 | | | 595 | 11· |
| Proposed by R. Roberts, Manchester .......... Iron | 400 0 | 60 0 | 35 0 | 6·66 | ·58 | 6,970 | ... | ... | 714,818 | ... | ... | ... ... | ... | ... | | | 816 | |
| Do. I.K. Brunel, East S.N. Co. building by J.S. Russell | 680 0 | 83 0 | 54 0 | 8·19 | ·65 | 22,942 | | | 2,973,593 | E. | | | | | | | | |
| Great Republic American Sailing Clipper ... Timber | 325 0 | 53 0 | 39 0 | 6·13 | ·73 | 4,535 | | | | | | | | | | | | |
| Tayleur, English ditto .......... Iron | 225 0 | 39 0 | 28 0 | 5·77 | ·72 | 1,631$\frac{2}{64}$ | ... | 1,979 | 193,102 | ... | ... | ... ... | 18 6 | 26·80 | | | 708 | |
| Screw Steam Packet, constructed of wood .......... | | | | | | 350 | .. | ... | 34,612 | 23,010 | 28,881 | ·30 = 246$\frac{33}{35}$ | ... | ... | 184 | | | |
| Screw Steam Packet, constructed of iron & wood | P 133 0 | 24 0 | 15 2 | 5·54 | ·63 | ... | ... | ... | 34,612 | 25,616 | 30,114 | do. = 258$\frac{4}{35}$ | ... | ... | 158 | ... | 208 | |
| Screw Steam Packet, constructed of iron .......... | | | | | | ... | ... | .. | 34,612 | 26,776 | 30,694 | ,, 263$\frac{7}{35}$ | ... | ... | 148 | | | |
| Kelpie, opium clipper, constructed of wood .......... | P 108 0 | 27 4 | 17 5 | 3·94 | ·64 | 355 | ... | ... | 34,684 | 24,558 | 29,621 | ,, 253$\frac{31}{35}$ | ... | ... | | | | |
| Monarch | ... | ... | ... | ... | | 1,356 | ... | ... | 171,586 | 141,347 | 156,467 | ,, 1,341$\frac{5}{35}$ | | | | | | |
| Essex | ... | ... | ... | ... | | 692 | ... | ... | 82,056 | 66,788 | 74,397 | ,, 637$\frac{24}{35}$ | | | | | | |
| Euphrates | ... | ... | ... | ... | | 577 | ... | ... | 75,657 | 62,159 | 68,917 | ,, 593$\frac{25}{35}$ | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |

The following particulars to be recorded on register, and the seven forms of transfer, mortgage, &c., in the Act:—

Length of weather deck at its medium height 138.9 feet.
Depth from deck to rabbit in keel ............ 17.2 feet.
External bulk to medium height of deck ...34.612 cubic feet.
Internal space to under side of deck .......... 23.010, ratio to bulk, .665
Cubical contents of hull including lower deck 11.602, ratio to space, .504
Mean of ex. bulk and in. space, cubic feet 28811 ÷ 35 = 825 tons bulk.
Do. do. × Factor by 30 = REGISTER TONNAGE, 246 TONS 94-100ths.

Length between perpendiculars at rab bits at stem & stern post, 2-3rds height, 123 feet } ratio of { Length to breadth 5.5; Depth to breadth .67
Breadth at ditto, 24 feet

| | | | |
|---|---|---|---|
| Displacement immersed to upper deck | 988 tons, | 18.3 feet high. | |
| Ditto to load water line or 2-3rds height | 538 ,, | 12.2 | Deep displacement. |
| Ditto light ,, 1-3rd height, | 159 ,, | 6.1 | Light displacement. |
| Area of midship section, height of deck ... | 345 square feet. | | |
| Ditto ditto 2-3rds ,, ... | 228 ,, | | |
| Ditto ditto 1-3rd ,, ... | 69 ,, | | |

These particulars furnish the exact size, proportion, capacity, and resistance, and can be obtained through the builder or surveyors now employed in measuring for tonnage, and who by using the ruled paper mentioned above can form a scale of tonnage displacement and resistance, at any draft of water, and show the weight of cargo carried, by a curve run through the three displacements and areas set off on a horizontal scale from the height and draught of water stated on the perpendicular scale.

The strength of the vessels may be ascertained in a like manner, by recording on the certificate of survey a specification in detail of the materials. The exact space occupied by the hull can be found by setting off the thickness of timber, and plank, or iron frame, at measured sections, on a scale, which not only shows the disposition of material and the strength, but enables the surveyor or owner to measure or compute both the dead weight carried at any draught loaded by the scale of displacement, and the capacity for light goods or passengers at any part of the hold or decks by curves of internal capacity on the certificate of survey. This certificate would in effect be a plan and specification of the vessel and materials requisite for safety and strength, their amount and cost being ascertainable from the three quantities of bulk, space, and cubic contents of hull, recorded in cubic feet, their ratio to each other affording a fair criterion of the relative value of different vessels. It is proposed that the CERTIFICATE OF SURVEY should be signed by the government surveyor, builder, owner or captain, and the registrar at the port, made out in triplicate, and a copy retained by the last three only.

In December, 1853, understanding the consolidation of the Shipping Bills was to be brought before Parliament that session, I forwarded to the Board of Trade a printed abstract of the discussion at the Institution of Civil Engineers, and copies of my plan and certificate of survey, describing my mode of measurement as above, with a request that they might be submitted to the Local Marine Boards and shipowners. In reply I was informed that before any measure was introduced into Parliament for alteration of tonnage, the nature and merits of my plan should be considered.

In April, 1854, I learned from the public papers that the Shipping Bill included an alteration in the measurement of tonnage, and when it was printed I found that in principle and detail it was an entire adoption of Mr. Moorsom's plan, as described in his book, which had been officially circulated to the local Marine Boards, and others. The law and rule were comprised in ten clauses (20 to 29); the instructions for measurement being in a separate book, with directions for computation of tonnage.

The Shipping Bills having been before Parliament some months, all questions affecting the interests of merchants, shipowners, or insurers had received consideration. The measurement for tonnage being of comparatively small importance to these parties, it was passed over till the end of the session, lengthened discussion rendering very doubtful the passing of so comprehensive a Bill. This measure was a consolidation of thirty-seven acts relating to the merchant shipping, embracing, in fact, the entire code of laws which at present regulate the mercantile marine of this country. The act consists of 548 clauses, divided into eleven parts, which may thus be classed:—

1st. BRITISH SHIPPING—the nautical and practical questions involved in their construction, safety and efficiency; 55 clauses.

2nd. MERCANTILE MARINE—masters, mates, and seamen; their competency, interests and discipline; 210 clauses.

3rd. SHIPOWNERS—their rights, responsibilities, and laws relating to registry, transfer, and mortgage; 112 clauses.

4th. GOVERNMENT SUPERVISION—Trinity-house pilots, lights, tonnage dues, and mercantile marine fund.

This consolidated Bill was brought in by Mr. Cardwell, and is a great improvement on the former acts, being a simplified exposition of the law, removing many uncertainties as to the rights and duties of shipowners and seamen, and facilitating the transfer of property and the despatch of business in the custom-house. It is such as might be expected from the legal experience of those to whom the revision of the acts was entrusted, but to a practical seaman there appears a great want of detail in all matters respecting the measurement, build, and efficiency of vessels, as well as in the regulations as to the competency of the officers and seamen, points which I consider can only be effectually determined by those possessed of practical knowledge and nautical experience on the construction and management of ships and seamen. Holding these views, I contented myself with submitting (in a printed form) to the Board of Trade my opinions and objections to the new measurement. I also put in a reprint of the 20th, 21st, 22nd, and 23rd clauses of the present Act, with amendments. I proposed to clause 21 that Rule 1 for internal measurement should have the addition of rule No. 1 for external measurement, and the use of diagrams and curves of areas taken from the Bill of 1850, the rule No. 2 of that Bill being already adopted as rule No. 2 of the present Act for measurement by girthing when ships have cargo on board. The clause enacting that paddle and screw steamers be allowed a deduction of 37 and 32 per cent. of their gross tonnage as a sailing ship I object to as unjust, on the grounds that light, dock, and harbour dues paid on register tonnage are more important to, and occupied by steamers than sailing vessels.

Confident that a few months' experience would lead to these alteration of the Act, the amendments I proposed in the clauses are given in the appendix. The Act was passed 18th August 1854, and came into operation 1st May, 1855. As will be seen, my plan differs distinctly from Mr. Moorsom's, and the statement, therefore, of Lord Stanley of Alderley, in the before-mentioned speech, "that not one single objection had been made to the present mode," and, "that the Government were at all times most ready to receive any objections to the existing system, or communications as to the introduction of a better," must have resulted from incorrect information. I may further allude to to the way in which I have endeavoured to press my views on the attention of scientific men, both at the Institution of Civil Engineers in 1853, and before the British Association, in 1854. Those are societies, it is true, which are not recognised by the Government as influencing their decision of these subjects, but, as was very properly observed by Lord Hardwicke at the Society of Arts, "They did not receive that attention and consideration from certain portions of the public that they required; *when anything in the shape of novelty was introduced it was received with coldness and dissatisfaction, and no man had the slightest chance before the Government authorities of the country of having any great experiment, for any great subject he might have in hand brought to a fair trial.*"

I have now pointed out the manner in which the Board of Trade has dealt with the tonnage question, and the alterations which were proposed by me at the time. It is not surprising that it has been found necessary to make some alterations in so comprehensive a measure.

Shortly after the rejection of this Bill of the Earl of Hardwicke's, a Bill was brought into the House of Commons by the Board of Trade, entitled "Merchant Shipping Amendment Act Bill." The Bill contains 24 clauses, altering six parts of the new Act, the 14th clause enacting, "That the owner of any ship that is measured under Rule 2, in the 22nd section, Act of 1854, may have the said ship re-measured under Rule 1, in the 21st section;" and "upon payment of such fee, not exceeding 7s. 6d. for each transverse section, the registered tonnage shall be altered."

This clause was not in the original Bill, but introduced after the rejection of Lord Hardwicke's Bill, to record and mark the deep, light, and launching draught and displacement, in order to register the real tonnage and weight the ship could carry. It was submitted to the highest authority that this could be effected by modifying the present Act, so as to admit of the measurements being taken either externally or internally, by the addition to the 21st clause of rule No. 1, of the Act of 1850, for external measurement, and the formation of diagrams and curves of areas, and scale of displacement, as shown in the amended clauses appended. Lord Hardwicke's Bill was refused in the House of Lords, on the ground that "*four shipbuilders had decided against it, and that all consulted were in favour of the existing system.*" And as to my proposed amendment, it was intimated that the Board of Trade considered the tonnage of merchant ships only as a fiscal question, "to procure a test of the size of the ship, for the purpose of paying light, dock, and other dues;" and that the shipowners having made no complaint of the new measurement, the Board of Trade would not consider any alteration of the present system till urged by them or parliament took it up.

The proposition that "tonnage is a fiscal question" as to the payment of light or dock dues, and that shipowners not objecting to the new measurement should be any ground for refusing investigation, I consider merely as assumptions based on mistaken or erroneous premises, as I will endeavour to show. It is true the shipowners have taken little interest in the measurement for tonnage, their attention being occupied with the consolidation of 37 Acts of Parliament, their rights and responsibilities being infinitely more involved in alterations in the legal procedure, ownership, and government interference as to crew and passengers, extending over the other 538 clauses of the new Act, than in the 10 clauses defining the mode of measurement and record of register tonnage.

The old or builders' tonnage, though formerly used for customs duties on cargoes, and representing the statistics of the shipping and trade of the empire, the old as well as the register tonnage, have long ceased to be used for fiscal dues, customs duty being only levied on goods and cargo carried, and not upon the tonnage of ships.

Payments for the use of lights, docks, and harbours, cannot be considered as fiscal dues or government tax, the tonnage light dues being paid to the Trinity House for their maintenance, the surplus belonging to the Mercantile Marine Fund, managed by the Board of Trade. The harbour dues, as well as some dock dues on the tonnage of shipping, are paid to local public trusts, as at Liverpool, and some ports. At London, and other places, private docks and chartered companies receive tonnage dues for space, quayage, and safety. These dues only average from one to five shillings per ton, per voyage, for light and accommodation, which cannot be considered a burthensome tax on shipowners, or one likely to induce much inquiry, particularly as there is every prospect that, ere long, light dues will be much reduced, or altogether withdrawn, as in other countries.

For a century past the registry of shipping has been a department of the custom-house; the old tonnage is said to have originated in duty charged on cargoes of wine, the measurement being made by custom-house officers, and so various were the dues and charges levied on tonnage, that even the safety of our ships was endangered in order to evade it. The acts of 1835 and 1845 obviated many of these evils, but foreign nations having adopted a rule approximating to the old tonnage, the same was continued in use by builders, merchants, and even for government contracts.

The tonnage measurers consist of one or two subordinate officers at each custom-house, who merely give to the registrar the dimensions, particulars, and tonnage, by the rule defined in the act, but who take no cognisance of the form, materials, or strength of the ship, as is the case with district surveyors of houses. In some ports there are separate measurers of tonnage for the light and dock dues.

The decision of shipbuilders against the displacement tonnage, I consider an interested adhesion to the old and obsolete, or the register tonnage, natural enough, considering that ships are still built by the old register tonnage, both being so absolutely indefinite, as a measure of burthen or cost, that by builders' tonnage, a shallow, sharp ship may be built of half the burthen, with two-thirds of the materials of a deep, full ship of the same old tonnage. The opinion of established tonnage measurers of the custom-house in favour of the existing system is an interested view of effete forms, showing an adherence to routine of the worst description, only to be remedied by investigating the working of the new system.

Since May last, under the new Act, the custom-house established measurers remain, with the addition of Mr. Moorsom as surveyor-general of tonnage in London, and an assistant at one or two large ports. The measurements are taken according to a book of instructions by the measurers, and recorded in a formula or table (used for computing displacement by Stirling's rule) from which the areas are calculated, and the internal space computed by the measurer, the divisor 100 giving the tonnage on which the register is granted, a copy of this table of measurement being sent to the surveyor-general of tonnage at the central office in London. From a record of the measurements the surveyor can draw *detective curves* to ascertain the correctness of the measured distances by a curve run through them. These curves forming a diagram of each of the sections of the ship measured, by placing these at the recorded interval apart, a complete drawing of the internal form and lines of the ship is obtained, and by adding the thickness of the side, the external bulk, displacement, area of midship section, &c., forming a complete draught of the ship.

It must be seen that the fiscal dues, government taxes, and customs' revenues levied on shipowners, are now very small, so as hardly to pay the salaries of the separate custom house tonnage surveyors and measuring officers. At a very little more cost a descriptive measurement and displacement tonnage by experienced surveyors under the Board of Trade might be obtained, which would afford an amount of safety and efficiency, both for public and private interests, very far beyond a mere measurement of tonnage for custom-house dues.

The description of information which would thus be afforded will be found in the Table annexed to this paper, the first seven columns of which gives the dimensions, proportions, and sizes of vessels, from Noah's Ark to the modern ark now building in the Thames. The original type of ocean steamers, *Great Western* to the American *Susquehanna*, screw vessels *Great Britain* to *Victoria*, sailing clippers *Kelpie*, *Great Republic*, and iron clipper *Tayleur*, their proportions of length, which vary from less than four times to more than eight times their breadth, their depths which vary from 5-tenths to 9-tenths their breadth, and their sizes which vary from 350 tons to 23,000 tons—an extreme range—involving much consi-

deration to arrive at the happy medium, combining safety, efficiency, and economy.

The 13th and 14th columns contain the deep draught and displacement proposed in Lord Hardwicke's Bill, but objected to by the President of the Board of Trade, on the grounds (*as he was informed*) that "it was impracticable, and even if it could be carried into effect it would be useless." Now the practicability is proved by the fourteen vessels enumerated, and the usefulness is shown by the other columns, and in these, the one showing the weight of the hull being deducted from the one showing the displacement, will give the exact weight of cargo, armament, men, and provisions the vessel can carry, and the given draught of water, whilst the scale of tonnage, displacement, on the certificate of survey proposed, will show the weight of cargo at any draught, and would be useful to the government, merchant, purchaser, or charterer, as defining the capabilities of the ship contracted for. The 17th column, giving the fixed weight of engines, boiler, and water, must also be deducted from the load displacement (less weight of hull), for the weight of cargo and fuel the steamer can carry.

The 18th column contains the area of cross or midship section immersed in square feet, which, with the deep displacement, being the principal fixed and ascertainable elements of resistance, are recorded as the basis of relative steam power, cost, and speed realised. The speed given in knots and decimals are mostly the average realised by contract steamers on mail service, from 26,000 to 114,000 miles.

The term nominal horse-power used in the table being equally as indefinite as old or builders' tonnage, so ably explained by Mr. Atherton, I have left that question to his greater knowledge, experience, and scientific attainments, and have confined myself in this paper to the history of the tonnage question, my experience of the practical working of the new Act, and its numerous anomalies.

As much of the relative advantages of the different plans depend on the facilities and correctness of the measurements and computations, it is necessary to state the particulars of the present and proposed principle and mode.

The Rule No. 1 for *internal* measurement is computed by 15 to 60 breadths at 3 to 12 sections, and then a record in a tabular form, to facilitate the computations of the contents of the vessel by Stirling's rule in cubic feet, using the divisor 100 for the register tonnage, and thus approximating to the old tonnage. It is stated, "that any important errors in the result can easily be *detected* by drawing the figure of the ship, without the necessity of re-measurement; the tabular forms themselves remaining with the surveyor-general, the owner being furnished with a printed form of certificate of surveyor, with the description, dimensions, gross and register tonnage, for the seven forms of transfer, mortgage, &c.

The principles and mode I propose is an external measurement of 5 to 15 transverse sections of the length, some 20 to 100 breadths, recorded when measured on paper, ruled to a scale of square feet, marked by spots and figures on the scale and height, so that a curve may be run through these spots, and thus form a diagram of each section of the breadth; the curve also showing any mistakes in the first record, *preventing* errors in the computing the areas of sections, which set up on the scale will form the curves of areas, from which may be deduced, by Stirling's rule, the external bulk in cubic feet to the height of deck; the displacement at the deep and water line being ascertained by two other curves, the whole affording a *complete drawing of the form of the vessel*, whilst every measurement taken would be marked on the scale, and every figure used in the computation would be recorded on this CERTIFICATE OF SURVEY, which it is proposed to substitute for the tabulated formula recently used under the new Act, which formula contains the internal measurement of breadths, and their product, which is left in the hands of the surveyor-general.

I would observe that the present plan places in the hands of one or two professional surveyors, the designs, lines, and proportions of every measured or new ship entering British ports, or built by able or experienced builders, and this without any public object, as the surveyors of tonnage give no opinion except as to size or capacity for cargo, and the legal identification of the vessel, such as has heretofore been done by custom-house officers, the measurers not being experienced shipwrights or nautical surveyors. For all the purposes of the custom-house officers it would be sufficient to substitute the dimensions in the present certificate of surveyor, form A, for forms B and C, form of registry D, and other forms, E, F, G, H, I, the particulars before proposed to be recorded in the forms of transfer, mortgage, &c., taking as the legal identification of the ship the three qualities of bulk, space, and contents of hull in cubic feet.

It is proposed that the formula of measured distances now deposited with the surveyor-general for the forming of the *detective curves*, should be used for the measurement, taken in the presence of the builder and owner, and that the distances be set off on paper, ruled to a scale, thus at once forming a detective diagram or curve that will prevent any error in the measurements or levels before the tonnage is computed. The diagrams of each section being thus formed at the most convenient place for measurement, the scale on the paper becomes a more correct formula than the present for forming the curves of areas, and computing the bulk, space, and tonnage, and forming a scale of displacement and internal capacity, as well as information as to the proportion, resistance, and the section of the frame of the vessel, and thus (with specification of material) affording all the information that is necessary to Government, owners, insurers, merchants, or passengers. A copy of this to be made out in triplicate, signed by a Registrar, Government surveyor, and owner, and deposited at the port of registry, the Board of Trade, and with the owner, where it may be inspected and verified by the surveyors to Lloyd's Committee for the classification of vessels, whose book is now the only public record of the efficiency of British merchant shipping.

Throughout the various legislation on tonnage since 1828, all efforts have ended in confusion, simply because tonnage was originally based on error, and expedients have been adopted to suit the views of of different parties instead of simply seeking the truth. The result of this abortive legislation is the present confusion, there being now four different measurements for tonnage in use, as shown in the 7th, the 8th, the 9th, and the 11th columns of the table. The old or builders', the steamers' register, the late ships' register, and the new register tonnage, under Act, 1854, all alike indefinite as a measure of ships' cost or capabilities. So much is this the case, that ships are now sold by the ton, on a mean between the old and the new tonnage, they varying as much as ten and twenty per cent. in the same ship. A few months has shown numerous anomalies in the new internal measurement and clauses of the bill, Mr. Scott Russell having informed the Society of Arts that his new steamer built as 480 tons under late law, measured by the new act 543 tons. This may arise from the extraordinary provision of clause 23, reducing the tonnage of steamers even more than is shown in the 8th and 9th columns, the register and gross tonnage.

This is a public question, inasmuch as many steamers paying light and dock dues on their register or reduced tonnage, are hired as transports at 40 to 60 shillings per ton per month on the gross tonnage, government providing them with coals; their capacity for cargo being small, the cost must be so enormous, that millions of public money might have been saved, had there been the means of ascertaining their *capabilities for mercantile transport service*, and paying them accordingly.

The difficulties of measuring steamers at exact equal distant sections, has obliged a great many to be measured by rule No. 2. The Amended Act of 1855

merely authorises the payment of fees for re-measurement —probably the increased tonnage spoken of by Mr. Scott Russell may have led to this outlay by steam transports.

My proposal is, that by embodying in the present Act a clause B to the effect that the Rule 1 for external measurement of the Bill of 1850 be also added to the 20th and 21st clauses of the consolidated Bill, in the form shown in italics in the before-mentioned copy of clauses and rules or measurement and computation, which will be published hereafter.

I would suggest the expediency of the whole question of the descriptive measurement of ships and steamers, and the legalised unit of marine horse-power being referred by Government to a commission, during the recess, of public officers, scientific engineers, and practical nautical men.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 2nd August*, 1855.

Par No.
140. Civil Services Estimates—Class 8.
413. Consuls, &c.—Return.
444. Colonial Bishops—Return.
435. East India (Torture)—Copies of Letters.
279. Bills—Limited Liability (as amended in Committee and on Re Commitment.)
280. Bills—Fisheries (British Islands and France) (amended.)
281. Bills—Public Health Act (1854) Continuance and Amendment.
283. Bills—Diseases Prevention.
284. Bills—Union of Contiguous Benefices (amended).
Railway Accidents (1st January to 30th June, 1855)—Return.
Births, Deaths, and Marriages—16th Report of the Registrar General.
Cape of Good Hope (Kaffir Tribes)—Further Papers.
Turkish Loan—Declaration exchanged between the British and French Governments.

*Delivered on 3rd August*, 1855.

407. Sale of Beer, &c., Act.—1st Report from the Committee.
431. East India (Annexation of Ihansi)—Correspondence, &c.
446. Militia Estimates—Report from the Committee.
230. Bill—Income Tax Elective Franchise.

*Delivered on 4th August*, 1855.

439. Civil Service Commission—Copy of Treasury Minute.
405. Barrack Accommodation for the Army—Report.
285. Bill—Coal Mines Inspection (amended by the Lords).

*Delivered on 6th August*, 1855.

333. New Palace (Westminster)—Return.
209. (1) Militia—Supplementary Return.
441. Civil Service (Number of Examinations)—Return.
442. Army Prize Money—Account.
452. Militia (Ireland)—Return.
221. Bills—Grand Juries (Ireland).
286. Bills—Navigation Works (Ireland) (amended).
287. Bills—Burials (amended).
288. Bills—Exchequer Bills (£7,000,000).
War with Russia (Loss of Officers and Men at Hango)—Further Letters.
Patents for Inventions—Report of the Commissioners.
Tariffs (Foreign Countries)—Return.

*Delivered 7th August*, 1855.

399. Army Clothing (Crimea)—Return.
290. Bills—Leases and Sales of Settled Estates (as amended by the Select Committee).
291. Bills—Burials (as amended in Committee and on Consideration).
292. Bills—Public Health (No. 2).

*Delivered on 8th August*, 1855.

281. Metropolis Sewers (Pipe Sewers)—Return.
438. Newspaper Stamps—Return.
451. Board of Ordnance and War Department, &c.—Returns.
293. Bills—Chinese Passenger Ships (as amended by the Lords).
294. Bills—Lunatic Asylums and Regulations Acts Amendment (as amended by the Lords).
265. Bills—Sale of Spirits (Ireland) (as amended by the Lords).

## PATENT LAW AMENDMENT ACT, 1852.

### APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette August 3rd*, 1855.]

*Dated 23rd July*, 1855.

1668. A. Achard, Chatte, near St. Marcellus, France—Application of electricity as a transmitting agent of motive power.

INVENTION WITH COMPLETE SPECIFICATION FILED.

1735. N. Brough, Birmingham—Clasps and buckles, 31st July, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed August 3rd*, 1855.

37. Jean Baptiste Edouard Ruttre, Paris—Improvements in the treatment of rags and other goods formed partly of wool and partly of vegetable fibres, in order to separate the vegetable fibres from them and obtain the wool in its pure state.
253. Frederick Samson Thomas, 17, Cornhill, and William Evans Tilley, 6, Kirby-street—Improvements in plating or coating metals.
266. Alexander Morton, Kilmarnock—Improvements in weaving carpets.
274. Deane John Hoare, 10, Salisbury-street, Strand—Improvements in propelling vessels.
296. William Hartfield, Prospect-row, Bermondsey—Making book covers, in tortoiseshell, inlaid or not with pearl or ivory, and for improvements in machinery for embossing, carving, and inlaying book covers with pearl and ivory, and for making metal joints by which such books may be widely opened, the said improvements to be applicable to inlaying pianofortes.
308. William Beckett Johnson, Manchester—Improvements in steam boilers and engines.
331. Auguste Vallery, Rouen—Improved machinery for the preparation of flax, hemp, and other textile materials.
336. John Raphael Isaac, Liverpool—Improvements in the construction of portable buildings.
346. Christophe François Delabarre, Paris—Improved apparatus to be used in propelling gases and forcing liquids.
407. Nathan Thompson, jun., New York—Improvements in constructing life boats.
709. William Tytherleigh, Birmingham—The application of a certain well-known process to the covering of iron in sheets or bars with copper or copper alloys, whereby he produces a new and useful product.
726. Elizabeth Abbott and Matilda Abbott, Horningsea, Cambridge —Improvements in stays.
905. John Orr and James Templeton, Glasgow—Improvements in the manufacture of figured fabrics.
963. James Marsh, 13, Store street, Bedford-square—Improvements in the construction of pianofortes for rendering them more portable.
967. William Johnson, 47, Lincoln's-inn-fields—Improvements in regulating the pressure or flow of gas or fluid bodies. (A communication.)
1091. Robert Stirling Newall, Gateshead—Improvements in apparatus employed in laying down submarine electric telegraph wires.
1140. Antoine Fidelis Cossus, Cagliari, Sardinia—Improvements in treating oils and fatty matters.
1141. William Longmaid, Victoria cottage, Stoke Newington, and John Longbottom, Leeds—Improvements in heating coppers, pans, and boilers.
1142. Joseph Louis Rey and Adolphe Guibert, Marseilles—A composition to preserve wood and iron, called, 'a submarine and preserving coating.'
1152. John Cruickshank, Marcassie, Elgin, N.B.—An improved construction of offensive and defensive equipment of cavalry.
1160. Francis Leeshing, Busby, near Glasgow—An improved method of preparing or treating certain dye-stuffs, so as to obtain greater dyeing power.
1161. David L. Davis, Dedham, Norfolk, Massachusetts, U.S.—An improved method of applying elastic bearings to railroad chairs and rails.
1174. Silas Safford Putnam, Massachusetts, U.S.—A new or improved forging machine.
1175. Samuel Edwin Robbins, Vermont, U.S.—Improvements in fire arms. (Partly a communication.)
1229. Thomas Vincent Lee, Prospect cottage, Dulwich—Improvements in generating steam in marine and other boilers.
1256. Richard Whytock, Edinburgh—Improvements in colouring yarns or threads intended to form elements of various loom fabrics and for crotchet work and knitting.
1280. David Newell Brown Coffin, jun., Massachusetts, U.S.—A new and useful improvement in self-closing stop cocks.
1282. Cyrus Curtice, Massachusetts, U.S.—A new and improved light alarm or burglar annunciator, or apparatus to give alarm when a burglarious attempt is made to enter a room or dwelling.
1284. Ethan Allen, Massachusetts, U.S.—An improved breech-loading fire-arm.
1300. John Buncle, Springfield, Linlithgow, N.B.—An improvement in bleaching resinous substances (calophane) for the manufacture of soap.

*Sealed August 7th*, 1855.

307. John Lees, Park-bridge Iron Works, Ashton-under-Lyne, and William Heap, Ashton-under-Lyne—Improved machine or apparatus for cutting and straightening bars of metal.
328. John Foster, Long Eaton—Improvements in machinery for the manufacture of lace.
365. Richard Archibald Brooman, 166, Fleet-street—Improvements in the manufacture of capsules for stopping or covering bottles, jars, and other similar vessels, and in the machinery employed therein.
375. Jean Wothly, Zoffingen, Switzerland—Improvements in the preservation of meat.
391. Thomas Harrison, Hackney—A composition for covering and protecting the bottoms of ships and vessels.

Journal of the Society of Arts.

*FRIDAY, AUGUST* 24, 1855.

## MEMBERS' VISIT TO PARIS.

Members are reminded that the Society's cards, railway tickets, and passports, will be issued from the Society's house from the 27th of August to the 1st of September, both inclusive. None can be issued after that period.

From the 3rd of September to the 15th of September, the Society will be officially represented in Paris at the rendezvous, 14, Rue du Cirque, where Members are particularly requested on their arrival to register their addresses in Paris.

Members and Institutions requiring cards, tickets, or passports, are reminded that it is absolutely necessary to give their own name and those of their friends, the names of the Representatives and others nominated by the Institutions, the route they propose to take, the number of railway tickets required, and whether single journey or return.

Members must also state the day of their departure, in order that the date may be inserted in the railway-ticket, as each ticket is available only for a certain number of days after date.

Passports are free to the Members and to the Representative of each Institution.

To Members' friends, and those nominated by the Institutions other than the Representative, passports are 5s. each.

Members and Institutions must accompany their requests with the necessary remittance.

Unless all the particulars required are sent, it will be impossible for the Secretary to comply with the wishes of the Members.

A synopsis of the various routes to and from Paris, with the cost of each, appeared in the last number of the Society's *Journal*.

## A FEW REMARKS ON ANIMAL PRODUCTS.

By P. L. Simmonds.

Among the great variety of animal products, specimens of which it would be desirable to obtain for the Trade Museum, are some of the following, with details as to the amount and value of the commerce carried on in them at various localities, and the comparative prices, modes of preparation and preservation, transport, &c. Firstly,

### Products of Animals.

Specimens of preserved provisions and animal food of all kinds, smoked and spiced meats, pemican, home and American made. Buffalo or moose deer meat is dried, pounded, and mixed with melted fat. Cured Meats from various Countries—The preserved soup of Russia, preserved provisions of Australia, preserved turtle from the Gulf of Mexico, salted lobsters from the British American provinces, Buffalo humps. Preparations of Blood—Meat dried and preserved in a fresh state, simply by desiccation, as shown in the Swiss department in 1851; osmazone and meat biscuits. Dried beef forms a large article of import into New Orleans. The sun-dried biltongue (literally ham tongue) of the Cape Colony has never, that I am aware, reached this country; it consists of strips of raw meat cut out of the loins, sirloins, or fleshy parts of cattle, or the larger antelopes, which, sprinkled over with salt, and exposed to a warm sun, and thus sun-dried, constitutes the usual food of the pastoral farms in the new settlements of the Cape Colony for months.

Jerked beef, or charque, forms a large article of consumption in Brazil, Cuba, and some other quarters. The preparation of the dried meat is principally carried on in Chile and Buenos Ayres, but upwards of 20 million pounds are annually sent from Rio Grande do Sul to the other provinces of the Brazilian empire. When salted and smoked, or dried in the sun, it is called Sesina. About 6000 cwt. of charque, with a proportionate quantity of tallow and fat for domestic purposes (grasa), are shipped annually from Talcahuano to Lima.

Beef jerking is confined to the hot and dry summer months, the jerking season in Chile being looked forward to like harvest time in England. In well-regulated establishments, the labour is divided, the jerkers having nothing to do with the killing, skinning, &c. So expert are they as to excite the astonishment of novices at the rapidity with which they slice the animal up, the slices being deprived of fat, and so thin as to admit of a quick sun drying them, on hurdles well elevated above the ground. After being thoroughly dried, the slices are made into long bundles, and sewed up in hides for farm use or exportation.

Much benefit would ensue from jerking meat on the distant Australian out-stations, in saving the great expense of salt and cartage from the seaports, supplying a food that would not produce scurvy, or those bilious and dysenteric complaints to which salted meat in warm countries gives rise, while furnishing a useful export to the Mauritius, Ceylon, Africa, and India, in exchange for their sugar, coffee, rice, and other staples.

In the Brazils and Cuba jerked beef is in general use among both whites and blacks, and although unknown as yet in India, yet what benefit would it not confer on our European troops, in substituting it for salt meat where fresh could not be had. How useful would the knowledge of jerking be to our troops cooped up in the Crimea, as they could at once jerk the cattle captured or purchased, thus saving the expense of feeding until required for slaughter, even when food for them was attainable. How easy also, from the trifling weight, for each soldier to carry on a march his jerked ration, which a slight grill suffices to cook, though often eaten without this.

In Chile, when the horned cattle are sufficiently fat, or rather at the killing season, which is about the months of February and March, from 500 to 1,000, according to the size of the farm, are slaughtered. The whole of the fat is separated from the meat, and melted, forming a kind of meat, called grasa, which is employed for domestic purposes. The tallow is also kept separate, and the meat is jerked. This process is performed by cutting the fleshy substance into slices of about a quarter of an inch thick, leaving out all the bones. The natives are so dexterous at this work that they will cut the whole of a leg, or any other large part of a bullock into one uniformly thin piece. The meat thus cut is either dipped into a very strong solution of salt and water, or rubbed over with a small quantity of fine salt. Whichever mode of curing is adopted, the whole of the jerked meat is put on the hide and rolled up for ten or twelve hours, or until the following morning. It is then hung on lines or poles, to dry in the sun, which being accomplished, it is made into bundles, fastened with thongs of fresh hide, forming a kind of network, and is ready for market. In this operation it loses about one-third of its original weight. The dried meat (charque) finds immediate sale at Lima, Arica, Guayaquil, Panama, and other places. It furnishes a great part of the food of the lower classes and the seamen, being the general substitute for salt beef and pork.

The grease and tallow also meet with ready sale, and are of more value than the meat. The females are usually employed in cutting up the fat, and frying it for grease. The tongues are the only part of the head that is eaten, the remainder being left to rot.

The hides are usually consumed in making bags for grain, pulse, &c., thongs for the various purposes to which rope is applied in Europe, or leather of a very good quality.

The various products of the horse—horse tails, horse hides, horse manes, mare's grease, hoofs, &c., are

valuable. In some years Russia has exported 20,000 to 30,000 horse hides. From the River Plata we receive a very considerable number.

There are immense quantities of horses in Russia; a *taboon* or herd consists often of about 1,000 horses; and some of the great land owners possess from eight to ten taboons. Their commercial products even are valuable, considering the slight expense and trouble at which they are reared and maintained.

The wild horses in South America, roaming over the pampas, are killed solely for their hides and fat, and the products of their manes and tails. The fat (mare's grease, as it is commercially termed), upon arrival here, and at New York, is transmuted into soap, and is doubtless often admired for its aroma and variegated colours.

In Paris, the value of a dead horse has been computed (by M. Duchatelet), if properly managed, to be worth from 60 to 110 francs. The hair weighs from 100 to 200 grammes, worth from 10 to 30 cents. The skin weighs from 24 to 34 kilogrammes, and is worth from 13 to 18 francs. The blood is worth from 2 to 3 francs. The flesh, which weighs from 150 to 200 kilogrammes, is worth, for manure or food for other animals, from 35 to 45 francs. The fat is worth about 1 franc 20 cents. the kilogramme, but the quantity is not very great. The shoes, the hoofs, and the bones, are likewise all worth small sums, which make up what is stated above.

In consequence of a Report by the Committee of Public Health, the Austrian Government recently allowed the butchers to sell horse meat to the public in the markets of that empire.

*Horse Flesh* is a common article of food in Toorkisthan. Captain Burslem says: "I remarked that aged horses were very rarely met with, and on inquiring the reason was informed that the horses were so violently worked when young as soon to break down, after which they are slaughtered and made into *kabobs*. I was assured that the eating shops of Cabul and Kandahar always required a great supply of horse-flesh, which is much liked by the natives, and, when well-seasoned with spices, is not to be distinguished from other animal food."

Under the local name of "dending," the muscles of the deer, the buffalo, the wild hog, jerked, or dried in the sun, form an article of exportation from the Indian islands, principally to China. Deer's sinews to the extent of about 200 piculs (250 cwts.) are annually exported from Siam.

Ghee is the butter made from the milk of cows and buffalos, and clarified. It is an article of very considerable commerce in various parts of India and Northern Africa, and is generally conveyed in duppers, or bottles, made of hide, containing from 10 to 40 gallons each. Ghee will continue sweet for some time, but the Somalis in Northern Africa are celebrated for melting down sheeps' tails, and mixing the fat with the ghee to increase the quantity, and this gives it a most disagreeable odour.

In India there are two kinds of ghee—cow and buffalo ghee. At Bombay the commercial kinds of ghee are classified into Kurrachee, Cutch, and Concan. At Madras into westward and northward.

One hundred female buffalos in the East, according to Colonel Low, will give yearly, one with another, 9125 gantangs of milk (the gantang containing about 256 cubic inches). Even in that quarter adulteration is practised, for one-fourth part of water is added, and owing to the very rich nature of the milk of the animal, this dilution s not easily detected

The produce of ghee from pure milk in the Straits, is as high as one-eighth, 15 gantangs of milk making one picul (133⅓lbs.) by weight of ghee. One hundred female buffalos will yield 76 piculs of ghee (90¼cwt.) in a year. The butter milk is of little value, and is generally given to the buffalos to drink. Each native consumes, when he can obtain it, about 30 chittacks of ghee monthly, and there are 1600 chittacks in a picul.

Buffalo butter finds comparatively a limited sale in the Straits settlements, that made from cow's milk being preferred, but what is sold to the shipping as cow's milk is a mixture of the two, or merely dyed buffalo butter. A gantang of rich cow's milk yields about half a pound of butter. The quality of the ghee, owing to the richness of the pasturage, is far superior in the eastern parts of the Archipelago to that brought from India.

In India the common Bazar cow will yield but three or four seers, or quarts, of milk, while an English cow, housed and well fed, will give 14 to 16 quarts. In Behar a buffalo cow yields ten seers of milk at two daily milkings, and the quality of the milk is richer than that of the country cow; the milk of the latter yields about one-sixteenth of its weight of butter. The dairy is the most lucrative branch of Indian agriculture. In Mysore the natives never use raw milk, objecting that it has no taste. It is boiled from one to three hours. A little of the previous day's tyre, or curdled milk, is added to promote coagulation, which is completed by the next morning. From the top five or six inches are taken and put into an earthen jar, when it is churned by rapidly trundling in it a split bamboo. In half an hour some hot water is added, and when the churning has been repeated for another half hour, the butter usually forms. The demand for milk in the East is almost unlimited, as so little animal food is eaten, and hence arises the large number of vegetable oils that are raised for food.

Butter is the universal sauce of the Arab, and the consumption of it is immense; their vegetable dishes all float in butter; with it they work their *adjoue*, or date paste, or cake, into a proper consistency; dried corn or bread crumbs, boiled in butter, is a common breakfast with all classes, and in the desert, the kunmayes, or truffles, are prepared for use in the same manner. In short, butter may be said to be to the Arabs what the potato is to the Irishman—it forms an indispensable part of his diet, and besides the various forms in which it is taken with other articles, it is a common practice with both Bedouins and town's people to drink a coffee cup full of butter every morning, the former, and the lower order of the latter, adding another half cup, which, to the disgust of strangers, they snuff up their nostrils! Arab butter is made from the milk of sheep and goats, that of camels not being used for the purpose. The home supply is not nearly sufficient for the consumption, and butter consequently forms an important article of importation. It is brought from the opposite coast of Africa, chiefly from Souakin, Massouah, and Upper Egypt.

Mr. Johnston (Travels in Abyssinia) thus describes the mode of making the ghee, or fluid butter there: "Churning is performed by the milk being placed in large skin bags, suspended upon the hips by a leathern thong passing over the shoulders and across the breasts of the female. A quick semi-rotatory movement of the trunk continually agitates the contents, until the butter is formed in soft white lumps; it is then taken out with the hand as it collects upon the surface of the milk, and is placed into lesser skins, where in a few hours it assumes the appearance of a light-yellow oily fluid—the ghee of the Berberah market—from whence it is exported in great quantities to India and the Persian Gulf."

Specimens of cheese from the milk of various animals, and details as to the manufacture and preparation, with the cost at the place of production, would be interesting. Samples of the cheese made from the sweet and rich milk of the rein-deer, and of the caskaval cheese of the Danube, with various cheeses calculated to stand change of climate, and full information as to the processes followed, are desiderata. The chervice or clear fat of the carcase and marrow of the ox, boiled, is much used in Constantinople and the coasts of the Black Sea, for culinary purposes.

Specimens of the various solidified milks made in this country, on the Continent, and in America, with information as to their relative value, are highly important, now that sea travel is so large a business. A committee of

medical gentlemen, appointed by the New York Academy of Medicine, recently appointed to visit and report upon Mr. Blatchford's manufacture of solidified milk, at Armenia, in the State of New York, thus describe the process :—

"To 112lbs. of milk, 28lbs. of Stuart's white sugar were added, and a trivial proportion of bi-carbonate of soda (a teaspoonful), merely enough to insure the neutralizing of any acidity which, in the summer season, is exhibited even a few minutes after milking, although inappreciable to the organs of taste. The sweet milk was poured into evaporating pans of enamelled iron, embedded in warm water heated by steam. A thermometer was immersed in each of these water baths, that, by frequent inspection, the temperature might not rise above the point which years of experience have shown advisable.

"To facilitate the evaporation, by means of blowers and other ingenious apparatus a current of air is established between the covers of the pans and the solidified milk. Connected with the steam-engine is an arrangement for stirrers, for agitating the milk slightly while evaporating, and so gently as not to *churn* it. In about three hours the milk and sugar assumed a pasty consistency and delighted the palates of all present. By constant manipulating and warming, it was reduced to a rich creamy-looking powder, then exposed to the air to cool, weighed into parcels of a pound each, and by a press, with the force of a ton or two, made to assume the compact form of a tablet (the size of a small brick), in which shape, covered with tin-foil, it is presented to the public.

"Some of the solidified milk which had been grated and dissolved in water the evening previous, was found covered with a rich cream. This, skimmed off, was soon converted into excellent butter. Another solution was speedily converted into wine-whey, by a treatment precisely similar to that employed in using ordinary milk. It fully equalled the expectation of all, so that solidified milk will hereafter rank among the necessary appendages of the sick room. In fine, this article makes paps, custards, puddings, and cakes, equal to the best milk; and one may be sure it is an unadulterated article, obtained from well-pastured cattle, and not the produce of distillery slops—neither can it be watered.

"For our steam ships, our packets, for those travelling by land or by sea, for hotel purposes or use in private families, for young or old—we recommend it cordially, as a substitute for fresh milk."

Mr. S. Piesse prepares a lactin or artificial milk in the following manner:—Honey, 4 oz., gum arabic powder, half an ounce, 3 yolks of eggs, fine salad oil, 6 ounces. Mix the honey and the gum first, then add the egg, and finally gradually mix in the oil. One ounce of the lactin dissolved in half a pint of water, produces half a pint of artificial milk. A more simple, and equally effective process, however, for the purposes of the emigrant, who wishes to have milk for his family on a long voyage, is as follows:—Put milk into bottles well corked, place them into a pan with cold water, and gradually rise to the boiling point; take them from the fire, and let the bottles cool in the water in which they were boiled. The milk will remain perfectly sweet for upwards of six months. In Italy they carry the process further, in the production of a dry substance called *lattenia*. Instead of putting the milk into bottles, they evaporate it to dryness under constant stirring. A dry mass is thus obtained, which, when dissolved in water, is said to possess all the properties of the best milk.

An object of curiosity would also be the collection of specimens of the bezoars, a concrete substance found in the stomach and gall-bladder of many animals, and to which several valuable properties were formerly ascribed. They have been obtained from the wild boar, the ox, the camel, the chamois (or wild goat), and the guanaco.

In my next communication I shall describe some other animal products of commerce on which further information is desirable.

## ON THE SANITARY APPLICATIONS OF CHARCOAL, AND ON VENTILATION.

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(*Concluded from page* 655.)

With regard to the warming of the air for winter use, in this and other climates, a few words may be said. The method of heating it by means of steam or hot water pipes is an excellent one, but the process could often be more cheaply and readily carried out by passing the air through wrought-iron tubes, arranged, for the sake of economising the heat of the fuel, in a manner somewhat similar to those in tubular boilers, &c. The barriers hitherto opposed to the warming of the air by the direct action of heated iron, as in this way, and in the case of stoves, arises chiefly from the disagreeable empyreumatic odours produced, and which are supposed to result from the partial charring of the organic impurities usually present in the air, and perhaps also, in the case of overheated cast iron, from the giving out of minute quantities of sulphur, and, it may be, of phosphorus combined with hydrogen. These produce head-ache, accompanied with a disagreeable dry sensation, which is corrected, in some measure, by allowing a little water to evaporate within the apartment so heated, and perhaps in all cases the admixture of a small amount of vapour with the air, when artificially heated, will be found of use, as it seems to "temper" it in some way, which has not yet been very well explained. Supposing, then, that the disagreeable effects produced on the system when air is heated in this manner does arise from previously-existing impurities, it is quite clear that if these were removed during the passage of the air through the filter, none such will be experienced, and in employing it for this purpose, I should feel inclined to recommend that the air be first heated, and afterwards *drawn*, by means of the fan, through the charcoal filter. In this case a small amount of moisture, if still required, could very readily be introduced, by having a portion of the delivering tube, shortly after leaving the fan, expanded and arranged with a small funnel and stop-cock, so as to present a flattened cavity for water, over the surface of which the heated air would have to pass. The great advantage of first heating the air is, that it enables the apparatus adopted for that purpose to be placed so as more readily to avoid accidents.

Given, then, purified air of the proper temperature and degree of humidity, passing at the rate of, it may be, hundreds of cubic feet per minute, and it comes to be a serious question, how to thoroughly diffuse it without causing "draughts" and dust, in the first place, and, in the second, so as to prevent the entrance of the impure or malarious air from the outside, and this leads me to make a few remarks on the subject of ventilation, strictly so-called, although it must not be forgotten that a true system ought to embrace all the objects, such as purity, and so forth, here indicated.

Ventilation, then, in its ordinary sense, and viewed strictly with reference to individuals, may be defined to be the constant, but insensible, changing of the atmospheric air over the human body, so as to ensure, in accordance with the above conditions, as far as possible, not only a fresh supply of air, but also the removal of that which is constantly being rendered impure from having fulfilled its part as the essential agent concerned in respiration, &c. And here it must be remarked that any system for the ventilation of a building in which a number of individuals are congregated involves a question of *dilution*, for it is practically impossible, as will be again shown, that all the impurities which are constantly being generated under such circumstances shall be immediately removed, and their contact with others entirely prevented. Indeed, to suppose otherwise would be to assume that *circulation* of the air could totally be prevented, and that every particle of impurity as evolved could be made to ascend almost vertically upwards, and be at once removed.

The point, then, as it seems to me, is to secure, as far as possible, *the maximum of dilution*, with the fulfilment of the other objects before indicated.

In considering this subject, it must be kept in view that atmospheric air follows exactly the same physical laws that other fluids do, and that forces acting on, or in, a given mass either of water or of air, will produce similar results. For instance, a large jet of water of sufficient force, if admitted into a tank partially filled with the same fluid, will pass in a straight line to the opposite, or resisting point, then recoil, so to speak, and thereafter become intermixed, to a certain extent, with the water already there. But, suppose that, instead of being a close vessel, the tank had an opening immediately opposite this entering stream or jet, it will be found that it will then pass almost directly out, and that only an extremely partial admixture of the two fluids will occur. Illustrations of these conditions are sometimes afforded by nature on a large scale, as when a river like the Rhine is seen to pass in its onward course directly through a lake, or, as in the case of the Indus, to advance without commixture for a considerable distance into the ocean.

Suppose, however, that, instead of a jet of water forcing its way through in a given direction, we have one or more entrances for the supply of fresh quantities, and that moreover we establish currents, by having, it may be, several openings in the tank through which the water is allowed to escape, and what occurs? In this, as in the other cases, the amount of intermixture between the two fluids is comparatively small. Currents are established in straight lines betwixt the inlet and exit points, and the result is very similar to that in which the river passes through the lake.

Take, however, another view. Suppose that the entering stream of water, instead of being single, has been divided or broken, as it were, into an immense number of small jets, and that these are then admitted from a great number of points all round; and also not in lines perpendicular to the sides of the tank, but at various angles; and the result will then be the establishment of a series of revolving currents, which, passing in every direction, will secure a thorough intermixture of the two fluids. This, moreover, it must be observed, will occur the more readily, if the exit water, or that flowing from the tank, has been made to depend upon the amount of that entering, and not upon a fall or draught, as that would actually tend to interfere with an effective circulation by establishing straight currents in certain lines.

Let us see now how these simple illustrations can be applied to the subject in question. The proposition is—the best mode of inducing the thorough circulation within, and dilution of, the air in a given building; and in dealing with a question of this nature, we have only to consider how certain conditions affect the great majority of individuals.

A chamber filled with air may be supposed to represent the tank in the former case. Admit a jet of air into it—open a window against which the air is blowing—and the result will be partial diffusion, and a bad cold or face-tick, &c., to the unfortunate with whom it may come into contact, *en route*, or even after its recoil, should it strike with sufficient force against the opposite side. Suppose, however—and I may mention that examples of the following illustrations may be seen in London—that we resolve on at least preventing the injurious effects which proceed from "draughts," and have therefore our inlet and exit openings placed at a considerable height above the floor, and it is evident that the air will pass through in a manner similar to that of the stream of water in the former case.

Take another instance: instead of causing the air to pass directly out at the opposite side, let us have one large entrance opening above, and an exit one of similar size below it, and the results, although much more favourable in every way than those in the former case, will still be defective. The volume of air, if it reaches the opposite side at all, will recoil and seek an exit through the point of least resistance, which in this case is very nearly in a line with its newly-acquired direction.

Suppose, again, that we have a number of openings for the passage of the air, arranged at intervals around the sides, and that a large exhausting shaft, or shafts, is made to enter at the top of the chamber, and what takes place? The air is drawn from the lower openings in straight lines towards the shaft in the roof, and the result is that only the comparatively few individuals who happen to be placed at or near to the sides of the apartment will receive the requisite amount of fresh air, and even these will suffer from the effects produced by draught.

Take another instance—Suppose that, instead of allowing the air to enter at the sides, we resolve that at least the individuals in the apartment shall have the benefit of what we do admit, and adopt the plan of having openings or perforations in the floor, through which the air shall be made to pass, and the result, then, is dust, and the inevitable cooling of a portion of the human body which ought to be kept warm, viz., the feet.

We shall pass now to more favourable conditions. In order to avoid "draughts," let us retain our entering current at the height of seven or eight feet above the floor, but divide it by having several openings around the room, and also a number of exit ones at a lower level, and one of which may be represented by the chimney, &c. In this case the diffusion will be much more perfect than in any of the others, but still, between these entrance openings and the supposed exit ones, a certain amount of *direct* current will be established, which will actually tend to prevent diffusion, by impeding circulation.

If, however, the current of entering air—just as in the case of the stream of water—were broken, not into a few, but into an immense number of smaller ones, and that these, instead of passing into the chamber from one or two, should pass in from *all* sides; and that, moreover, these minute jets of air should also, as in the same instance, be made to enter at different angles, the result will be the establishment of a series of revolving currents, which in their course will ultimately leave no portion of the air in the chamber in a state of rest. This motion will, however, be insensible from a general movement of the air in masses, and, just as in the case of the water tank, I pre-suppose that the air is not being dragged out by means of shafts, &c., which will establish currents in straight lines, and produce the effects already explained, but that it is forced into an apartment in requisite quantity, and allowed to seek an escape by, in some cases, special openings, and at others through those thousand-and-one apertures which every chamber, however close, ordinarily affords.

From the foregoing, it seems clear, that in all cases, in order to ensure, according to the rule already laid down, as perfect ventilation as possible, the diffusion and circulation of the required amount of air cannot be accomplished by means of draught-shafts, or alternations in the temperature of relative bulks of air, and that no system can be efficient that does not take it, as it were, into its grasp, and make it do the work.

The illustrations already given can, I believe, be applied to any given instance, and although it will not be worth while to multiply examples, I may still be permitted to refer, for a moment, to the ordinary case of large hospitals, and other public buildings, in which fires are the great ventilating media during cold weather. Here, the ventilating shafts are the chimneys, the openings of which, instead of being, as in the former instances, placed in the roof, are brought to within about three feet from the floor. In such cases, the points of supply are the doors and chinks of the windows;—and now what occurs? Certain lines of currents are established, and a very partial diffusion takes place: a few patients, or others, as the case may be, receive a very large supply of air in the hurtful form of draught, while the majority are left in a still atmosphere, which is being rendered every minute

more impure by the emanations from their bodies. And while on this subject, I may mention that the hospital physician has continually to recognise, in practice, this same question of *dilution*, which I consider to be the essential point in ventilating all public buildings whatever—and to secure which he is obliged, as when dealing with typus fever, and gangrene, to diminish to often one-half the number of cases in wards devoted to infectious diseases; for if this precaution be not taken, the attendants themselves eventually become struck down, and a considerably greater proportion of the patients die.

Returning, however, to the case of the low-placed ventilating shaft, or chimney: from this and from the ascent of the heated air, are allowed to arise those conditions of intensified impurity in the higher portions of an apartment, by which an individual may be standing with his feet in a draught, and his head in the still foul air above, unless some method, such as that proposed by Dr. Arnott, be adopted.

The tendency of the heated air under all conditions will, of course, be to ascend, and a few small openings ought, therefore, to be left at the top; but in the system or mode which I am about to propose, the chief exit points ought to be low down, and under conditions in which it is an object of great moment to exclude the *outside* impure air, no *special* apertures ought to be made; for every apartment, however closely shut up, will still afford a thousand openings, of one sort or another, through which the air can be made to pass; but, at the same time, if these natural openings are, in any instance, too large, means must be taken to contract them sufficiently. In all these cases it must be noted, that I presuppose that the air is being made to pass into a given chamber, in quantities sufficient not only to fill it, but also to give, under ordinary circumstances, a certain amount of *exit current* through these openings, and the result of this will be to prevent "draughts," or the entrance of the air from without.

The heated and impure air will, doubtless, in all cases, even in those in which a continued *circulation*—in the true sense of the term—is ensured, have a tendency to ascend, and thus a slight accumulation of impurity, as in other cases, occurs towards the top, and hence the advisability, perhaps, of having a few small openings in the roof, but, at the same time, particular care must be taken that these are not arranged so as to cause an upward draught, or left too large so as to allow too free an exit for the air at this point; and if these indications prove in any case difficult of attainment, it will be better to have one large opening with a valve, which can be kept *shut* during the time the air is being forced into the apartment, and opened afterwards; and it must, of course, be borne in mind, that if the lower or inhabited portions of any room or chamber be thoroughly well ventilated, the existence of a little impurity above will not be of any consequence, and even that will be in a very diluted state.

The whole question of the ventilation of a building in which a number of human beings are congregated, must, I believe, resolve itself, in a given climate, into a balancing between certain difficulties, for, as I have already shown, any system proposed can be only relatively, not actually, perfect. Suppose, for a moment, that we lay aside experience, and look at the thing through the light afforded by one or two scientific facts.

The elements for the calculation are these. In a given chamber, filled with people, the particles of the air which come into contact with their bodies become heated, have thus their specific gravity lessened, and, consequently, ascend, carrying with them also the greater proportion of the products of respiration and other gaseous impurities. Here we say, perhaps, that Nature herself indicates the method to be adopted. What has to be done in ventilating a building is evidently to have openings in the roof, and the chief point is accomplished.

But having thus readily disposed of the upper impure air, an equally essential consideration, viz., the supply of fresh, has to be attended to. We have got rid, we shall suppose, of the impure air above, (although even that depends upon the supply of cooler air to those below, for otherwise, the temperature all over soon becomes equalized, the ascent of the impure air now ceases, and before long the atmosphere becomes intolerably stagnant, for the removal of the products of respiration, &c., arises now from the slow process of interstitial diffusion), but we have now to secure the entrance of a sufficient quantity of fresh; and now comes the difficulty, for not only is it possible, as every one knows, to do an immense deal of harm by the direct action of currents of air, but also, that by one system or mode of application alone is it practicable to insure, by means of exit shafts at the top, a requisite supply of fresh air to even a majority of the occupants. The only possible mode of carrying this into effect is to have a perforated floor, through which the air is passed to be again drawn off by a shaft, or shafts, above, and as before-mentioned, this in practice has proved a failure, for to say nothing of the dust which must infallibly be raised the effect of a current, even, of heated air directed against the feet of the unfortunate sitters, could only be to produce one result.

I hold, then, that, practically, any system for the ventilation of a large building, by means of draught-shafts must fail, and, that, that only will be really efficient which ensures a thorough circulation of the air after its admission.

The *physiological* objection to such a system, viz., that it pumps out the air, and thus tends to diminish in a given time the bulk of that essential fluid which is required for carrying on the purifying functions of the lungs and skin, is correct in theory, but, in the case of such an extremely subtle substance as the air, which rushes with extreme readiness from all quarters on the slightest attempt to produce a vacuum, in practice must prove of an extremely fractional description.

To sum up, then—the indications to be fulfilled, by as perfect a system of the ventilation as it is practically possible to have, I conceive to be the following: in the first place the air should be purified; and it ought to be of the proper temperature, and neither too dry nor too moist: and in the second, it must be delivered into a given building, and diffused or circulated so that the individuals within shall be constantly, but insensibly, receiving supplies of fresh air in requisite quantity, and that this should be effected in such a manner as to avoid draughts, and prevent also, as far as possible, the entrance of the unpurified, or malarious air, from without. The first of these conditions can, I believe, be ensured by the means already detailed, and it now only remains to treat of the second.

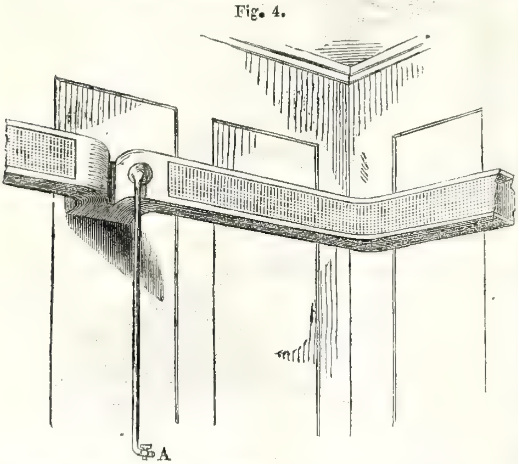
I shall assume that the fan, or supplying agent adopted, is capable of furnishing the required volume of air, and at once pass on to the question of its diffusion. In order to effect this, I have adopted the following arrangement. The air, after passing through the filter, &c., is conducted, by means of a large tube, into the adjoining apartment, at a height of about eight feet from the floor.

This tube, immediately on entering the chamber, bifurcates or divides into two branches, which pass round the room at the same level, and ultimately unite at the opposite side, thus forming, as it were, a loop, composed of tubing, of which Fig. 4 endeavours to represent a portion—the small tube A, as elsewhere mentioned, being employed for demonstrating the purity of the air after its passage through the filter.

This tube, or "air diffuser," may be of very simple materials. In the present experiment it is constructed of light zinc, and attached to the wall in a temporary manner by means of a few nails. It is of a square form, four inches in depth from before backwards, and six inches in breadth in the vertical direction. The front of the tube, as attempted to be shown in the figure, is composed of a tolerably close-textured canvass, and it presents an air-

delivering surface of 35 square feet, the length of the tubing being 70 feet. Immediately at the entrance-point for the air, and extending for a little way, the front of the tube is completed by means of metal—not canvass—in order to ensure more completely the division of the current, and to prevent an unequal or extra amount being delivered at this part. The result of the whole of the arrangement is, that the air, on being forced by means of the fan into this delivering tube, is caused to pass from

Fig. 4.




all sides through the pores or meshes of the canvass, and it thus becomes constantly and insensibly diffused in every direction throughout the room. In this manner—returning to a former illustration—we get our large entering current of air broken into almost an infinity of jets, which are constantly being passed from *all sides* into the apartment, and not only so, but also being made to enter at *varying angles*, so as to insure, as formerly explained, the establishment of a series of revolving currents, which, in their progress, shall pass into every corner, and leave no part unventilated. The angles at which these minute jets or currents pass through the canvass, can be readily demonstrated by means of down or light feathers, or by the flame of a taper, but for the sake of convenience, and in order to avoid accident, in the experiments actually made the former method was adopted. In the first place, the fact that the air during the action of the fan did pass through at every part of the canvass was ascertained, and the direction of the currents then established. The angles at which these entered the apartment were found to vary at different parts, that of the side ones being, as might have been expected, by far the most acute; in fact, the only part where a *direct* current existed at all, was found to be on the side opposite to the main entrance. Of course, if the canvass were very close in texture, and the amount of air urged insufficient to cause some pressure within the tube, the result would be that these currents would pass more directly from the sides and for a greater distance towards the centre of the room, but the effect produced would ultimately come to be the same. With regard to the amount of air delivered from the different sides under ordinary circumstances, or those in which the air is not made to pass through under particular pressure; as was to be anticipated, the largest quantity passes through the canvass towards, and at, the point where the two currents meet, opposite the main entrance, and the least at the sides; and this leads to the practical suggestion of having the canvass at the latter parts, viz., the sides, of a coarser description than at the others, as by this means the amount of air delivered from all quarters will become equalised. This indicates also another advantage, which the canvass more readily affords than any other material, such as perforated zinc, &c., viz., that when in a given chamber more or less air, from its shape or other circumstances, is required at one part than at another, this can, in the same manner, be readily delivered by using a wider-meshed canvass at those parts, and *vice versa*. In the same way, also, the adoption of the canvass secures another convenience, as it prevents the necessity, within certain limits, for increasing the size of the tube, or air-diffuser; for one, even, of very moderate size, by employing very coarse canvass, can be made to deliver almost any amount of air, and on the other hand, if a small amount only be required, canvass of finer texture can be used, and so on; and in addition to these advantages, the cheapness of this material is, of course, a recommendation.

With regard to the position of the "air-diffuser" above the floor: this must also, to some extent, be adapted according to circumstances, such as the height and breadth of a chamber, &c. In some special cases, even more than one tube may be required, and of course in all public buildings with galleries, a separate diffuser, coming off from the main one, will have to be adapted for the ventilation of these. As a rule, I am inclined to think that ordinarily six to eight feet from the floor, or from two to four above the heads of the sitters, will prove in the great majority of cases about the proper distance, and the same height will probably answer for hospitals, although the relative distance between the entrance of the air and the individuals will be somewhat increased from the recumbent position in the case of the patients. The rule in the first place is to avoid the *direct* current of the air, and this at once establishes the position of the diffuser *above* the heads of the occupants, and in the second, at the same time, to have the tube so placed as to secure, consistently with safety, full effect from the circulation of the air which is constantly going on. I have already shown that the air in an apartment with an arrangement of the above description *must* be in constant movement, and the object is to hit as near as practicable to that point when its action becomes insensible, and, at the same time full benefit from its diffusion at the proper level secured. If care be taken not to place the "diffuser" *too low*, the height then comes to be of less importance, as, from the absence of special openings of any size above, the general movement of the air, as was formerly explained, must be downwards, as the exit points are all below, and as it is presumed to be passing in in considerable quantities, it has no resource but to seek a way out through these.

There are some people who would prefer, as far as their feelings are concerned, to remain almost constantly in a "draught," but, in considering various sanitary arrangements, reference can only be had to such as will secure the greatest amount of benefit to the majority, and certainly under our climate in this country such instances as the above are comparatively rare.

From what has been said it will be evident also that the distance of the "diffuser" above the heads of the occupants will have to be regulated according to the amount of force employed, for if a large volume of air be driven into an apartment with considerable force, it is clear that the tube will require to be placed considerably higher up than it would under more moderate circumstances. It is impossible, therefore, to lay down the exact position of the "air diffuser;"—all that can here be done is to indicate a few of the elements involved in the calculation.

Utility is, in all cases, a main consideration; and, although it is often difficult to combine the "useful with the ornamental," care ought at least to be taken to avoid causing a disfigurement; and as these "diffusers," as attached in the present experiment have, perhaps, somewhat that effect, I should recommend that, in practice, they be embedded in the walls, at the proper height, and this could be readily done—especially during the construction of new buildings; and in such cases the necessity for even a tube of metal, or other material, could be obviated by simply leaving a plastered cavity, of the requisite size, all round, with edges of wood disposed for the convenient attachment of the canvass, which, when an

object, could be dyed of various colours, such as red, green, &c. Other steps could, of course, likewise be taken to render such arrangements actually ornamental, and this is by no means an unimportant consideration, for health itself is not unfrequently sacrificed when this cannot be secured.

I may here mention that, although of course the plan here proposed may be applied anywhere, it is for public buildings, or those in which a number of persons are collected, that it is chiefly applicable, for, as I have already attempted to show, *by no other system is it practically possible* to secure, in such cases, even an approach to thorough ventilation.

With regard to the application of the foregoing method to buildings in India: the general rules already laid down can be applied, and under certain conditions, as in malarious districts, where the purity of the air within, and the exclusion of the unpurified without, come to be objects of vital importance, the system—including, of course, the charcoal filter, &c., here recommended, ought to receive a fair trial.

We know the invaluable power of charcoal over putrid elements of decomposition, which, in themselves, prove most hurtful to human life, but we are, as yet, ignorant of what its influence may be when dealing with those more special poisons which give rise to diseases like ague, or intermittent fever, but some facts and analogies, into which I have not here time to enter, would lead us to believe that, probably, it may have some power over even these.

To set this point at rest, one way or another, I would propose that a certain barrack, in *at least* one of our fever-stricken districts in India, be fitted up in the manner here indicated, and the results, at the termination of a reasonable period, carefully balanced. The expenses involved in carrying out such an experiment would be comparatively trifling, and would be more than repaid, were the lives of only half-a-dozen of those expensive items—European soldiers—to be saved in the course of as many years.

This subject, then, as bearing on the health of the resident in all unhealthy districts in India, I consider of vast importance, and, as affecting the welfare of the soldier there, and the expenses of the Government, one which calls for attention from the Indian authorities.

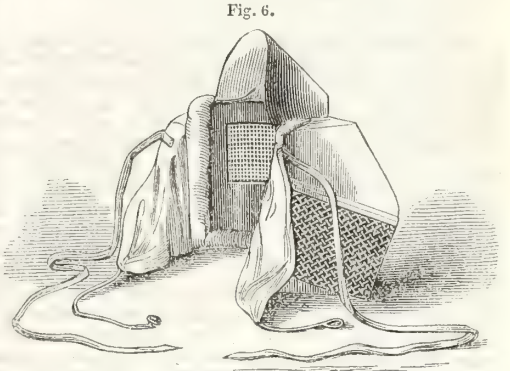
So much, then, for the subject of the purification and diffusion of the air in public buildings, &c.

The next application of charcoal as a sanitary agent which I would mention, is one by which it is brought to bear upon each individual separately. This is effected by means of a respirator, or, more strictly speaking, a filter for the *inspired* air, and it must not be confounded with any other respirator, as the entire object of this instrument is to *purify* (not to warm) the air. The objects accomplished by it are the following. All the inspired air, or that which enters the lungs, is made to pass through a layer of small angular fragments of carefully prepared charcoal, fully an inch in thickness; and, on the other hand, all the expired air, or impure breath, is allowed to pass freely out by a separate passage, and in this way its after contact with the charcoal entirely prevented. This is effected by means of valves of a very durable description, but which act with great freedom. The arrangement of these will be readily understood by referring to Fig. 5, which shows a section of the instrument,—Fig 6 being an attempt at a general view.

In Fig. 5, C represents the upper or expiratory valve, B the lower or inspiratory one, through which the purified air passes. Both valves are shown open in the figure, and the arrows indicate the directions of the currents, but in practice C of course shuts while B opens, and *vice versâ*, and from the sloping of the seat of the valves their tendency under all ordinary positions of the body is to remain shut until called into action.

Fig. 5.


Fig. 6.



Mr. Rooff, of Willow-walk, Kentish-town, is the manufacturer of these respirators, as well as of the old form first brought out by Dr. Stenhouse. Some years ago Mr. Rooff took out a patent for the application of valves to such instruments, and under my directions he has been successful in applying these so as very effectually to accomplish the foregoing objects, and thus to render the instrument as far as possible effective. The application of the valves of course obviates the objections to the old form of the charcoal respirator, in which the *expired* as well as the inspired air has to pass through the charcoal, thus rendering that impure which it is an object of importance to retain as long as possible intact, for in the case of a respirator, only a small quantity of charcoal can conveniently be employed. The other objection to this form, and one which I at once saw would prove fatal to its employment in warm climates, is that it tends, like all the common forms of air-warming respirators, slightly to impede respiration, by opposing somewhat the exit of the breath, an objection which the introduction of the upper valve, C, has entirely removed. For some purposes, however, the old form of the charcoal respirator will be found of advantage, as, for example, in instances in which a *mechanical* filter, as well as one calculated to destroy a certain amount of gaseous impurity, is a desideratum, as in the case of needle-grinders, firemen, painters, &c., and in "London fogs" I can myself strongly recommend it.

The new, or valved charcoal respirator, from the nature of the materials of which it is constructed—wire—thin tinned iron, and charcoal, with the requisite padding, is very light, but it appears somewhat bulky. Its object is, however, to prevent, as far as practicable by such means, the introduction of the elements of disease into the system, and hence *efficiency* has in this instance been the chief consideration.

The action of the instrument while being worn is so easy, that I have myself slept with one on during a warm close night without inconvenience—a thing of very great moment, for it is during sleep that the body is most easily influenced by the floating elements of disease.

These, then—the "air-filter" and the respirator—are two definite methods by which, as directly affecting individuals, charcoal can be brought to bear on the purification of the air, but there are an immense number of simpler applications of this substance, into which however I shall only very shortly enter.

If charcoal be placed so as to present a considerable surface to the currents of air, which are to a greater or less degree constantly passing through every chamber, these become deprived, to a very considerable extent, of a certain amount of impurity. This is readily accomplished by having flattened-shaped cages, or baskets, constructed, and filled with angular fragments of wood-charcoal, about the size of common beans. These cages ought to be from one-and-a-half to three feet in extent either way, and from two to three inches in thickness. They may be made of stout-wire gauze, set in wooden frames, or extemporised of various other materials, such as small canes, narrow slips of wood, &c.

These charcoal protectors must, in all cases, be applied so as most readily to allow the air, during its circulation, to come into contact with them, and they ought to present a considerable surface, as well as bulk; for it will not do to place a few handfuls of charcoal in the most out-of-the-way corners of an apartment, as is sometimes done, under, apparently, the expectation that all impurities will be drawn thitherwards by some magically attractive power! Like every other thing, charcoal, to be effective, must be put under *reasonable* conditions.

Other methods than those here mentioned can, of course, be adopted, by which charcoal may be employed for the purification of the atmosphere in a room, but, perhaps, sufficient has been said to indicate the general principles by the application of which these are to be carried out.

Undoubtedly, however, the most important of all the indications to be fulfilled by the use of this substance, is, the *prevention* of the various deadly products of decomposition from ever reaching, as such, the surface at all; and its employments for this purpose may be shortly summed up. It ought to be used for covering exposed filth of every description; and dead bodies, under many circumstances, should be buried with a layer of about three inches of pounded charcoal over them; and for this purpose, that from peat, when it can be procured more cheaply than the wood variety, may be used, although its absorptive power is not quite so great as that of the latter.

For some purposes, peat charcoal answers remarkably well, but in others, that from wood will be found preferable. Its power is somewhat greater than that of the former; it is less readily damaged by exposure to wet or moisture, and, with ordinary care, does not cause annoyance from *dust*—a thing which it is very difficult to avoid when employing the peat charcoal, on account of its friability. As a rule, therefore, I should recommend that wood charcoal be used within buildings, and that from peat, chiefly employed for out-door purposes.

With regard to burying dead bodies with quick-lime: its advantages have never, as far as I am aware, been clearly proved; but, be this as it may, the following experiment, which was lately brought to my notice, will show that it is not for a moment to be compared with charcoal. Two horses were taken and buried, not far from each other, in a similar soil—a thing to be attended to in such an experiment, as a porous soil, (from the *air*, and, consequently, oxygen, contained in its interstices,) tends to hasten decomposition in the same way as charcoal does. One animal was covered with quick-lime, the other with charcoal. At the termination of a certain period both graves were examined. In the course of opening the one with the lime, the workmen were obliged to desist, on account of the intolerable fœtor emitted. On opening the other one, however, the operator was surprised to find that, with the exception of the bones and portions of the skin, the animal had entirely disappeared, and thus is afforded a very striking demonstration of the relative power of the two substances.

So much, then, for the employment of charcoal as a sanitary agent. In dealing with this subject I have chiefly endeavoured to indicate the *principles* which ought to be kept in view in bringing its powers to bear, and I have also done my best not to assume more than what at present is capable of proof. Charcoal may or may not be a disinfectant in the true sense of the word—it may or may not prove a safeguard from special diseases which are caused by elements of the constitution of which we are at present ignorant—but this we do know, that it has the property to a wonderful extent of destroying those putrid and deadly gases which too often —in the cottage on the hill side, as well in the crowded city—are allowed to impregnate the atmosphere, and which, in reality, constitute far deadlier, because more insidious, enemies than those more striking diseases such as cholera, which would almost seem to be, in kindness, sent to point with warning finger to those preventive measures which never can, with impunity, be relaxed.

## WANDSWORTH TRADE SCHOOL.

A report has just been issued of the proceedings of an experimental Trade School, lately founded at Wandsworth by the Rev. Dr. Booth, F.R.S., Chairman of Council of the Society of Arts, which has excited much curiosity amongst those interested in new educational schemes. The object of the present school is to provide instruction for the children of artisans and small tradesmen in the knowledge of common things, that may be turned to practical usefulness in after life. By the payment of eightpence or a shilling a week, children are taught a little of mechanics and chemistry, and the use of the steam engine, along with geography, history, and arithmetic, and their bearings in relation to trade. The school during its first quarter had an average attendance of about twenty-six boys, but owing to the incompetency of the master first selected, the number had considerably fallen. A new master was then chosen, Mr. Robert Marks, late a pupil of the Highbury Training College, and the holder of a first-class certificate from the Committee of the Privy Council on Education, and with the assistance of Mr. Buckmaster, of the Government School of Mines, and an able drawing master, Mr. Lanchenik, considerable improvement has taken place, and the number of pupils has risen to fifty-eight. The school is attended equally by the sons of churchmen and dissenters, and the Committee of Management are extremely sanguine in the ultimate success of their experiment, concluding their report with warm expressions of the deep thankfulness they feel at the success of a school intended to provide for the educational wants of such large and influential classes as those which comprise the skilled artisans and small tradesmen of the country, classes which hitherto have been altogether overlooked in the educational movements of the last few years, whether made by the state or by private persons. They also express their very decided and deliberate opinion that it is politically unsafe thus wholly to neglect the education of such self-willed and

excitable masses. They would gladly see trade schools of this kind established throughout the country, especially in extensive manufacturing localities. If the success of this attempt has been so remarkable in a small place like Wandsworth, still greater might naturally be anticipated among a larger population.—*Literary Gazette.*

## Home Correspondence.

### BRITISH IRON MANUFACTURE.

Sir,—Having been personally acquainted with Mr. Richard Cort for the last twenty years, I have read with much interest his Review of the Report of the Committee of the House of Commons, in 1812, upon his late brother's petition, and his exposition of the vast benefits which the nation has derived during the last sixty-seven years from the puddling and rolling processes in iron manfacture, invented by his late father.

The columns of the *Journal of the Society of Arts* have never before made public claims upon the national gratitude so extensive and well-founded as those which Mr. Richard Cort's recent articles disclose; and I should hope that every member of the Society of Arts, as well as the ironmasters in general of the United Kingdom, will agree with me in thinking that the time has come when steps might be taken so to press those claims upon the attention of Parliament as to procure for the last surviving male representative of Mr. Henry Cort, and his two aged sisters, a suitable provision for their declining years.

Prior to the publication of these articles, it was my impression that means should be used by Mr. Cort's personal friends, amongst whom I number myself as one, to raise, by private subscription, a sum to purchase an annuity sufficient to make him independent and comfortable for life; but with the narrative before the public which your Journal contains, it would, I think, be a shame and a reproach to the country were Parliament to allow individuals to furnish from their own limited resources that which ought to be given from the public purse, not with a grudging hand, as a charitable dole, but as a long unjustly withheld, and at best most trifling and inadequate acknowledgment for services such as no other individual has ever rendered to native industry—and consequently to the prosperity, happiness, and grandeur of Great Britain.

Knowing, however, the extreme difficulty which every person labours under who knocks single-handed at the Treasury doors, let his claims on the public consideration be what they may, allow me to suggest, through your columns, that local committees should be formed without loss of time in the principal seats of the iron trade, for the purpose of aiding and assisting Mr. Cort to bring his claims effectually before the House of Commons during the course of the ensuing session; and also, that the Committee of the Society of Arts should name five or six of their number to co-operate with and act as a central head for such local Committees.

In this way effect may be given to Mr. Sanderson's wishes, that a national acknowledgment should be made to Mr. Cort on account of his father's national services; some reparation be made to the family of a man who left inventions which have proved a legacy to his country exceeding £259,000,000; and future inventors encouraged by the assurance that they shall not expend their private fortunes in prosecuting useful discoveries, and thereby leave their children destitute, without a grateful nation doing what is just, liberal, and honourable in the case.

I remain, sir, your obedient servant,

RICHARD BROUN, Bart.

Chelsea, August 6, 1855.

### MR. CORT'S INVENTIONS.

Sir,—I little thought, when lately remarking, in your 135th number, on that standing disgrace to British justice and gratitude, the treatment of Mr. Cort, that a descendant of the honoured name was in existence, able to furnish you with the overwhelming details which have formed so prominent, painful, and invaluable a feature in three late numbers. When a boy, I recollect my father having some correspondence with Mr. C. Cort, perhaps forty years since. Hearing nothing further of the name through successive epochs of the redolent prosperity of the iron trade, I concluded this fearful business had merged into the class of irreparable wrongs, which remain unadjusted until the books are opened in judgment upon oppressors and extortioners. I supposed that any possibility of compensation was as effectually precluded as the repair of Dudley's bellows and furnaces, cut and destroyed by rivals in trade and owners of forests, jealous of the introduction of pit coal to the first stage of ironmaking, and which Cort has introduced to the last stage, —inventors to be ranked together as similar in achievements and in fate. The disorders of civil war afforded some excuse for the usage of Dudley; in truth his inventions were comparatively valueless until Cort set the crowning stone on the performance; his difficulties are more an instance of indomitable energy struggling with adverse events—the malice of rivals, and vested interests in comparatively lawless and unsettled times, than the exhibition of an enormous aggregate of national and official apathy towards individual oppression. The nation or the Government made immediately no great gain by Dudley's loss, but the whole circumstances of Mr. Cort's affair, in a time of internal peace and order, by the Government of a boastfully free state, and unvindicated by the committee of a representative legislature, offer facts which can only meet a parallel in the annals of the most rapacious despotism. That the whole blaze of the prosperity of the world, wealth to the amount of thousands of millions sterling, has been created, within little more than half a century, by the inventions of one single man; that he was deliberately and perseveringly hindered from reaping any other reward but loss from his labours by the acts of official authority, in no barbarous times, but within the memory of living men; and that these injuries, so artfully aided by designing men, hoodwinked or bewildered a Committee of the House of Commons, presided over by a future president of the Royal Society, into a report upon the circumstances so utterly absurd and false, that the famous resolution of the whole house passed about the same period, that the guinea, for which every man fortunate enough to have one, could obtain in open market seven silver shillings and a pound bank-note, was absolutely of the same value as one shilling and the note alone, may be considered as the dictum of a profound oracle compared with that report; these are the facts now brought before the country by the papers of Mr. Richard Cort, that deeply-injured man's surviving son. The House of Commons is supposed by some to be a degenerate body, and its modern votes lightly spoken of, but these *laudatores temporis acti* will find their best correction in referring to this narrative. The oppressive cruelty of state officers was slurred over by a report, not only untrue, but adding insult to the injuries of the petitioner for redress, purchased at a cost of £250, which the whole House had not the justice to follow the recommendation of even that unjust committee to repay.

That the *whole share* of the merit of the puddling process and the invention of grooved rollers was due to Mr. Cort alone, in contradiction to the unhappily false verdict of the committee, all ironmasters know; no other name is ever mentioned amongst them as the author of these transcendent national gifts, and no person reading the details and documents in Mr. Richard Cort's papers, can entertain the least doubt on the subject. The report of the committee is doubly unjust, for if they obtained evidence that others had a greater share in these great

things, it was a treachery to merit to conceal the names of the right inventors. But they had no such evidence, a random assertion is made, *de non existentibus*, and *the evidence suppressed is that which justifies the claim of the petitioner before them.* Wrong, grievous wrong, had been done, and the wrong-doers found means to confirm that wrong, and throw in a compassionate sneer, the better to interpose between the truth and their punishment. An action for damages against the Crown was in those days deemed an attempt as insane as to use the head for a mural battery, or there could hardly be a clearer case. The property of Mr. Cort was seized for the official default of his partner; not only were the works seized and destroyed, where he had brought his processes to perfection, but the patents also, with the contracts with various firms for their use. These contracts were not enforced, and the defalcation thereby refunded to the public purse, but the contracting parties were suffered to make and sell their iron in peace, freely using the new process, and pocketing the extra profit of the royalty contracted for. A creditor has no legal right to more of his debtor's property than will cover his claim, and surely Mr. Cort might have equitably recovered from the crown the £160,000, or whatever the balance was, which would have remained out of the £187,000 which the patents would have realised during the term when these just public servants kept them folded in a napkin. To avoid such a dilemma it appears to have been convenient to place Mr. Cort in a cleft stick, granting him £200 a year in lieu of his just rights, a certainty, however small, which of course would have been taken away had he ventured to move to regain the tens of thousands owing him. The whole transaction is so bad that we are warranted in conceiving that where there was dishonesty and cruelty, there was also corruption, and that the authorities who suffered the ironmasters to evade the contracts due to the holders of the patents, found convenient reasons for a clemency to them, so foreign from their mercies to the inventor. A far more comprehensive and efficient method for reaping where another sowed was arranged than the vulgar Luddite practices under which Dudley suffered. It was no doubt a master-stroke to demolish the inventor in the moment when he had fully taught his art. The hive was full of honey, it was time it should be plundered and destroyed. It would be an interesting addition to the matter already given, to know the names of the firms who principally supplied the government stores during the years the patents were wrongfully held in abeyance. In a future letter I propose to offer some remarks on the practical details set forth in the notable report of this committee. The estimate of Mr. Richard Cort, that the aggregate national savings by his father's processes to this date, are near 260 millions sterling, *I believe to be very far from exaggerated.* In writing to a friend immediately after reading his second paper, I stated these savings at a rough calculation as at least 300 millions; but if we consider the amount of actual value which has been called into existence throughout the world by these inventions; the iron manufacture of the United States and of the Continent, which are equally with ourselves indebted to *him* for its present development; the extension of the steam engine both at sea and on land, which, without a quantitative process for supplying well-finished iron, would have been as nothing; the present almost universal application of the metal, including *iron ships* and *iron ways*, with all the wealth collaterally springing from these sources, the mind altogether fails in contemplating the magnitude of the results proceeding from one individual.

I am, sir,
Your obedient servant,
DAVID MUSHET.

August 13th, 1855.

## THE VINEGAR PLANT.

Sir,—There is a plant called the Vinegar Plant,—a kind of fungus, growing on the surface of mothery vinegar, and which is, I understand, sold in Manchester by the chemists for the purpose of converting sugar and water into vinegar. Can any of your correspondents give us the history and particulars of it, "both parentage and education, life, character, and behaviour," and how it came to be first known and used? It appears to be the yeast of vinegar.

I am, Sir,
F.S.A.

August 13, 1855.

## LONG RANGE GUNS.

Sir,—If I mistake not, one of Sir Samuel Bentham's plans in gunnery was to place a large gun in a steamboat, length long, and aim it by means of the rudder power.

There can be no doubt of the efficacy of this plan, and as little of the preferableness of large artillery to small.

The perfect gun requires a length proportional to the diameter of the bore. The exact proportions are not yet ascertained, but one thing is very clear, the proportion of length in small arms very far exceeds that of modern great guns.

And the proper *expansive* expenditure of the powder requires a given length of bore to follow up the projectile without wasting the force on the atmosphere curling round the mouth of the gun.

The projectile should be elongated to the greatest possible extent, to reduce the sectional area of resistance against the atmosphere.

An elastic piston or wad should take off the shock of the powder on the projectile, causing pressure instead of a blow.

The gun should be breech-loading, and the interior polished, and free from all rust.

The heavier the gun, the more perfect will be the expenditure of the force on the projectile, and the less the recoil.

If the gun be of cast metal, there does not seem to be any difficulty as to weight of material.

The gun could be fixed on a platform elastically supported to absorb all shock, with a mere vibratory amount of recoil.

It would not require to be swivelled or trunnioned. The steam power and the rudder could perfectly adjust it to the aim by longitudinal or lateral movement on the water.

A gun of twelve inches bore would require to have, in cast iron, an external diameter of at least four feet at the breech, and a length of thirty feet. Such a gun would weigh about sixty tons, and it would require a wrought tubular lining.

Placed at an angle of ten degrees with the horizon, such a gun would have a range of about six miles, throwing with accuracy an explosive elongated projectile four to five feet in length, which, pitching vertically in a town or fort, would explode horizontally, and not upwards at an angle of 45 degrees, as is the case with spherical shells.

A gun of this class could be constructed without difficulty, and the effect tried at sea along the coast.

And it is obvious that projectiles from such a gun might be discharged into a fort, every one hitting an efficient mark, while a similar gun in the fort would not strike, save casually, the vessel, because the error of a few yards at the fort would not signify, but a few yards error at the vessel would cause a simple plunge in the water, extinguishing the projectile.

The practice of moving guns in order to manipulate them, has hitherto kept down weight. Let them become fixtures, and the vessel become, as it were, a stock to the barrel, and this difficulty will be obviated. And when we have accomplished the greatest possible range with a twelve-inch bore, it will be time enough to try a larger calibre.

I am, Sir, yours,
PROJECTOR.

August 17, 1855.

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

*Delivered on 9th August*, 1855.

Par No.
159. West Indies—Copy of Correspondence.
409. Arctic Expedition—Report from Committee.
437. Valuation (Ireland)—Return.
282. Bills—Nuisances Removal, &c., and Police of Towns (Scotland).
289. Bills—Judicial Procedure and Securities for Debts (Scotland).
296. Bills—Charitable Trusts (Amended).
297. Bills—Metropolis Local Management (as Amended by the Lords).
Marriages in Ireland—Report of the Registrar-General.
Borneo (Sir James Brooke)—Reports of the Commissioners.
Public General Acts—Cap. 59, 60, 61, 62, 63, 64, 65, 66, 67, and 68.

*Delivered on 10th August*, 1855.

416. Towns Improvement Act (Ireland)—Return.
428. Medical Officers (Army and Navy)—Abstract of Return.
440. Post-Office—Accounts.
454. Malt—Return.
457. Crown Lands (Scotland)—Return.
459. British and French Fishing Vessels—Return.
Mercantile Laws, and the Law of Partnership—2nd Report from the Commissioners.

*Delivered on 11th August*, 1855.

425. Chamber of London—Annual Accounts.
430. Revenue, &c., (Ireland)—Accounts.
455 East India (Annexation of Karouly)—Return.
Australia (Discovery of Gold)—Further Papers.
General Board of Health (The Cholera Epidemic of 1854)—Report.
Noxious Trades and Occupations (France)—Report by Dr. Waller Lewis.

*Delivered on 14th August*, 1855.

464. Emigration (North America)—Copies or Extracts of Despatches.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette August 10th*, 1855.]

*Dated 11th July*, 1855.

1552. T. W. G. Freeby, 1, Westbourne-terrace Villa—Revolving fire-arm and cannon.

*Dated 20th July*, 1855.

1641. A. White, Great Missenden—Swinging beds and covers for sleeping off ground.
1643. J. H. Johnson, 47, Lincoln's-inn-fields—Railway axles. (A communication.)
1647. E. F. Lefebvre, Orleans—Motive power.

*Dated 21st July*, 1855.

1649. P. A. le Comte de Fontaine Moreau, Paris—Voltaic batteries. (A communication.)
1651. G. H. Perry, Wolverhampton—Provision cases. (A communication.)
1653. E. Myers, Rotherham—Buffer and carriage springs.
1655. S. J. Pittar, 10, Lisle-street, Leicester-square—Bridges. (Partly a communication.)
1657. J. W. C. Wren, Tottenham-court-road—Folding perambulator.
1659. G. Hepplewhite, Grovesnor-street, Commercial-road East—Spare rudders for ships.

*Dated 23rd July*, 1855.

1661. T. H. H. Kelk, Orgathorpe, near Loughborough—Materials for paper, textile fabrics, and cordage or ropes.
1667. C. Goodyear, 25, Avenue-road, St. John's-wood—Boats.
1669. G. H. Rollet, Liverpool—Projectiles.

*Dated 24th July*, 1855.

1670. W. G. Craig, Gorton, near Manchester—Consuming smoke.
1671. L. A. Ritterbandt, M.D., Warwick-street, Regent-street, and J. Bower, Hunslet, near Leeds—Manure.
1672. L. Bradley, Richmond—Reaping machines.
1673. J. Westwood and R. Baillie, Poplar—Preserving timber-built ships.
1674. H. Stent, Birmingham—Apparatus for measuring gas, &c.
1675. S. Twist, Birmingham—Producing ornamental devices on glass.
1676. B. Wood, Caledonian-road—Colouring matter for ink, artists' colours, &c.
1677. J. H. Johnson, 47, Lincoln's-inn-fields—Breech-loading and self-capping fire-arms. (A communication.)
1678. J. H. Johnson, 47, Lincoln's-inn-fields—Breech-loading ordnance and fire-arms, and projectiles. (A communication.)
1679. S. E. Steane, Oxford—Application of perfumery to articles of domestic use.
1680. R. H. Brooman, 166, Fleet-street—Pipes and tubes. (A communication.)
1681. T. Petitjean, Tottenham-court-road—Silvering, gilding, and platinizing glass.
1682. T. Hewitt, Morley-park-works, near Derby—Pumps.
1683. R. P. Huthnance, Chipping Norton—Drying.
1684. B. Baily, Leicester—Knitted fabrics.
1685. G. T. Bousfield, 8, Sussex-place, Loughborough-road—Cutting wood. (A communication).
1686. C. Goodyear, 25, Avenue-road, St. John's-wood—Carriages.
1687. J. B. M. Potin and A. G. N. Lingee, Paris—Composition for coating substances.

*Dated 25th July*, 1855.

1688. E. S. Tucker, Kentish-town—Busk and hook for stays.
1689. J. Girard, Paris—Rotary engines.
1690. V. Scully and B. J. Heywood, Dublin—Vessels for containing fluids.
1691. W. Weallens and G. A. Crow, Newcastle—Steam-engines.

*Dated 26th July*, 1855.

1692. D. Davies, Stockport—Boiler for heating buildings with hot water.
1694. T. M. Hall, Preston—Chimneys, particularly of locomotive and marine engines.
1696. J. Gedge, 4, Wellington-street South—Pumps. (A communication.)
1698. T. A. Poncelin, Paris—Preparing coffee.
1700. R. H. Hancock, 18, West street, Smithfield—Stopping ordinary trains.
1702. T. Dawson, King's Arms Yard—Bedsteads, couches, &c.
1704. C. Goodyear, Avenue-road, St. John's-wood—Carpet and other bags. (Partly a communication.)

*Dated 27th July*, 1855.

1706. Captain W. Allen, R.N., Athenæum Club—Vehicle for transport of camp baggage.
1708. J. A. Benfield, Rotherhithe—Propelling vessels.
1710. W. Bridgewater, Cheltenham—Tiles.
1712. J. and R. K. Whitehead, jun., Elton, near Bury—Textile fabrics.
1714. G. Woods, 60, Crown-street, Finsbury-square—Pack saddles.

*Dated 28th July*, 1855.

1716. R. H. Abraham, 11, Howard-street, Strand—Carriage on two wheels, to be called a "Rotalter.'
1718. F. G. H., and A. J. Levasseur, Paris—Oil lamps.
1720. R. Wilson, Glasgow—Finishing woven fabrics.
1722. J. Kerr, Bedford-terrace, Trinity-square—Revolver fire arms.
1724. T. B. Daft, Isle of Man—Inkstands.

*Dated 30th July*, 1855.

1726. J. Peacock and H. H. Barry, Bedford-street, Strand—Making copies of writings simultaneously with originals.
1728. C. Piper, Cambridge—Gun stocks.
1730. W. Truran, Marazion, Cornwall—Smelting.
1732. J. Hanson, Dough, Belfast—Digging potatoes.

*Dated 31st July*, 1855.

1734. H. Mackworth, Clifton—Washing and separating minerals, &c.
1736. H. Colby, New York—Altimeter or self-adjusting quadrant.
1738. L. N. Dupont, Louviers Town—Fabric called "drap de soie."

*Dated 1st August*, 1855.

1742. R. A. Brooman, 166, Fleet-street—Paper, pasteboard, and pulp. (A communication.)
1744. C., W. J., and R. Vaughan, Birmingham—Handles of iron bowls and other iron vessels.
1746. L. Glukman, Dublin—Box for papers, &c.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1739. J. Robert, Liege—Machinery for manufacturing fire-arms.—1st August, 1855.
1740. B. Britten, Anerley—Projectiles.—1st August, 1855.
1754. W. Meyerstein, 47, Friday-street—Sewing machine.—3rd August, 1855.
1770. A. Warner, 11, New Broad-street—Coating or combing sheet iron and steel with sheet lead, zinc, tin, copper, or alloys of such metals.—4th August, 1855.

[*From Gazette August 17th*, 1855.]

*Dated 2nd August*, 1855.

1748. J. Stanley, 224, Whitechapel-road—Weighing machines acting upon levers, steelyards, &c.
1750. S. Waller and J. Butterfield, Bradford—Machinery for weaving figured fabrics.
1752. R. A. Tilghman, Philadelphia—Candles.

*Dated 3rd August*, 1855.

1756. J. Lane, Birmingham—Gold leaf.
1758. J. B. Mourguet, Paris—Destruction of weevil whilst drying corn.
1760. F. R. A. Glover, M.A., Endell-street—Carrying knapsacks, &c.
1762. R. A. Tilghman, Philadelphia—Alkalies and alkaline earths.
1766. J. H. Johnson, 47, Lincoln's-inn-fields—Separating carbonic oxide from gas, and application to heating purposes. (A communication.)
1768. J. H. Johnson, 47, Lincoln's-inn-fields—Material for ornamenting various articles. (A communication.)

*Dated 4th August*, 1855.

1772. J. Anderson, Edinburgh—Shirts.

*Dated 5th August*, 1855.

1778. H. Gilbee, 4, South-street, Finsbury—Flat-bottomed boats. (A communication.)
1780. J. Platt, Oldham, and J. Hibbert, Ashton-under-Lyne—Mules for spinning and doubling.
1782. J. Lilley, Birkenhead—Textile fibres, and manufacture of pulp and dye.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1798. C. F. Thomas, Massachusetts—Boilers for steam carriages.—8th August, 1855.
1803. A. Webster, Vermont, U.S.—Machinery by which a horse may be suddenly disengaged from a carriage while running away with the same, or whenever required to be detached from it quickly. (Partly a communication.)—9th August, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed August 7th*, 1855.

555. James Murdoch Napier, York-road, Lambeth—Improvements in the furnaces used in the manufacture of soda or alkali.
601. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in steam engines. (A communication.)
781. David Cope, Birmingham—Improvements in the manufacture of metallic spoons, forks, and ladles.
1225. Etienne Jules Lafond, and Count Louis Alfred de Chatauvillard, Belleville, near Paris—Improvements in the processes of and apparatus for treating mineral, animal, and vegetable matters for obtaining oils, essences, paraffine, and other similar materials.
1315. John Sutton Nettlefold, Edward John Nettlefold, and Joseph Henry Nettlefold, Holborn—Improvements in locks.

*Sealed August 10th*, 1855.

326. Robert Kerr, 41, Coleman-street—Improvements in preparing loaf sugar for use, and certain apparatus for the same.
344. John Mason and Samuel Thornton, Rochdale, and Thomas Spencer Sawyer, Longsight—Improvements in finishing or polishing and drying yarns or threads.
345. Henry Spencer, Rochdale—Improvements in machinery for preparing and spinning cotton and other fibrous substances.
371. Henry Schottlander, Paris—Improvements in ornamenting looking glasses.
404. John Edmund Gardner, Strand—Improvements in portable cooking apparatus and in cooking lamps.
420. Alexander Brown, Tarbet, Dumbarton, N.B.—Improvements in the manufacture of paper, and in the production of textile materials.
547. Joseph Malcomson and Robert Shaw, Portlaw, Waterford, and William Horn, Mark-lane—Improved expansion valves for steam engines.
1046. Samuel Cunliffe Lister, Bradford—Improvements in treating old ropes, also old canvas and gunny bags, and similar materials, part of which improvements are also applicable to hemp, flax, rhea, and other similar fibre, to render parts of the fibres suitable to be spun.
1195. William Simson Young, Leith—Improvements in steam boiler furnaces, and in the prevention of smoke therein.
1297. William Baines, Coverdale-terrace, Hunter's-lane, near Birmingham—Improvements in certain parts of railways, and for the methods of manufacturing and constructing part of the same.
1338. Nathan Hackney, 20, North-street, Hull—Improvement in the manufacture of earthenware, china, and porcelain.
1354. George Cottam, Winsley-street, Oxford-street—Improvements in hayracks and harness brackets.
1362. Samuel Cunliffe Lister, Manningham, Bradford—Improvements in treating silk waste, also the noils of silk wool and goats' wool or hair before being spun.
1371. George Frederick Morrell, Fleet street—Improvement in ink bottles or ink vessels.
1393. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in furnaces or fireplaces. (A communication.)

Extension.

*Sealed 10th August*, 1855.

11. Frederick John Reed, 59, Friday-street, Charles Foard, Stock Exchange, and Thomas Shepperson, Dulwich-hill, Camberwell, (executors of Richard Groucock, deceased, to be held in trust for John Juckes, Henry Surmon, William Harnor, and William Craven)—Improvements in furnaces or fireplaces.

*Sealed August 14th*, 1855.

341. Robert Molesworth, Half-moon-street, Bishopsgate-street—Improvements in the construction of brushes.
348. Eugène Carless, Stepney—Improvements in the manufacture of paper-cloth, known as artificial leather, and in coating or covering the surface thereof with colouring matter, said colouring process being also adapted to the colouring or staining of paper.
350. William Carter Stafford Percy, and William Craven, Vauxhall Iron Works, Collyhurst-road, Manchester—Improvements in the manufacture and in machinery and apparatus used in the manufacture of bricks, tiles, pipes, and other articles made from plastic materials.
359. John Hackett, Derby—Improved fabric or fabrics for the manufacture of umbrellas, parasols, and buttons, and for other purposes.
360. John Hackett, Derby—Improved leather cloth, and the employment thereof for various useful purposes.
372. Samuel Kershaw and James Taylor, Heywood—Improvements in carding engines.
434. James Reddie, Anstruther, N.B.—Improved metal shovel.
436. Jesse Brickles and Thomas Thorpe, and Joseph Lillie, Manchester—Improvements in the manufacture of plain and ornamental woven fabrics.
450. Richard Archibald Brooman, 166, Fleet-street—Improvement in rollers used in spinning.
486. Andrew Hotchkiss, New York—Improvements in projectiles.
524. William Foster, Black Dike Mills, Bradford—Improvements in machinery or apparatus for cleansing wool and other fibrous materials.
531. James Murdoch, 7, Staple-inn, Holborn—Improved method of enlarging or reducing designs, maps, and other similar articles, also apparatus or machinery to be employed in the same.
921. Louis Alexandre Avisse, Paris—Improvements in lubricating revolving shafts of all descriptions, and also the axles of railway and other wheels.
1322. John Greenwood, Irwell-springs, near Bacup—Improvements in purifying oils.
1324. Samuel Colt, Pall-mall, and William Thomas Eley, Broad-street, Golden-square—Improvements in the manufacture of cartridges.
1366. William Clay, Liverpool—The application of certain descriptions of bar iron to purposes where great strength or stiffness is required.

Extension.

*Sealed 14th August*, 1855.

12. Alphonse René Le Mire de Normandy, 67, Judd-street, Brunswick-square—Improvements in the manufacture of soap. For three years from 8th September.

Letters Patent Cancelled—1853.

2744. William Calder, Glasgow—Improvements in the treatment and finishing of threads or yarns.—By order of the Lord Chancellor, dated 14th July, 1855.

Patent on which the Third Year's Stamp Duty is Paid—1852

264. Alfred Vincent Newton, 66, Chancery-lane—Improvements in apparatus for manufacturing gas and coke.

*Sealed 17th August*, 1855.

357. James Wright, 16, Park-street, Kennington—Improvements in the construction of furnaces for the purpose of consuming more effectually than heretofore the smoke contained therein.
364. George Redfield Chittenden, London—Improved apparatus for measuring fluids.
366. George Tillett, Clapham—Improvements in the construction of bedsteads.
367. David Hulett, Holborn—Improvements in apparatus for heating, cooking, and lighting by gas. (Partly a communication.)
376. Joshua Kidd, Kildwick, near Bradford—Improvements in machinery and apparatus for sewing and stitching cloth and other fabrics.
386. Frederic Prince, 3, South-parade, Chelsea—Improvements in fire-arms and ordnance.
402. William Henry Zahn, 13, Norfolk-street, Strand—Improvements in windmills.
409. Barnaby Angelo Murray, Dublin—Improvements in winding, doubling, and twisting silk, flax, and other fibrous substances.
414. William Brown, 113, Albany-road, Old Kent-road—Improvements in machinery for printing.
422. Thomas Nash, jun., 164, Great Dover-road—Improvements in painting brushes, applicable also to other brushes and to brooms.
439. Charles Frederick Stansbury, 17, Cornhill—An improved mode of ringing fog-bells. (A communication.)
494. William Hyde, Spring Hill, Ohio—Improved marine life-preserving apparatus.
785. Samuel Fielding, jun., Green, Rochdale—Improvements in apparatus for oiling or lubricating the pistons of steam engines.
819. Thomas Wimpenny, Holmfirth, and Jonas Wimpenny, Rawtenstall—Improvements in machinery or apparatus for drawing and spinning wool or wool mixed with other fibrous substances.
1307. Richard Anstey Tucker, Lenton, Nottingham—Using the gas and smoke arising from coal or other substances during the process of combustion for fuel.
1323. Samuel Colt, Pall-mall—An improvement in the construction of fire-arms.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3743 | August 11. | The Prince's Shape for the Edges of Japanned Trays, Bread Baskets, &c. | Littlehales and Green | Birmingham. |
| 3744 | August 13. | A Reel | Edward Israel | Milk-street, Cheapside. |
| 3745 | August 14. | Percussion Cap and Cartouche Pouch | Charles Frederick Dennett, and George Pays | Notting-hill. 260, Oxford-street. |
| 3746 | August 16. | The Trouser Alliance | Samuel Benjamin Woolf | 45, Old Bond Street. |

Journal of the Society of Arts.

*FRIDAY, AUGUST* 31, 1855.

## MEMBERS' PARIS VISIT.

The South-Western Railway have granted to those members holding through tickets to Paris the privilege of starting from any station on their line without extra charge.

The Secretary is also enabled to announce that the South-Eastern Railway Company, at his request, have granted to the members holding through tickets to Paris, the privilege of joining or leaving the train without extra payment at any of the following stations:—

| | |
|---|---|
| Reigate Junction | Staplehurst |
| Dorking | Ashford |
| Guildford | Rye |
| Reading | Canterbury |
| Tunbridge | Deal |
| Tunbridge Wells | Ramsgate |
| Hastings | Margate |
| Maidstone | |

The Tidal Trains only call at Tunbridge—they are due there one hour after leaving London.

A Correspondent in Paris has been requested to send over the following information, for being posted up in the Hall of the Society of Arts for the convenience of Members; a copy will also be found at the temporary offices in Paris, 14, Rue du Cirque.

Addresses of moderate-priced hotels and *maisons meublées* in the quarters round the *Exposition Universelle* and the Tuileries, with the prices at which they could give accommodation in the first half of September, and a statement of the *number of rooms* at each of the prices named, which might be secured by parties writing three or four days beforehand, also price of meals.

## SPECIAL COLLECTIONS OF ARTICLES OF DOMESTIC AND SANITARY ECONOMY FOR THE USE OF THE WORKING CLASSES.

*Report addressed to the Council of the Society of Arts, by T. Twining, Jun., V.P., August 27th,* 1855.

Gentlemen,—I beg leave to submit to you the following report, in compliance with the resolution adopted at the meeting of the 28th of March last, and which was to the following effect:—

"Resolved,—That the Council approves the proposal to form Permanent Economic Museums, as developed in Mr. Twining's Memorandum, and requests him, as a first step, to ascertain, with such facilities and assistance as the Council can give, what amount of co-operation may be depended upon in this and other countries, and to report thereon."

As concerns English co-operation, before leaving for the Continent, towards the end of April, I arranged for the issue of about 7000 copies of the Memorandum, to such societies and persons in the United Kingdom and the British Colonies as were considered most likely to take an interest in the undertaking.

The amount of communications elicited by this means has been small; but from the interest expressed in the plan by almost all those to whom a more direct application for their opinions has been made, there is little reason to doubt that it will be well supported when the opening of our winter session, and the return of the English Jury from Paris, shall have brought us to a favourable juncture for active operations.

Abroad, matters have progressed most satisfactorily. My first step was to obtain assurance that the subject of Economic Museums should be admitted as one of those to be discussed at the International Conferences convened for the month of July by the *Société d'Economie Charitable* of Paris.* This was effected without difficulty through the courtesy of M. le Vicomte de Melun, President of that Society, who has manifested a lively sympathy in favour of the movement, and has contributed much to its present success in France.

My next step was to prepare and have printed an abridged translation of my Memorandum, for circulation in France, Belgium, and the French part of Switzerland, and similarly a German translation for Germany and German Switzerland. It may not be amiss to remark, that, independently of the very cheap rate of postage for pamphlets which prevails in many parts of the Continent, considerable facilities exist in Germany for either collecting or diffusing information on matters connected with industry, owing to the existence throughout that vast country of a surprising number of Industrial Societies, mostly called *Gewerbe Vereine* (Trades Societies), several of which have attained to considerable importance. In Switzerland analogous facilities are afforded by a system of Cantonal Societies, comprising almost every department of public improvement, under the title of *Gemeinnutzgie Gesellschaften*, or *Sociétés d'Utilité Publique.* They are connected together by a central society, representing the whole confederation, and which shifts its annual meetings from one chief town to another, after the manner of our British Association.

At Zurich an important industrial establishment is being organised, somewhat resembling in purpose the Industrial College for Artizans, of which it will be remembered I proposed the formation in this country towards the close of 1851. I mention this because we are apt to doze, under the impression that other nations are slumbering.

Whilst at Berne, I communicated to Councillor Franscini, Member of the Federal Directory, and Minister of the Interior, the acknowledgments of the Society of Arts for the valuable assistance afforded by his Excellency in obtaining, last year, a collection of Swiss educational materials and results for our Educational Exhibition. He was pleased to express the most cordial willingness to facilitate our communications with societies and eminent men in Switzerland on every subject connected with the furtherance of arts, manufactures, and commerce, or tending to the improvement of the condition of the classes on whose labour they depend.

I have lately been informed, by some very intelligent gentlemen from Geneva and Lausanne, that they hope to establish in those towns small collections of articles for the use of the working classes, carefully adapted to the local wants. Such is the spirit of enterprise and emulation prevailing among the leading cantons, that an example of that kind would be rapidly followed by other chief towns in succession. The system of local museums thus established, would have a much greater amount of beneficial influence on the condition of the people throughout Switzerland, than could be effected by a single establishment on a large scale at Berne; but of course it will be very desirable to have at that city a central depôt and a committee for general management and correspondence.

In Belgium the success of the economic movement may be considered as secured under the direction of M. Ed. Ducpetiaux, the eminent friend and benefactor of the labouring classes in that kingdom. It appears that he had previously entertained views, and even begun operations conformable to the plan detailed in my Memorandum, and that it was chiefly with a view to join in our endeavours that he attended the Paris conferences, where he took a leading part, and became one of my best friends and supporters.

These conferences, convened under the title of *Réunion Internationale de Charité*, and which continued for eight

* It may be well to remark that the words *charite* and *charitable* are used in France in an extended sense, comprising every effort of practical philanthropy founded on religious motives.

days, were opened on the 17th of July, in the building of the *Société d'Encouragement*, kindly lent for the purpose.

M. le Vicomte de Melun, the distinguished President of the *Société d'Economie Charitable*, occupied the chair, and was ably supported by M. A. Cochin, mayor of the 10th arrondissement, and worthy representative of a family long conspicuous for talent, patriotism, and benevolence.

The plan adopted, and which proved most satisfactory, was to divide the investigation of benevolent institutions of every kind and country between five sections or bureaus, which met every morning, went thoroughly into the specialities allotted to them, and drew up reports. These were read and discussed at the general meetings held in the afternoon, and resolutions adopted briefly expressing the sense of the assembly. Of these, the following deserve notice as bearing on the subject of this report:—

1. A resolution recommending the formation, in the various countries, of collections of articles of domestic and sanitary economy, according to the views developed in my memorandum, and adopted by the Society of Arts.

2. A resolution for organising a system of international correspondence on all subjects connected with the welfare the labouring classes.

3. A resolution appointing a committee for selecting in the *Exposition Universelle*, with the concurrence of the Imperial Commission, such articles as might be most worthy of being offered to the attention of the working classes in a small special exhibition.

The labours of this Committee have been attended with the most satisfactory success. This must be mainly attributed to the intelligent and persevering zeal of its honourable members, who have evidently taken delight in a work which, from its character of practical, disinterested, and unobtrusive benevolence, came at once home to their sympathies and their habits. But much is also to be ascribed to the patronage which their Imperial Majesties have not ceased to bestow on the idea of a Working Classes Exhibition, and to the decided favour with which it has been taken up by H.I.H. Prince Napoleon; and many thanks are due to the eminent man to whom the fortunes of the *Exposition Universelle* have latterly been entrusted, and whose vast resources of mind and indefatigable activity have raised it from a comparative failure to a superlative success. M. Le Play, in the midst of almost overwhelming occupations, has not forgotten his former studies nor his former friends, and takes pleasure in furthering the domestic improvement of those classes whose condition he has so thoroughly investigated for twenty years, and so thoroughly elucidated in his great work, "*Les Ouvriers Européens*," just issued from the Imperial printing-house.

It was at first intended to exhibit the articles selected by the Special Commission, in a model building erected by our enterprising countryman, Mr. G. Clark, on the premises of the Palais de l'Industrie, adjoining his interesting *Cantine Modèle*. I have since been told that it has been found more convenient to allot for this purpose a separate space of 500 square metres.

My last advices state that everything is going on satisfactorily, and that the collection will probably be inaugurated at the time of the Society of Arts' visit.

## NOTICE.

The following is the notice which has been posted up in the English part of the *Exposition Universelle*. Similar ones have been published in French and German.

A special Commission, duly authorised by the Commissioner-General, has undertaken to select throughout the whole Exhibition such articles as their cheapness, combined with good quality, may render particularly useful in a simple home.

A certain number of these articles are to be exhibited in a separate section.

The preparatory measures are already nearly completed. Exhibitors who may be desirous of submitting any articles to the above-mentioned Commission, are requested to apply immediately to M. Savoye, commissioner for classification; to M. Audley (Bureau des Réclamations); or to M. de Pelanne, sub-inspector. These gentlemen will supply any information relative to the days on which the Commission holds its sittings.

All representatives and Commissioners of foreign countries are particularly requested to circulate the present notice among their countrymen, and to engage them to contribute to the realisation of so useful a scheme.

The special Commission, in order to facilitate the selection and classification of the different objects, has adopted the following divisions:—

I. Lodging.
II. Fittings and furniture.
III. Food. Stores for washing, lighting, and warming.
IV. Clothing.

### I.—Lodging.

*Building.*—Plans and systems of model-lodgings; building materials.

### II.—Fittings and Furniture.

Every article included in the present division is classified according to the usual arrangements of a family dwelling, consisting of three rooms,—a kitchen, a bed-room, and a sitting or working room.

It is highly desirable that the furniture and utensils should be made up in such a way as to answer their purpose in the smallest possible compass.

#### A.—The Kitchen and its Appendages.

*Preservation of Eatables.*—Liquids: Cellar, casks, jugs, bottles, filters, funnels, plugs and cocks, measures, bottle brushes. Provisions: Safes and pantries, boxes, baskets. Fuel: Coal cellars, charcoal boxes and shovels.

*Heating and Ventilation.*—Fittings: Fire-places and hearths, stoves, ventilators. Furniture: Utensils for the fire-place and stoves, fire-dogs, tongs and shovels.

*Lighting.*—Fittings: Conduits and gas apparatus. Furniture: Lamps, candlesticks of all descriptions, lanthorns, snuffers.

*Preparation and Cooking of Alimentary Substances.*—Fittings: Stoves, cupboards, dressers. Furniture: Dressers and kitchen-tables, boiling-pots and saucepans, cauldrons, boilers, kettles, coffee-pots, dutch-ovens, gridirons, frying-pans, skimmers, sieves, cullenders, ladles and dippers, roasters, coffee-mills, carving-knives, hand-mortars, spice boxes, scales, measures.

*Table Service.*—Fittings: Cupboards. Furniture: Sideboards and buffets, dining tables; soup-tureens, dishes, plates, tea-things, oil-cruets, salt-cellars, decanters, glasses, knives, forks, and spoons.

*Scullery and Washing.*—Fittings: Sink-stone and its accessories. Furniture: Tubs and pails, mats, water-pots, brooms, sponges, scrubbing brushes, &c. Utensils and apparatus for washing; apparatus for drying and ironing.

#### B.—The Bedroom.

*Furniture.*—Fittings: chimney-pieces, cupboards, blinds and shutters. Furniture: closets, drawers, hat and cloak pins.

*Bedding.*—For adults: wood and iron bedsteads, night tables and their accessories. For children: cradles, bedsteads, hammocks, mats, and carpets.

*Articles for dressing and cleanliness.*—Washing-stands, basins, and jugs, razors, scissors, looking-glasses. Combs and brushes, sponges, soap, pomatum, essences for taking out spots, clothes brushes.

*Furniture in case of illness.*—Easy arm-chairs, warming pans, foot warmers, night lamps, syringes, urinals, &c.

#### C.—Sitting or Working Room.

*Furniture.* — Fittings: chimney-pieces, cupboards, shutters and blinds. Furniture: chairs, sofa-beds, cabinets, writing tables or desks, with their accessories, such as inkstands, pens, &c.

*Useful and ornamental articles of furniture.*—Alarm-clocks, time-pieces, lenses, looking-glasses, chimney-ornaments, barometers, thermometers ,umbrellas.

*Library and sundry appendages.*—Book-cases and hanging shelves, prayer-books, almanacks, pocket, memorandum, and account-books, maps, engravings, and cheap articles of sculpture.*

*The husband's tool-box.*—Hammers, scissors, knives, pincers, nippers, turnscrews, corkscrews, gimlets, awls and bodkins, files, graters, hatchets, saws, rules, rulers, squares, compass-boxes, paint brushes and colours, glue, lenses, nails, &c.

*The wife's work-box and cabinet.*—Scissors, pin-cushions, bodkins, ribband-measures, needles, pins, buttons, thread, silk, tape, &c. Family medicine chest.

III.—Alimentary Substances, and Stores for Washing, Lighting, and Warming.

*Drinks.*—Wine, beer, cider, perry. Home-made drinks. Brandy and family liqueurs.

*Corn, farinaceous and glutinous substances.*—Unprepared. Prepared.

*Vegetables and fruits.*—Unprepared. Prepared.

*Meat.*—Unprepared. Prepared.

*Fish.*—Unprepared. Prepared.

*Oils, butter, &c.*—Unprepared. Prepared.

*Condiments.*—Unprepared. Prepared.

*Household Stores.*—For washing and scouring. For lighting. For warming.

IV.—Clothing.

*Linen.*—Body linen: in pieces; ready-made. Bed linen: in pieces; ready-made. Table linen: in pieces; ready-made. Dusters, rubbers, &c.: in pieces; ready-made.

*Clothing.*—For men: in pieces and made-up. For women: ditto.

*Shoes.*—For men. For women.

*Head-dress.*—For men. For women.

Clothes of all descriptions for children.

## THE WOOLS OF COMMERCE, AND THE INFORMATION TO BE OBTAINED THEREON.

By P. L. Simmonds.

Departing somewhat from the plan I had laid down for myself in arranging a few remarks and observations on Animal Products, some of which I deemed might possibly be found useful and suggestive to members at home and abroad, I shall endeavour in future to follow Professor Solly's simple subdivision, according to his Trade Museum arrangement, although it is inconvenient in some points, if strictly followed,f or it does not enable me to describe, or to allude to, the various commercial products furnished by any particular animal—for it groups similar products of several together. Without, therefore, strictly adhering to his classification in the synopsis he has issued, I shall commence with the "wool series"—the second of our great staples—one of the most important raw materials of our commerce, since our imports of wool average some 360,000 bales yearly (in 1854, 106,000,000 pounds). Our home clip of wool is further about 200,000,000 lbs., and the value of the woollen manufactures exported (exclusive of home consumption) nearly £10,000,000 sterling.

Without entering further into the statistics of the trade, which has already been fully gone into by Mr. Henry Forbes, before our Society, by Mr. Thomas Southey and others,—without touching upon the immense extension of sheep and increased production of wool in the Cape Colony, Australia, and South America,—without going into the details of the Alpaca, the Angora goat, and ordinary goats' wool,—I shall content myself with entering somewhat fully into the practical detail of the qualities of wool, the points to be studied, and the information to be gleaned from an examination of the results of experience and judgment in the chief wool-growing countries. Of course, any such remarks must necessarily be discursive and general, both from the large field to be traversed and the channel through which they have to appear—the objects aimed at by the Society of Arts being rather the promotion of mechanical and practical improvement than agricultural and pastoral occupations.

The sheep, perhaps, of all domestic animals, except the dog, is most easily modified in its form, size, quality of fleece, and other properties, to suit it to various situations and purposes for which it is intended by man. We have, accordingly, at one end of the scale, the long coarse wool of the Leicester, Cotteswold, and other long-wooled breeds, furnishing what is called by manufacturers "combing wool," and employed in making blankets, rugs, and coarse worsted goods, chiefly in Yorkshire and in Scotland. At the other end of the scale we have the short fine wool of the Merino sheep, fitted for spinning into the finest threads, of which the most beautiful superfine cloth is manufactured in the West of England.

Upon examining these two classes of wools with the microscope, a further and very curious difference is observed, viz., that whereas the fibres of the combing wools are mostly round and smooth, those of the clothing wools are jagged or barbed at the sides. There are intermediate qualities adapted either for combing or clothing, but this last-mentioned property is essential in a wool intended for the manufacture of cloth, the threads of which require to be "felted" together in the fulling mill, by which a closer texture is produced than could ever result from separate threads, however closely they may be woven together.

Corresponding to the varieties of fleece possessed by different breeds of sheep, there are varieties in the form and size of the carcase, and in the disposition of the animal. Whilst some breeds are adapted to rich and succulent lowland pastures, and are of a quiet and lazy disposition, inclined to fatten at an early age, but of tender constitution, others are suited to pick up a living by travelling over a wider range, and to endure the rigours of exposed hills and mountains.

Now, it will be evident that, in introducing a breed of sheep into a new country, it is of the utmost importance to select that one which experience has proved to be best adapted, by its constitution and habits, to the soil and climate in which it is desired that it should thrive. It would be as reasonable, for instance, to take a fat Leicester sheep from his sheltered and succulent pastures, and expose him on the bare short herbage to the sweeping blasts and snow storms of the Cheviot or the Lammermuir hills, as it would be to transport a city alderman to the backwoods, and bid him get his own living with the rifle of the American Indian.

The progress made in sheep farming in various countries—the comparative increase in the weight and profits on wool—the modes of tending, shearing, washing the fleece, baling, taking to market, relative yield of wool, modes of boiling down the carcase and steaming for tallow, all these points are deserving of notice and attention, and reliable information upon them would be of great interest to many.

The Americans, who are always ingenious in overcoming difficulties, have recently been adopting India-rubber cotton floaters for enveloping and packing bales of cotton, a number of which, thus united and inclosed, are floated down shallow rivers, when the stream is too low to be navigated by boats or steamers. One of these gum elastic wrappers costs about £2 10s.: two or three bales of cotton on a raft only draw about a foot. Might not this plan be worthy of trial on the Murrumbidgee, the Lachlan, the Darling, and other tributaries of the Murray

* The Commission do not feel empowered to draw up a catalogue of works calculated to form a family library. It is, therefore, deemed sufficient to point out such books as, by their character and daily use, become, as it were, a part of the furniture. The same reserve has been observed in regard to engravings and small articles of sculpture.

river in Australia, where the wool could be thus forwarded from the distant inland sheep stations to the shipping port with great economy; and the point is also worth the attention of the Dutch Boers on the Orange river in Africa, and, perhaps, of some of the settlers on the tributaries of the River Plate, and the interior rivers of South America.

Our Society has already directed great attention to the production and improvement of wool, and to an investigation of the progress of wool manufactures. Indeed, it is a source of satisfaction to know that the various subjects discussed, and the information elicited through its old Transactions, its premium lists, its lectures, discussion meetings, and *Journal*, have resulted in great benefit to the arts and commerce, and originated many important productive and manufacturing improvements.

It is both instructive and gratifying to find the high price of wool, occasioned by the increased demand for manufactures in France, Germany, and America, forcing a part of mankind back as it were to the most primitive pursuits, and the successful prosecution of trade stimulatiing on the cultivation of the land in new and distant countries. The produce of our flocks at home, for want of correct agricultural statistics, can only roughly be computed by estimate, but the imports from abroad are clearly ascertainable from the trade returns. The annual demand for wool is fast becoming greater than the annual supply, and to our own agriculturists we must look, as well as to our own colonies and foreigners, for an increase.

As in tillage land the same acre of ground may be made to produce from 30 to 50 per cent. more than its usual yield, by the aid of fertilisers, so may a flock of sheep be made to shear from 30 to 50 per cent. more of wool by adapting their food to the especial formation and growth of wool. One of the constituent parts of wool is albumen, hence, those cereals which contain the largest per centage of albumen make the most wool when fed to sheep. Wheat and rye contain large proportions, peas and beans 29 per cent., oats only 10½ per cent.

It has been ascertained by actual experiment that the following are the results of feeding different kinds of roots and grains for the production of wool.

| | | | | |
|---|---|---|---|---|
| 1000 lbs. of | Potatoes, raw, with salt, | make | 6½ lbs. | of wool. |
| Ditto | Mangel Wurtzel, raw | ,, | 5¼ | ,, |
| Ditto | Wheat | ,, | 14 | ,, |
| Ditto | Oats | ,, | 10 | ,, |
| Ditto | Rye, with salt, | ,, | 14 | ,, |
| Ditto | Rye, without salt, | ,, | 12½ | ,, |
| Ditto | Barley | ,, | 12½ | ,, |
| Ditto | Peas | ,, | 16½ | ,, |
| Ditto | Buckwheat | ,, | 10 | ,, |

These results show that peas, wheat, and rye, produce the greatest increase of wool, and give about twice the number of pounds of wool that roots do in equal weight. Indian corn meal, oil cake, and such gross substances, are the proper feed when fat mutton and tallow are the objects; but the careful flock-master, whose main object is the wool, must rely on good hay and water, and a daily moderate allowance of those grains, with some potatoes or carrots as green food, for the attainment of his object, viz., the greatest amount of good wool, and that in the very best condition.

The points to be treated, as respects the quality of wools, were thus defined by the Jurors of the Great Exhibition: —"The fineness and elasticity of the fibre; the degrees of imbrication of the scaled surface of the fibre as shown by the microscope; the quantity of fibre developed in a given space of the fleece; the comparative freedom of the fleece from extraneous matters; and the skill and care employed in preparatory processes, such, for example as that termed 'scouring' the fleece, upon which depends its liability, or otherwise, to mat at the bottom of the staple."

The qualities most valuable in regard to the fleece are thus pointed out by a colonial correspondent of great experience and judgment:—1. Fineness. 2. Fullness. 3. Freeness. 4. Soundness. 5. Length. 6. Softness.

1. Fineness of the fibre of the wool can be judged of by practice when a lock of it is laid on the cuff of a coat of a dark colour. A deficiency in this quality will show itself by an abrupt falling off in fineness either in the neck or breech of the animal, or in both. The difference in fineness between these parts and the rest of the fleece should be so gradual as to be almost imperceptible. The "settler" cannot exert himself too much to breed "close up," as it is called (*i.e.* to make the whole fleece as nearly as possible equal throughout), otherwise the character of his flock as "good breed" will never be established, and the wool will invariably prove bad in the manufacture. No hair must be anywhere visible on the animal, especially under the fore-legs.

2. Fulness means the closeness with which the staples or locks of wool grow together on the skin. Upon opening the wool of a sheep possessing this quality in perfection, only a thin line of skin, as fine as a pencil-stroke, will appear round each staple, but if deficient, a space almost bare. This is a point in which the Australian sheep are generally deficient, and of course the weight of the fleece suffers most materially. Some ot the German sheep have greal rolls or puckers of skin under their necks and on other parts, which give them a singular appearance, but the extent of wool-bearing surface is thereby increased.

3. Freeness means that the separate staples, or locks of wool, and also the separate fibres of each staple, are distinct, and by no means entangled together, or what is called "smushy," like cotton wool. A deficiency in this quality shows itself most plainly along the ridge of the back. In a well-bred sheep the wool, on being opened, should fall apart under the hands as clear and broken as the leaves of a book. A want of knowledge of this quality has caused infinite mischief in Australia from people having mistaken an absence of freeness for fullness or closeness of growth, which we have already explained.

4. Soundness, or strength of fibre, is a quality in which New Zealand wool, like its native flax, is said to be pre-eminent. Along the ridge of the back there is a sort of division between the wool of each side. Tenderness, *i.e.*, deficiency in soundness, invariably shows itself there. Take out a staple from this part, and give it a strong steady pull, holding one end in each hand. If this proves sound, depend upon it that the whole fleece is so too. This is an indispensable quality in a combing wool, such as New Zealand is fitted to produce, as the process of combing tries the soundness especially. It is one also in which the Australian wool is liable to be deficient, arising from a check to the growth of the wool from the sheep having been half-starved by drought, an affliction to which those countries are so often liable. For though the wool begins to grow again as soon as the sheep recovers his flesh, there is always a weak place in that year's clip at the point where the growth recommenced, by which it is materially damaged for combing purposes at least.

5. Length of fibre must be carefully regulated by the nature of the pasture and climate; for any, the least, excess will cause a proportionate deficiency in soundness, by which the wool will be depreciated for clothing, and rendered utterly useless for combing. If the length of the wool be too great for the nature of the country, it will be known by the twisting of the wool into hard bands, like pieces of twine, which break almost like rotten thread. It is an error as mischievous as the short cottony wool, and cannot be too carefully avoided. To judge of the length of the staple in a fleece, the best part to examine is the division along the ridge of the back, as it is there usually somewhat shorter than in other parts.

6. Softness sufficiently explains itself. A want of this quality is most conspicuous between the points of the shoulders and up the neck.

There is an oily matter natural to the wool of merino sheep, an excess or deficiency of which is equally objectionable, but there seems to be no definite term to express the different kinds of oil, yolk, or gum, as they are alternately called. Probably those sheep should be chosen whose fleeces abound in what may be termed transparent oil within the fleece, which, flowing to the end of the staple, there forms a yolk or gum, which by combining with dust, gives the surface of the wool a dark look. There can be no doubt that this yolk preserves the fleece from "dead ends," and the deleterious effects of stormy weather, that it greatly facilitates the growth of the wool, and much increases its strength, softness, and elasticity. Manufacturers, I believe, will be found to prefer a fleece well supplied with the yolk, after it has been thoroughly washed, to a dry fleece with "dead ends," as they acknowledge that the wool from oily sheep is manufactured with much less waste, is easier worked, and will make handsomer and more lasting cloth than the wool of sheep quite destitute of oil. But there is another kind of gummy matter, quite different in its appearance and effects from the above. This may be observed in yellow, thick, pitchy particles within the fleece, and does not circulate freely to the end of the wool, consequently the fleece has a light-coloured surface, with "dead ends," and as the wool cannot be freed from this thick adhesive gum, by a common cold-water wash, such fleeces will show a larger per centage of shrinkage in cleansing than any others.

The German fleeces are much fuller of yolk than the spout-washed Australian wool; on this account a considerable allowance of weight must be made when comparing the weight of the former with that of the best conditioned flocks of Australia.

The weight of the fleece obtained from various kinds (both the maximum and the average), is a matter highly desirable to be known.

We have a great number of breeds in Great Britain, from the Shetland, yielding only about 1¼lbs. of fine cottony wool, and various short and long woolled sheep, ranging from 2 to 10lbs. the fleece, but there are other breeds scattered over the globe, of the peculiar characteristics of which we know little.

Among the sheep peculiar to Turkey and Asia, and hitherto unknown in Europe, is a breed called the Karamanlia, generally met with in the neighbourhood of Broussa, where large flocks of them are bred, and where they are in high estimation for their flesh and their wool, but more particularly for their tails, which, when boiled down, yield as much as 15lbs. of excellent fat. This fat keeps good much longer than butter, and replaces it in case of need.

The Bengalee sheep is small, lank, and thin, and the colour of three-fourths of each flock is black or dark grey. The quality of the fleece is worse, if possible, than its colour; it is harsh, thin, and hairy in a very remarkable degree. The breed on the Coromandel coast is of a still more inferior quality, both in fleece and carcase. Their coarse hair and their incompact form, suggest an affinity to the goat or deer. Two or three may in some places be bought for a rupee (2s.), and yet are an unprofitable purchase.

There are in Bengal a few sheep with four horns, which are superior in size, and better proportioned, than the common kind. The Cabool sheep readily fatten; they have a large excrescence on the rump, far exceeding that of the Cape sheep; it is of a semicircular form, and nearly half as large as the whole body. The fleece of the Indian sheep ordinarily weighs but half a pound. In Coimbatore there is a small compact breed of sheep called the Curumbar, modelled very much like the Southdown, but on a reduced scale, and with a head shaped like the Merino. The animal fattens readily, and its flesh is close-grained and well flavoured. The wool is thick and curly, and almost entirely free from hair. The fleece is generally white and the head black. The sheep are shorn twice a year.—(*Simmonds's Colonial Magazine*, vol. 6, p. 144.)

Measures have lately been taken to improve the quality of the Punjaub wool, in which there is now a brisk export trade, *via* Kurrachee, including 30,000 to 40,000 maunds, of about 75 lbs. It has increased about 90 per cent. over previous years. The wool-staplers of Khorasan, and the producers of wool on the hills north of Cabul, Ghuznee, and various parts of Central Asia, bring it down by caravans to the frontier, and as the navigation of the tributaries of the Indus becomes developed, a further increase of the produce brought down may be looked for.

It is impossible for a stranger to conceive the extreme care and attention paid to the production of fine wool in Germany, where immense flocks are reared for their wool alone, kept during the greater part of the year in large barns, and so carefully tended, that neither dew nor rain is allowed to fall upon them. In the King of Saxony's flock, wethers are kept to the age of nine or ten years, solely for the 2 lbs. of wool which they annually yield. If subjected to a varying temperature or checked perspiration, a knot is formed in the staple, which can be seen under a very strong magnifying power, and which very materially deteriorates from the value the Germans attach to the article. Next to equality, fineness of texture is the great desideratum, and a beautiful machine has been invented by Mr. Jeppe, of Rostock, for the admeasurement of the thickness of the wool, and the proof of its strength, which unites the accurate workmanship and delicacy of watchwork. By this instrument 100 hairs of each fleece, selected from nine different portions of the body, forming an average of fineness, are subjected to a given pressure, which is registered on a very minute index. The result of one experiment was, that an Austrian fleece had been produced, of which twelve hairs only equalled in thickness one Leicester!

In the Museum at Stutgard are said to be samples of every wool in the known world, comprising those even of our most recently-established colonies, carefully washed, weighed, and sorted, with such descriptive remarks appended as are necessary to illustrate the subject.

So important is the proper selection of breeding animals considered in Germany, that the best flockmasters there do not trust to their own judgment, or that of their shepherds, but employ persons called "sheep classifiers," who make it their special business to attend to this part of the management of several flocks, and thus to preserve, or, if possible, to improve, the best qualities of both parents in the lambs.

The ordinary flocks in Saxony produce very fine wool, but much less in quantity than those of the improved breed; the first yielding from 2 to 2¼ lbs., worth from 2s. 6d. to 3s. 6d. per lb., whilst the flocks of M. Gadegast, and a few others, yield from 2½ to 3¾ lbs., worth from 3s. 6d. to 4s. 4d. per lb. Thus whilst the yield of an ordinary sheep of the country would be worth on an average 6s. per annum, the yield of an improved sheep would be as much as 10s. a year. This large difference in the produce of each sheep in a flock of some thousands would of course amount to something well worth the extra care and expense.

There are flocks of the Negretti breed in Mecklenburgh and Pomerania of undoubted blood, which average 4 lbs. per fleece, worth 3s. 6d. per lb., and many rams are to be found yielding from 8 to 10 lbs. of washed wool. This weight is also often reached in the Cape Colony and in America.

The Merino race ought as much as possible to be kept pure in France; and the flesh of the French breed of sheep would be improved for food by a cross with the English breed.

M. de Lavergne, a recent French writer, from careful inquiries, estimates the number of sheep in France and the United Kingdom severally at 35 millions, but while the English sheep are supported upon 77 million acres, those of France live upon 132 millions. Scotland, in spite

of all her endeavours, can maintain only about 5 million sheep, and Ireland, which from its pasture ought to rival England, reckons at most only two millions, upon 200,000,000 acres.

Estimating the value of our flocks, we shall find:—

| | |
|---|---|
| 35,000,000 sheep at, say 25s. average, worth | £43,750,000 |
| The fleece, at a low average of 4lbs., say at 10d. the pound ............................ | 5,833,333 |
| | £49,583,333 |

The average return of an English sheep farm is fully six times greater than a French one.

In Canada, the number of sheep, in round numbers, is 1,600,000, and the average weight of the fleece 2 lb. 10 oz. The increase of wool there in nine years has been 64 per cent., and that of sheep 33 per cent., showing an improvement in the weight of the fleece of not far from 30 per cent. The proportion to population in the United States and Canada is about the same, 9 sheep to every 10 inhabitants.

About one-fourth of the French sheep of the present day consist of merinos and half-merinos, the rest have at the same time improved both in carcase and wool, simply by means of more skill in their management.

England has proportionately three times more sheep than France. To this numerical difference has to be added a no less important difference in quality. And the reason for this is, that in France wool has been looked upon as the principal product, and meat the accessory; in England, on the contrary, the wool has been looked upon as the accessory, and meat as the chief production. About 10,000,000 head of sheep are slaughtered annually in the British isles, of which 8,000,000 belong to England alone, yielding, at the average weight of 80 lbs. of neat meat, 800,000,000 lbs. In France there are about 8,000,000 slaughtered, which, at the average weight of 40 lbs. neat meat, equal to one-half the weight of the English sheep, gives 320,000,000 lbs. So that while the 35,000,000 of French sheep are equal in wool to the same number of sheep in England, they are deficient in meat in the proportion of one-half.

The Americans, although importing wool largely for their manufactures, are, nevertheless, paying great attention to the increased weight of the fleece on their sheep. While the number of sheep between the two last decennial censuses increased but 20 per cent., the aggregate weight of the fleece was augmented 46 per cent.

In 1840 there were 19,311,374 sheep, yielding 35,802,114lbs, of wool, equal to but $1\frac{84}{100}$ lbs. per head. In 1850, the average weight of each fleece was $2\frac{43}{100}$ lbs.; from which it would appear that such an improvement had taken place in the various breeds of the American sheep as to increase their average product about 32 per cent. throughout the United States. And a critical examination of the returns of sheep and wool proves not only that the breeds are capable of much improvement, but that improvements are steadily taking place. The Americans, indeed, assert that they can outrival the world in wool as in cotton. For while Spanish sheep, yielding naturally wool 2,000 to the inch, carried to England, degenerated to 900 to the inch, when brought to the United States, they recovered to 2,100, a finer class of wool than the original.

The woollen fabrics used in the United States contain, according to the Secretary of State's last report, 300,000,000lbs. of wool, of which in 1853, 60,000,000lbs. were raised in the country, 21,000,000lbs. imported in the raw state, and 119,000,000lbs. imported in manufactured fabrics. In the year ending 1853, 3,669 sheep and 216,472lbs. of wool were exported from the States. The high price of wool and mutton has given an increased impetus to sheep husbandry in America. Texas is destined to be a great sheep as well as stock-raising State. The average price of wool in America for ten years previous to 1853 was 28 cents (14d.) per lb.; in 1853 it rose in Pennsylvania to 40 cents., and in Ohio to 50 cents.

In Norfolk, the average price of half-bred Down and Leicester hogget-wool for 32 years ending with 1853, was 39s. 3½d. per tod of 28lbs. The highest point reached was 60s., in 1834; the lowest, 24s., in 1848.

5, Barge-yard, City, August 29th, 1855.

## FIRE-PROOF SAFES.

Recently, Mr. George Price, of Wolverhampton, delivered a lecture in the Hall of the Architectural Institute of Scotland, at Edinburgh, "On the best means of preserving the precious metals, deeds, commercial books, and other valuables, safe both from thieves and fire." Mr. D. Rhind occupied the chair. The lecturer commenced with a short reference to the importance of the subject, and then procedeed to state that iron safes, chests, and boxes, were quite of modern date, especially fire-proof ones, which were not introduced prior to the present century. Our forefathers, he said, in the simplicity of their arrangements and requirements, were satisfied by placing their valuables in an oak chest, secured by one or more locks in front, or in a brick or stone closet, with either a wooden door studded with nails or a plain iron one, and in both cases secured by a common warded lock, or a lock without any wards, or the usual iron bands, with hasps and staples and padlocks. The most interesting specimen of the former which had come under his notice was the celebrated oak chest in which the Crown jewels of Scotland were deposited in the year 1707, the lid of which was secured by three locks, and in the year 1818 forced open in presence of the Royal Commissioners, because, as the account stated, "no keys could anywhere be found." Surely there were no Hobbses or Goaters at even this late period, for he had no doubt that a bent skewer would have opened the three locks without effort, and thus saved this ancient relic from such unhallowed violence. Many of these oaken chests were still in existence, and in a state of perfect preservation. The first examples of the manufacture of iron safes or chests were the foreign coffers, two only of which he (the lecturer) had had an opportunity of seeing. They were manifestly an improvement upon the oak chest, both as regarded the material of which they were made, and the locks by which they were secured. Cast-iron chests had been made for many years in Wolverhampton and other places, but wrought-iron ones, he believed, were first made in London, where alone the trade existed till within the last twenty years, at which time several locksmiths in the vicinity of Wolverhampton commenced making them. The manufacture of fire-proof iron safes, although such an important desideratum, did not appear to have been thought of till the year 1834, when, from the following list of patents connected with the trade, it would seem that Mr. Marr, of London, was the first to introduce the improvement:—Wm. Marr, London, February 13, 1834; Chas. Chubb, London, May 13, 1838; Thos. Milner, Liverpool, February 26, 1840; Edward Tann, sen., Edward Tann, jun., and John Tann, London, November 25, 1843; William Milner, Liverpool, March 3, 1850, and February 20, 1850; and George Price, Wolverhampton, January 31, 1855. The lecturer described shortly the nature of the improvements for which each of the patents was taken out, stating that the application of the principle upon which most, if not all the makers of the present day, constructed their fire-proof chests and safes, was first patented by Mr. Milner, in 1840, and was thus described in the specification—"For constructing boxes, safes, or other depositories of an outer case of iron or other material, enclosing one, two, or more inner cases, with spaces between them containing an absorbant material or composition, such as porous wood, dust of wood, &c., in which are distributed vessels, pipes, or tubes, filled with an alkaline solution or any other liquid evolving steam or moisture, which tubes, on the application of heat or fire, would burst into the surrounding absorbant matter, which, thus

pervaded with moisture and rendered difficult of destruction, would protect the inner cases or boxes and their contents." The seventh and last patent, dated January of the present year, was by the lecturer himself, and its objects were, first, to paint the inside of the body, and all the internal parts thereof, with a composition to prevent the oxidation or eating away of the iron by the action of the salt or moisture contained in the inner chambers; secondly, to case-harden all the exterior of safes, chests, and boxes, in order to make them drill-proof; to construct the locks in such a manner as that gunpowder might not be inserted therein for the purpose of blowing them up, &c. After a lengthened description of iron safes in general, and the style of their construction, Mr. Price proceeded to enumerate the qualities requisite in iron safes in order to render them secure against fire and thieves. In the first place, he said, the iron should be of such a thickness as to prevent its being broken open by violence, or injured by a fall from an upper story or other casualty during a fire. Secondly, the door should be so neatly fitted that no instrument could be inserted between its edge and the outside of the safe for the purpose of forcing it open, and the iron should be so prepared as to resist the attack of drills when employed to make an opening for the purpose of either taking out the small lock, or of conveying gunpowder into it. Thirdly, the large lock should be so made that were holes drilled through the door, no space would be left inside the case to contain sufficient gunpowder to explode it. Fourthly, the case containing the lock should fit the interior of the safe as tightly as the opening and closing of the door will allow, to exclude the external heat in case of fire, and to prevent the escape of the moisture generated by the fire-proof composition, designed to preserve the contents. Fifthly, the inside case, forming the chambers for the fire-resisting materials, should fit the inside of the body quite tight, to prevent the undue escape of the vapour when in a fire, and should be so secured to the outer frame that no violence exerted on the door would force the removal of the lining or casing. Sixthly, the non-conducting and steam-generating composition placed in the chambers or inside casings, and at the back of the lock-case, should be prevented from having any injurious effect upon the iron, so that, when subjected to the action of the fire, whilst preserving the contents from combustion or damage of that kind, it should not injure plate or specie, or affect the writing upon, or substance of, deeds and books. Seventhly, the small lock which secures the bolt should be easy to use, not liable to disarrangement, likely to wear well, powder-proof, and incapable of being picked. All these qualifications were to be found, the lecturer contended, in the safes which he constructed and had patented. In drawing towards a conclusion, Mr. Price wished it to be understood that the thickness and number of the chambers, and the quantity of the chemical fire-resisting composition, must always be in proportion to the probable intensity and duration of a fire, as no safe could be made to withstand an unlimited amount of fire and for an unlimited period. It was altogether a question of time, and for this reason, where the risk was very great, the safe should be built in the wall or otherwsse surrounded with masonry. Many of the remarks he had made in reference to iron safes, chests, and boxes, equally applied to closets and strong rooms with iron doors, but as the latter repositories were not moveable, being built of masonry, their security against fire might be increased by the use of the chemical fire-resisting material in the wall forming such closet or strong room. Frequent questions had been put to him as to whether his fire-proof safes were safe repositories for gunpowder; to which he had no hesitation in replying that they were, for the moment the outer plates became red-hot the steam generated would be absorbed by the gunpowder; which would then become a wet paste, not liable to explode till dried again.

# Home Correspondence.

## HEATH *v.* UNWIN.—PATENT LAW.

Sir,—This great drama is acted out—the curtain has fallen on the last scene of the performance. The crooked twig of litigation which has passed through every court of law and equity, bent by the judicial hand, first to the right and then to the left, has received the final manipulation of the highest court of appeal, and now, perfectly rectified, we are bound to assume the decision has been shot forth, "straight as the arrow from the Tartar's bow." To doubt the correctness of a supreme tribunal, would be to speak evil of dignities, and this we must not do. When the door of hope is closed, the "lasciate ogni speranza," written on the lintel, no wise man will proceed to cavil, the only consolation remaining, being the belief that what is irrevocable, is "wisest, virtuousest, discreetest, best." But it is from those who have made great shipwreck that we can best learn how to avoid similar disaster, and as no subject can be of much more importance in a journal devoted to the encouragement of useful arts and inventions, than a discovery how to escape "the heavy blows and great discouragement" dealt by legal tribunals in opposition to your onward course, when they take from inventors those properties you are inciting them to create, I beg, as a warning to those who shall come after, to offer a few remarks, not on the decision itself, for that is made useless, but on the principle illustrated by its extraordinary previous career. A paradox of extreme importance to the rights of inventors will appear on the face of it, which I would fain hope some legislator of truly comprehensive mind, acting on calm deliberation and not on preconception or acerbitous impulse, may devise means to reconcile.

In this case, of which I gave a narrative in your 135th number, a very simple matter had been so complicated by repeated determinations, re-determinations, and in-determinations, that the judges were finally called in to aid the deliberations of the House of Peers. Several of the judges had already been counsel in a cause which has endured through two generations of the Bench, and eleven only gave their opinion. Seven were in favour of the patentee, and four against him; of these four, three were of that court which had already distinguished itself, and created the litigation, by interposing legal subtleties before the verdicts of twelve men of common sense and buisness. The Lord Chancellor, when Baron Rolfe, was also of that court, and joined in the judgment which 11 years since reversed Heath's verdict, so that, when in appeal, he was only confirming himself. The only peer besides, who took a part in the final decision, was Lord Brougham, from whom, as a nobleman of some scientific pretensions, I did hope a different view of the case. But probably he sketched a like bold outline to that sweeping decision in Taylor *v.* Attwood, a case of equally memorable duration, that the contest was of "folly against fraud," and gave fraud the benefit of the appeal. This severe view of the penalties which ought to attach to want of due caution, may consist with the strictest elevation of justice, and in that case I admit that Heath did not act wisely in trusting Unwin, but that he ought, if possible, to have devised some means of shaping a new patent, if it could have been done without invalidating the first, in order to protect his improvements from the attacks of fraud, and if the folly of not doing so must be properly visited by a forfeiture of all, the late judgment might be comprehensively epitomised in three homely words, but, as patent property in a civilised country is of vast and increasing value, not to the inventor only, but to the great public, as imparting the stimulus of prospective remuneration, to induce thoughtful and ingenious minds to dedicate their time to realising great social desiderata, a precious jewel may be extracted from this toad's head, ugly and venomous as it is, if it leads to or indicates any

amendment in the law and practice of protecting such property. Now it appears to me the root of the whole evil is this:—Successful invention is generally the fruit of minds possessing a considerable share of native candour and simplicity. Their study is *nature* and *truth* in unsophistication. Nature will not reveal her best secrets to a wrangling, captious, hair-splitting, shallow, or dishonest character. An inventor is seeking after what is right, and nothing else; careful, scrupulous thought, patience and sincere investigation, so much absorb the inventive mind, that a straight edge is as capable of enacting a snake, as a plain, honest inventor is capable of even conceiving the nature of the sinuous quiddities into which men who live by words are able to distort the plainest common sense signification. In brief, therefore, the monstrous demand is made by our patent law upon a frank character of this sort, that he shall be not merely a "sharp man," but a first-rate lawyer. The greatest of our inventors was not even a "sharp man;" on the contrary, we read in Watt's letters habitual confessions that he was unable to deal, successfully to himself, with even ordinary men of business. Far exceeding this qualification, our law requires of an inventor that he shall be, or have intimate confidential access to, a first-rate lawyer; and even with this advantage, he must be no simple man to make out a sufficient consulting case of his own prospective ideas. We might as well insist on a child cultivating a moustache under penalty of losing his birthright, as expect a plain inventor, loaded with a burden of truth, to frame, or find means to frame, a specification contemplating all its contingencies, with such acuteness that it shall endure the equivocal attack of men practised in nothing else but such attacks. It is a flock of sheep before a charge of cavalry, soon slain or shorn. Surely it is too much to require of men of every class of society, before they fall inventing, that they shall add the most laborious and learned of professions to their own calling. It is true our patent laws are prefaced by a direction, that wherever there is doubt, that doubt shall be interpreted in favour of the patentee. But what is the fact? How is this word of promise kept to the hope? If ever there were a case of reasonable doubt, I should say we had it when on the side of the patentee are ranged one chancellor, one vice chancellor, and seven judges (besides juries), and on the side of the alleged pirate, one chancellor, one ex-chancellor, and four judges, the majority of this minority being, as I have explained, qualified by the *encore*. There must be a reasonable doubt if it be right to deprive an inventor of his property, and sow it broadcast to all comers when nine learned men againgt six think it wrong. And yet a patentee is called upon, at the outset of his career, to know more law than even all these dignified lawyers, for he must be superior to them all if he could do what they cannot themselves do now, and reconcile their confliction. If we take from the minority the Lord Chancellor and the three judges of the Exchequer, who were merely maintaining their previous decision, *remanet* one judge, and one law lord, in this court of appeal against the majority of nine. Even were it certain, and I have not heard that it is, that these two are better than the nine, either of equal dignity or of the stuff of which such dignities are made, there surely is reasonable doubt, if it be interpreting a doubt in favour of the patentee, to award a penal forfeiture of his whole property, after benefiting the kingdom, because he could not, sixteen years ago, foresee what seven judges cannot even now see at all. That the decree is in the correct letter of the law we are not permitted to disbelieve, but when there is such difficulty and contrariety in reading that letter, I should like to have seen an enlightened reason why the benefit of such ambiguity must not in this case apply to the patentee in the regular course, with also an expression of feeling, such as often does honour to our legal dignitaries, of deep regret that the binding letter of the law should compel the painful duty of handing over the fruits of intelligence and worth as the reward of moral turpitude.

What appears to be required for our protection is that patent questions should be decided by the ordinary common sense of men engaged in the ordinary avocations of life, who use plain things for plain uses, without the time or disposition for refinements of studied sophistry. A verdict given by such men ought not to be placed at the mercy of humourists or verbalists of the most intense degree. The Exchequer claims the prestige of more legal learning than the other courts of plea, and has evinced it here, but this precisely is the kind of learning which is unsuited to such affairs. It dwells in *antiquation*, and indulged from the very commencement in skits and sallies at that practical scientific learning upon which the whole foundation of our *modern* prosperity is based. Of all obstructions pedantry most hinders the ordinary business of life. Such minds are elevated above common things; as Bacon writes of the stars, they give but little light because they are so high. The prestige of learning must be maintained, and very often by merely departing from common-place views. The patent is defunct, but the infallibility of the court has been preserved; they may exclaim with the French rake—"It was necessary for our glory that it should die." But truly it is a state of things which requires amendment. No one doubts—not even the adverse judges—that this great invention is the property of the inventor, but even then he cannot be permitted to enjoy it, except "*selon les regles*;" "*selon les regles!* Ordinary men are content with ordinary evidence; they believe it is the water and the malt which make the wort without plunging in the vat to see; in fact the whole world proceeds upon the belief that the food taken through the mouth into the stomach nourishes the body, but there is no *legal evidence* of it, according to the subtle requirements of the more learned minority. The proper persons to decide these things are the ordinary men you encounter every day, more wise than nice, who burst out in an examination when they hear what question Lord Abinger put, and that a fellow-being has been subjected to the excruciation of sixteen years of profound law, to decide if it was a proper question, and that at last it is decided to be proper and rational. These are the efficient *practical* judges, men who believe that it is the plane iron which makes the shavings, although they cannot *see* or *feel* them in the very moment of being made, and surely it is a sad mistake to subject *their* unbiassed opinions to the correction of a narrow class who know nothing of the facts except by hearsay. An endless see-saw of litigation is thereby established; if one of the majority of judges had happened to have reached the woolsack this year, the final decision would have accorded with the first decision of twelve rational men. Anything would be better than these pendulum vibrations year after year—even an Act of Parliament that patent disputes shall be settled by drawing long and short straws. Let it be one way or the other; if common sense is sometimes to be thrown over, better that the eviction should be entire and complete, so as to avoid delusive litigation. A splendidly illuminated record of the proceedings of this case, epoch after epoch, on the pattern of Priestley's chart of chronology, would be a most suitable contribution to the Parisian Exhibition, illustrating the encouragement this great country gives to inventors in the useful arts. It might place us in no very enviable light before the civilised world, but it would be the truth, and an undoubtedly genuine specimen of native manufacture, and foreign criticism might suggest some friendly hints for its improvement.

I am, sir, your obedient servant,

DAVID MUSHET.

August 7th, 1855.

P.S.—I see, since writing the above, that the Solicitor-General, who was a counsel in the cause, has made strong remarks on the arrangements in the house of Peers as a Court of Appeal. I have no pretensions to be a legal reformer, but it certainly seems possible to ensure, in a Court of final resort, a more comprehensive investigation

of points which never can be investigated again. Were a definite number of law lords, say six, in addition to the Lord Chancellor, made requisite to form a quorum, there would be less chance of a single judge in appeal merely restoring his previously reversed decision. Lord St. Leonards, the Lord Chancellor, and Lord Campbell, vindicated their individual conduct sitting in appeal from any of the censure implied by the Solicitor-General, but nothing in their remarks was directed against an improvement of the existing arrangements; on the contrary, they cited difficulties which had arisen when of only two peers in appeal their opinions had been divided. Their remarks only place in a stronger light the singular irregularity in Mr. Heath's case from the ordinary treatment in cases of doubt. Three instances were mentioned where the assistance of the judges had been required, and the majority agreeing with the court below, that judgment, *as a rule*, had not been disturbed. The numbers of the majority and minority of the judges in these cases were quoted, the majority in each case being *less* than the majority in Mr. Heath's favour, yet the alleged ordinary practice of the peers was in this particular instance departed from, and the decision of the majority *overruled;* whereas the majority being *greater*, *á fortiori* that decision ought to have been confirmed.

The justices in favour of the patent were Crompton, Crowder, Platt, Erle, Wightman, Williams, and Cresswell. Of these, Erle and Cresswell, having presided at trials, were well versed in the case. The four adverse were Barons Parke, Alderson, Maule, and the Chief Baron Pollock. Baron Parke had *also* presided at a trial, and with Alderson, the present Lord Chancellor, and the late Baron Gurney, reversed the verdict which the jury gave before him. The Chief Baron at that time took no part in the judgment, because he had been counsel in a similar case, where the use of the chemical constituents of a substance was held to be a colourable evasion of the use of the substance itself. Why this scruple did not continue in force I have no information, but had it remained, the minority of judges would have been reduced to *three* against *seven*.

A letter in the *Times*, signed "Memor," has given strong extracts from a work by Sir Edward Sudgen, asking for the same reforms which Lord St. Leonards does not now praise Sir Richard Bethell for seeking.

## FINE ARTS EXHIBITION, PARIS.

Sir,—I forward you the accompanying numbers of the pictures of principal interest in the Exhibition here, conceiving, if published in the *Journal*, it might be useful. It contains, I believe, almost every picture that the English taste will desire to look at. Each wall is numbered, and No. 1 is always on the left hand of the visitor when entering, and the numbers of the pictures follow the course round the room. I have not had time to go through the English pictures, nor water colours, nor drawings, nor sculpture.

I am, &c.,

M. MITCHELL.

Paris, August 25th, 1855.

P.S.—I have added the letter *a* to the best pictures, *b* to the next, and *c* to the next.

### Vestibule.

**2.**—2270, 527, 528, 2237, 2239b, 2256, 2347c, 2015c, 2021c, 1967, 1978, 1987, 1979, 1977, 2140.

**4.**—2144, 2146, 2101, 2200, 2344c, 2008c, 1014, 3164c, 1650c.

### First Ante Room.

**3.**—172c, 167c, 2066c, 2114, 2046.

**4.**—21c, 2203, 2210, 2181, 2113, 2043b, 2093, 2068, 2070c, 721c, 722c, 2455, 720c, 1918.

### First Great Room.

**1.**—1759c, 1758, 1724, 1776c, 1783c, 1746c, 1781c, 1787, 1741b, 1732c, 1782c, 1775c, 1720c, 1688, 1774, 1805c, 1686.

**2.**—1766b, 1740, 1814, 2340, 1744.

**4.**—1770c, 1767b, 1690, 1691, 1735.

### Second Ante Room.

**2.**—2629c, 2810, 3606, 4084, 4082, 2689, 2728, 3378c, 4081, 4083c, 3562, 3135, 4017c, 3973, 3923a, 2684c, 1938c, 546, 1937, 1936.

**4.**—600, 598b, 550c, 603c, 559, 545c.

### Second Great Room.

**1.**—2620b, 2422, 3715a, 2621c, 3474, 2976c, 2496c.

**2.**—3881b, 3449, 3878c, 2501, 2819b, 2769, 2767c, 2587, 3396, 3185, 3781, 3114c, 3784c, 3289, 3291.

**3.**—3924c, 4206c, 4209c, 4208c, 3686.

**4.**—5470, 5030, 2504c, 4080c, 3279c, 3512, 3051, 3266a, 3270, 3264b, 3268b, 3267b, 3265c, 2766c, 4097c, 4096, 3813b, 3811b, 4102c, 3413, 3812, 3114c, 4095, 4094b, 4099c.

### Third Ante Room.

**2.**—2793, 2439, 3730c, 2600, 2991, 4018c, 3770, 2612, 2998, 2731, 4192.

**4.**—2555, 3071, 2525c, 3935, 3951, 3958, 3955.

### Third Great Room.

**1.**—3548, 3542b, 3546b, 3561c, 3456, 3942c, 3941, 3944c, 2574, 2577c, 2575, 3549, 3565, 3623c, 2988c.

**2.**—2927, 2926c, 2911, 2929c, 2918, 2915, 2937, 2922, 2940c.

**3.**—2933, 2938, 2914, 3988c, 2640c, 2643, 2642c, 2641, 3783c, 3326, 2405.

**4.**—4004c, 3557c, 3550b, 3555, 3559c, 3547b, 3564.

### Fourth Ante Room.

**2.**—2882, 2873c, 5036, 2867c, 2851c, 4041c, 3635c, 2861, 3933, 2893c, 2585c, 2446c, 2871, 2814.

**4.**—2890, 2878, 2860, 2891c, 5057c, 5059c, 3663, 5058, 5060, 3660, 3661, 3662, 5035c, 2868, 2892c, 2784c, 2785c, 2865, 2876c.

### Belgian Side Room.

**1.**—414b, 427a, 415c, 394c, 454, 475, 429, 275, 416, 279, 428, 393a.

**2.**—287, 294.

**3.**—407c, 461, 266b, 314, 409c, 368, 362, 363, 397.

### H. Vernet's Room.

**1.**—4151a.

**2.**—4149, 4156, 3484, 4154, 4158.

**3.**—4165c, 4159, 4152b.

**4.**—4162.

### M. Ingre's Room.

**1.**—3347a, 3357.

**3.**—3344c, 3365, 3367.

### Wurtemburg Side Room.

**1.**—186, 220, 243, 198b, 183c, 247, 3025, 195, 2047, 2106.

**2.**—2204.

**3.**—2206, 2205c, 2207c, 23c, 9, 2183, 2198, 25, 31, 22, 27c, 7, 49, 3984b, 2197, 28.

**4.**—2199, 2205.

### Belgian Outside Room.

**4.**—1919c, 1912c, 1908.

**1.**—1911, 1914, 406, 326, 443b, 411b, 267b, 369, 418b, 272c, 273b, 308c, 360c, 396c, 290, 285, 413b, 1527c, 1597c, 1609c, 1587, 1610b, 1581, 1589, 1554c, 3717c, 3621, 3241c, 4188c, 4037c, 4190b, 3782c.

**2.**—2849c.

**3.**—3238, 3237, 3239, 3229, 3234, 3233c, 3177, 2487c, 2997, 3184c, 2410, 1585c, 1582, 1518, 1519, 1573c, 1601, 1546, 1598, 1528, 1523, 1602, 1561, 1576, 1580, 400, 448, 265b, 399c, 281, 341, 299, 434, 453, 464c, 422, 417c, 457, 423, 452.

### End Room.

**2.**—2607, 3570c, 3569c, 3567, 3862, 3194, 2631c, 3537, 2770a, 3919, 3000, 3751c, 3392, 3691c, 3389c, 3388, 3387, 3052, 3665c, 3664c, 2426c, 3666, 3808, 3261, 2825, 3807, 3416c, 2823.

Right Outside Room.

**2.**—3487, 3721, 3706, 3630, 3755, 4051, 3477.
**4.**—3747*c*, 3742*c*, 3743, 2803, 3023.

Outside Room.

3104, 4016, 2993, 3310, 4217*c*, 2906*c*, 2824*c*, 2604, 2905, 3796, 2588, 3163, 3740, 2561*c*.

Left-hand Gallery.

3283*c*, 4989, 2518, 4171, 2497*c*, 3991, 2739.

## DISINFECTANTS.

Sir,—In the excellent letter of Mr. W. Bridges Adams in your last *Journal*, he recommends to the attention of the Society of Arts the subject of disinfectants, with the view of ascertaining the best and cheapest material for that purpose.

I venture to remark that Mr. Adams is clearly in error in recommending that the disinfectant most applicable for all purposes should be in a liquid form, and I feel sure your correspondent will, on further consideration and inquiry, agree, that whether used in privies, cesspools, chamber utensils, or in destroying bad smells, arising from whatever cause, no form can be more useful, effective, and generally applicable, than a dry powder.

Of all disinfecting materials, animal and vegetable charcoal have long been appreciated as the most powerful, the only obstacle to their general use being the expense, which has rarely been less, even for peat charcoal, than three or four pounds per ton.

The application of charcoal powder as a disinfectant for sanitary purposes, has recently been brought before the public in lectures by Dr. Stenhouse, at the Royal Institution, London, and by Dr. Wilson, at the Royal Society of Arts, Edinburgh, and also by Dr. Richardson (the editor), in the *Journal of Public Health* for June last, and by the editor in the *Artizan* Journal for this month.

Although charcoal has so long been esteemed as a valuable deodoriser and disinfectant, an erroneous opinion has prevailed until very recently, that its surprising power in destroying bad smells and deleterious effluvia was caused by its acting as an antiseptic agent. This fallacy has been proved by Dr. Stenhouse, from whose valuable lecture I venture to quote the following extracts. He says:—

"When putrefying animal and vegetable substances are covered with charcoal powder, the effluvia and miasmata which, under ordinary circumstances, they would evolve directly into the atmosphere, are absorbed and oxidised within the pores of the charcoal, where they undergo a species of what is called low combustion, which as effectually destroys them as if they were at once passed through a furnace; it is, therefore, on *its absorbing and oxidising power that the great efficiency of charcoal as a deodorising and disinfecting agent depends.*

"Hence the extraordinary efficacy of charcoal in the absorption and oxidation of gases and vapours is most satisfactorily accounted for.

"I am aware that some persons who admit the deodorising properties of charcoal deny that it acts as a disinfectant. I would direct the attention of such individuals to some of the facts already detailed. Thus, for instance, we have seen that the bodies of pretty large animals, covered only with a couple of inches of charcoal, have been allowed during many months to putrefy both in Mr. Turnbull's laboratory and in my own.

"Now, had the bodies of these animals been left to decay under ordinary circumstances, not only would the stench emitted have been intolerable, but some of the persons by whom these laboratories were constantly frequented would certainly have been struck down by fever or other malignant disorders. During the last twelve months, charcoal powder has repeatedly been most successfully employed both at St. Mary's and at St. Bartholomew's Hospitals, to arrest the progress of gangrene and other putrid sores.

"In the instance of hospital gangrene, we have to deal not only with effluvia, but also with real miasmata; for, as is well known, the poisonous gases emitted by gangrenous sores not only *affect* the individual with whom the mischief has originated, but readily *infect* the perfectly healthy wounds of any persons who may happen to be in its vicinity. So that in this way gangrene has been known to spread not only through one ward, but through several wards of the same hospital.

"In fact there is every reason to believe that many sick persons die not from the direct effects of the disease under which they labour, but they are actually poisoned by the putrid exhalations evolved from their own diseased bodies and those of other parties in their vicinity.

"This is especially the case in over-crowded military hospitals, where dysentery, cholera, and similar diseases prevail. In such circumstances the importance of employing some means of absorbing and destroying miasmata is so self-evident, that I think it quite unnecessary to dilate upon the subject.

"From the statements that have already been made, the utility of charcoal powder, as a means of preventing noxious effluvia from churchyards, and from dead bodies in other situations, such as on board ship, is sufficiently evident.

"Covering a churchyard or burial vault to the depth of from two to three inches with coarsely-powdered charcoal, would effectually prevent any putrid exhalations ever finding their way into the atmosphere. Powdered charcoal should likewise be introduced into all coffins, as not only favours the decomposition of dead bodies, but prevents them from being injurious to the living.

"In conclusion, I would confidently hope that the time is now nearly come, when the propagation of disease by infection shall become the exception, and not the rule; and when the most nervous and delicate persons will be enabled to attend unharmed on their friends, labouring under even the most malignant infectious disorders."

Numerous experiments have shown that charcoal powder for all sanitary purposes is more harmless, useful, and effective in thoroughly destroying effluvia than any other material, either in a state of liquid or powder.

In a letter which appeared in your *Journal* of the 17th November, 1854, I explained a mode of using charcoal for disinfecting house privies, by means of moveable boxes similar to the mode now suggested by Mr. Adams, and which had then been partially adopted in this district.

The use of charcoal powder for domestic purposes is gradually coming into use, especially for children's nurseries, and the rooms of sick people, hospitals, &c. It has been found equally efficacious as a purifier of stables and shippons, and I venture to predict that the time is not far distant when it will be generally used to fill up the coffins of deceased persons, to prevent the effluvia emitted from the corpse before interment, and secure the speedy and harmless decomposition of the body in the grave.

I have forwarded a sample of disinfecting charcoal, prepared by Mr. Chadwick, of this city, and hope you will lay it before the Society on the opening of the next session. It has been extensively used in the neighbourhood for upwards of five years, its price (30s. per ton, or 2s. per cwt.,) having brought it within the reach of all classes.

Hoping that the Council of the Society will accede to Mr. Adams's suggestion, to consider the important subject of providing a cheap and efficient disinfectant for general use,

I am, sir, your obedient servant,

JOHN THOMPSON.

Secretary to the Nitro-Organic Manure Company.

3, Watling-street, Shudehill, Manchester, August 14th, 1855.

## THE VINEGAR PLANT.

Sir,—If F.S.A. will look to pages 61, 74, 94, 166, 328, Vol. 2nd of the *Cottage Gardener* (1849), he will find full particulars of the vinegar plant. R. H.

27th August, 1855.

## STATISTICAL CONGRESS AT PARIS.

Sir,—Whilst increased means of communication, and extended intercourse and trading, connect closely all nations, it becomes most important that facilities be also afforded for comparing each other's institutions, and, moreover, for widening the field of observation on physical, moral, and social phenomena, in order the better to arrive at, and to appreciate, the laws which govern them.

To such an end the Statistical Commission of Belgium assembled a Congress of Statists in 1853, in Brussels, in order to agree upon a common form for the statistical returns and documents of all countries, which Congress was attended by official deputies from most states of Europe. The questions then discussed were:—

1. The Organisation of Statistical Offices.
2. The Census of Population.
3. The Survey.
4. Statistics of Emigration.
5. Agricultural Statistics.
6. Industrial Statistics.
7. Commercial Statistics.
8. Economical Budgets for Working Classes.
9. Pauperism.
10. Instruction and Education.
11. Crime.

The results of the Brussels Congress having been most encouraging to statistical inquiries, it suggested the assembling of similar congresses periodically, at different places, to take up other subjects of inquiry, and to extend further the work of assimilation. The French Government have, in consequence, determined on inviting the second of such international statistical congreses to meet in Paris this year, and invitations have just been issued for the 10th of September next.

The subjects detailed in the programme are:—

Statistics of Means of Communication, including—
- Land routes—Roads.
  - Bridges.
  - Railways.
- Internal Navigation, Natural and Artificial.
  - Canals.
- Maritime Ports of Commerce.
  - Lighthouses.
  - Telegraphic Lines.

Agricultural Statistics.
Prison Statistics.
Judicial Statistics—Nomenclature of Crimes.
Statistics of Provident Institutions
- ,, Savings Banks.
- ,, Friendly Societies.
- ,, Tontines.
- ,, Insurance Companies.

Statistics of Accidents—
- in the Workshop,
- in Mines,
- on Railways.

Statistics of Mental Alienation, or Lunacy;
- ,, Epidemics;
- ,, Great cities, including
  - Topographic Situation;
  - Surface;
  - Houses;
  - Public Health:
  - Public Security;
  - Consumption;
  - Industry and Commerce:
  - Means of Communication and Transport.
  - Municipal Organization;
  - Municipal Finances;
  - Public Institutions;
  - Provident Institutions;
  - Criminal and Civil Statistics;
  - Public Instruction;
  - Religion;
  - Public Amusements.

The Congress does not intend to deal with the lessons which statistics afford. It simply aims at organising a common system, whereby we may be able to obtain solid principles from the collection of facts experienced in many countries, and accurately and uniformly recorded.

I am, Sir, yours &c.,

LEONE LEVI.

12, the College, Doctors' Commons,
London, August 29th, 1855.

## CHEMICAL PURIFICATION OF TOWNS.

Sir,—In carrying any new plan into effect, it is sometimes useful to begin with the easiest and simplest methods, so as to set the type. In my communication on the Chemical Purification of Towns and Cities, I omitted to mention a very large subject for operations, the railways. Bookstalls have there been largely appropriated, and there is a glimmering perception that a railway station is a good site for a general bazaar, but it is very remarkable that the great facilities for the manufacture of guano have been wholly overlooked. An enterprising chairman on one of our metropolitan lines once conceived the idea of running excursion and parliamentary trains at express speed, as not really costing more, and as diminishing the risk of collision; but it was found to be impracticable owing to a peculiar habit of a large portion of the travellers. They considered it—like the old stage coachmen—a duty to drink large quantities of beer whenever they could, and it was impossible to prevent them from wasting time at the stations, as a result of this large imbibition of liquids. Now if any enterprising Smith or Heal, or other well-known station-name, would consider this matter rightly, it would be a very practicable thing to immortalise and enrich himself, and put additional revenue into the general pocket of railway companies, thereby improving the shareholders' dividends. The plan would be simply to introduce the use of moveable cesspools at the railway stations, provided with chemical neutralisers, which would be a far more efficient process than the water method, and would realise as a property that which is at present a waste. No locality would be more favourable for the commencement of the plan, which would probably be found an aid to the lessening of station expenses,—certainly in saving the cost of outlay and repairs in water apparatus and drains.

I am, Sir, your's faithfully,

W. BRIDGES ADAMS.

August 15th, 1855.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette August 24th*, 1855.]

*Dated 16th May*, 1855.

1110. J. Knowles and E. T. Bellhouse, Manchester—Working of marble, stone, glass, &c.

*Dated 18th July*, 1855.

1608. W. C. Thurgar, Norwich—Preservation of the fluid substance of fresh eggs.

*Dated 19th July*, 1855.

1638. S. Stocker, Brighton—Water-closets.

*Dated 26th July*, 1855.

1697. J. Hunt, New Kent-road—Self-fastening band.
1699. W. Brown, Bradford—Combing machinery.
1701. C. Thompson, South Shields—Prevention of smoke.
1703. C. Goodyear, Avenue-road, St. John's-wood—Gunpowder. (A communication.)
1705. W. Mardon, Christchurch-chambers, Newgate-street—Treating garancine. (A communication.)

*Dated 27th July*, 1855.

1707. C. Hodges, Manchester—Knitting machinery for hosiery. (A communication.)
1709. P. Effertz, Aix-la-Chapelle—Cutting, creasing, or marking paper, &c.
1711. C. F. Kirkman, Argyle-street, Regent-street—Spinning machinery.
1713. A. Smith, Manchline, N.B.—Cigar and other cases.

*Dated 28th July*, 1855.
1717. H. H. Barry, Bedford-street, Strand—Combing and carding machinery.
1719. J. Hyde, Sheffield—Furniture castors.
1721. W. Brownfoot, Leeds—Apparatus for raising or lowering blinds, maps, &c.
1723. E. Willis, King-street, St. James's—Wine bottles.
1725. C. Goodyear, Avenue-road, St. John's-wood—Covers for floors.
*Dated 30th July*, 1855.
1727. J. M. Fillier, Paris—Looms.
1729. W. F. Coles, 61, Paul-street, Finsbury—Boots and shoes.
1731. T. Clunes, Aberdeen—Pumps and fire engines.
1733. J.H.Whitehead,Mowville,Otley, York—Steam-boilerfurnaces.
*Dated 1st August*, 1855.
1741. S. Mellor, Salford, and T. Young, Manchester—Supplying water to steam boilers.
1743. J. Clarke, Leicester—Machinery for making loop fabrics.
1745. G. Bufnoir, Lyons—Stopping bottles.
*Dated 2nd August*, 1855.
1747. A. Allan, Perth—Valve gear.
1749. J. Saunders, Newgate-street—Roller for cloth, &c.
1751. R. Bodmer, 2, Thavies-inn, Holborn—Rotatory steam engines. (A communication.)
*Dated 3rd August*, 1855.
1757. A. E. L. Bellford, 32, Essex-street, Strand—Grinding mills. (A communication.)
1759. G. H. Fullard, Thorney, Cambridge—Pin for thatchcoverings.
1761. J. C. A. Pfaff, Wiesbaden—Motive power.
1763. H. J. Betjemann, 449, New Oxford-street—Extending tables. (A communication.)
1765. J. H. Johnson, 47, Lincoln's-inn-fields—Metallic waterproof fabrics. (A communication.)
1767. R. Richardson and W. Greenshields, Douglas, Isle of Man—Chenille fabrics.
*Dated 6th August*, 1855.
1774. J. Macintosh, Great Ormond-street—Incendiary materials to be used in warfare.
*Dated 7th August*, 1855.
1784. C. Bedells, Leicester—Elastic fabrics.
1786. J. A. Manning, Inner Temple—Treatment of sewerage.
1788. G. Nasmyth, Kennington—Preserving animal and vegetable matters.
1790. W. M. Tileston, 16, Cannon-street—Machinery for ruling paper. (A communication.)
*Dated 8th August*, 1855.
1792. B. W. Pycock, Southholme, Gainsborough—Curtain fixtures. (A communication.)
1794. N. Smith, Thrapstone—Horse rake.
1796. R. B. Cooley, Nottingham—Hats.
*Dated 9th August*, 1855.
1800. V. Delperdange, Bruxelles—Joining tubes and pipes.
1802. P. and M. Latour, Paris—Looms.
1804. P. A. Le Comte de Fontaine Moreau, 4, South-street, Finsbury—Feeding steam boilers. (A communication.)
1806. T. Sleight, Hull—Compound for bowel complaints.
1808. J. Robertson, Cask Works, Commercial-road—Casks.
*Dated 10th August*, 1855.
1810. W. Mickle, Willington, Durham—Smelting iron.
1812. G. Durham, 3, Drummond-crescent, Euston-square, and C. Wyatt, 1, Conduit-street, Regent-street—Machinery grease.
1814. E. Finch, Chepstow—Machinery for discharging coals from waggons.
1816. A. Morin, St. Etienne—Artificial fuel.
1818. P. and M. Latour, Paris—Machine for cutting nails and driving into shoe.
1820. G. R. Innes, Valparaiso—Raising and lowering rolling blinds. (A communication.)
*Dated 11th August*, 1855.
1822. P. L. P. Baragnon, Paris—Preserving and reckoning coin.
1824. P. Pretsch, Islington—Photography.
1826. C. E. Reeves, M.D., Edward-street, Portman-square—Repeating fire-arms
1828. L. Turletti, Paris—Portable alarm apparatus.
1830. E. Topham, Nottingham—Cleansing steam boilers.
*Dated 13th August*, 1855.
1832. W. G. Gregory, Leeds—Camp furniture.
1834. W. Horsfield, Langley Mill, Derby—Railway axle boxes.
1836. R. Blackburn, Wandsworth, and W. L. Duncan, Putney-vale—Bleeching.
1838. A. and F. Thornton, Nottingham—Plushed or piled fabrics for hats, &c.
*Dated 14th August*, 1855.
1840. J. Venables, Burslem—Ornamenting articles made of clay.
1842. G. Shears, East-place, Kennington-road—Stereoscopes.
1844. L. Marion, Paris—Consuming smoke.
*Dated 15th August*, 1855.
1846. J. Coghlan, M.D., Wexford—Pivoting artificial teeth.
1848. S. Statham, Cloudesley-street, and W. Smith, Hoxton—Electric telegraph cables.
1850. A. V. Newton, 66, Chancery-lane—Railroad chairs. (A communication.)
1852. J. H. Johnson, 47, Lincoln's-inn fields—Reins. (A communication.)

WEEKLY LIST OF PATENTS SEALED.

*Sealed August 24th*, 1855.
411. John Haines White, Manchester—Improvement in the method of applying artificial teeth.
416. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—Improvements in the application of breaks on railways. (A communication.)
418. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—Improvements in the manufacture of soda.
425. James Brodie, Bow of Fife, N.B.—Improvements in and applicable to tongs, pliers, vices, and other holding instruments.
429. Benjamin Fothergill and William Weild, Manchester—Improvements in machinery for combing cotton, wool, flax, silk, and other fibrous materials.
432. Thomas Helliwell, Greenhirst Hay, near Todmorden, and Joseph Barker, of Houghstone Mill, near Todmorden—Preserving pickers and pickersticks, and for preventing cops being knocked off the spindle in the shuttle during the process of weaving in the power loom.
433. Alexander Symons, Strand—An egg-cooking apparatus.
440. John Gedge, 4, Wellington-street South, Strand—Improvements in apparatus or machinery for stopping or retarding vehicles used on railways. (A communication.)
441. George Mackay Miller and John Wakefield, Inchicore, Dublin—Improvements in pistons for engines driven by steam or other elastic fluid, which improvements are also applicable to the pistons or plungers of reciprocating pumps.
454. George Mackay Miller, Inchicore, Dublin—Improvements in axles and axle-boxes of engines and carriages in use on railways.
488. Arsène Louis Garnier, Guernsey—An improved process for producing photographic pictures, which he intends to denominate "Système Garnier de photocherographic coloriée."
493. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—Improvements in the oscillating steam engine. (A communication.)
545. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—Improvements in machinery for making butt-hinges of wrought iron or other metal complete at one operation.
606. George Lowry, Manchester—Improvements in lubricators.
670. Alexander William Williamson, University College, Gower-street—Improvements in stoves or fire-places.
692. Joseph Peabody, Old Broad-street—Improved machinery for obtaining motive power by the action of the wind.
800. Eugène Pasquier, Reims (France)—Improved machine to be used for drying wool and other fibrous materials.
816. James Templeton, Glasgow—Improvements in the manufacture of pile fabrics.
1132. Samuel Stocker, Brighton—Improvements in machinery and apparatus for shaping of metals, and also in such metal goods made from sheets, plates, or tubes, and also for other parts, connected therewith, and for finishing the same when left by the machine or apparatus.

*Sealed August 28th*, 1855.
443. Fischer Alexander Wilson, Kennington—Improvements in closing and unclosing bottles and other vessels used for containing liquids, also in the modes of inserting, securing, and liberating liquids therein and therefrom.
449. Bewicke Blackburn, Clapham Common—Improvements in the manufacture of pipes.
460. George Lowry, Manchester—Improvements in machinery for preparing and spinning flax, hemp, and other fibrous materials.
461. Constant Jouffroy Duméry, 54, Rue du Chateau d'Eau, Paris—Improvements in alarm and safety whistles for steam generators.
466. William George Henry Taunton, Liverpool—Improvements in pumps, pump gear, and pump buckets.
478. Robert Boby, and Thomas Cooper Bridgman, Bury St. Edmunds—Improvements in corn dressing and winnowing machines.
487. Richard Archibald Brooman, 166, Fleet-street—Improvements in projectiles.
512. Louis Emile Bataille, Paris—Improvements in looms for weaving pile-fabrics.
517. Alfred Krupp, Essen, Prussia—Improvements in the construction of railway wheels.
553. William Prockter Stanley, Peterborough—Improvement in or addition to clod crushers.
554. William Score, Bristol—Improvement in bleaching oils, fats, and resin.
560. Samuel Swingler, Aston-juxta-Birmingham—Improvements in the manufacture of certain kinds of metallic spoons, forks, and ladles.
567. Benjamin Goodfellow, Hyde, Chester—Improvements in regulating the power for driving the pumps of hydraulic presses.
572. Edward Vincent Gardiner, 24, Norfolk-street, Middlesex Hospital—Improvements in furnaces, ash pits, flues, and fire-places, whereby smoke is prevented, fuel more perfectly consumed, and its heating value greatly economised.
592. Mark Smith, Heywood, Lancaster—Improvements in looms for weaving.
600. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the application of carbonic acid gas as a motive power. (A communication.)
673. John Shaw, Lees, Lewis Harrop, Oldham, and James Fielding, Lees—Improvements in machinery for spinning and doubling cotton and other fibrous materials.
667. Anguish Honour Augustus Durrant, Tong Castle, Salop—Improved axle and axle box for carriage wheels, shafts, axles, or general bearings of machinery.

Journal of the Society of Arts.

*FRIDAY, SEPTEMBER 7, 1855.*

## THE CAMP AND BARRACK SANITARY CART AND PORTABLE LATRINES OR SOIL PANS.

By James Bird, late Surgeon Royal Glamorgan Militia.

It is a well-known fact that the health or otherwise of troops, or of any other closely-congregated community will depend mainly upon the precautions taken in respect to its refuse matter.

The alvine secretions when fever or dysentery prevails, become rapidly putrid, and generate poisonous emanations intensely contagious to healthy persons exposed to their influence, while the accumulated dejections of persons in health, if not absolutely pernicious, are obnoxious in many ways.

It must be obvious, therefore, that the early and complete removal of all fæculent matter from camp or barrack is the primary and fundamental means of securing the health of troops, and of arresting the ravages of disease, and without this all other precautions are vain and ineffectual.

These remarks apply with double force to tropical climates.

It is intended to effect this by means of the sanitary cart and portable latrines, or soil pans, as constructed by order of the Government for experimental trial at Aldershott. The cart and latrines are of wood and iron, each latrine being 5 feet long, 18 inches wide, and 2 feet 6 inches deep, and capable when full of holding about 115 gallons: there is a spindle at each end, fixed eccentric, and a moveable cover, to be used when the latrine is carted away for the purpose of being emptied. Previous to removal a yoke is attached to each spindle—the yoke having side-triggers which preserve the latrine in an upright position, and admit of its contents being readily discharged. The cart is constructed on two wheels, having two arms projecting from the back, and resting upon the axle, with curved extremities adapted to the yoke. The shafts act as the long arm of a lever, the axle being the fulcrum. By this simple contrivance one latrine at a time can be removed with great facility, without risk of overflow, and its contents deposited without any manual labour being necessary either for filling or baling out.

By an arrangement the bottom of the cart can be extended so as to admit of four latrines, with the yoke, cover, and other appurtenances being packed up conveniently for travelling.

Noiseless wheels might be fitted to the latrines, when intended for hospitals, or other buildings of a permanent character, for the more easy transmission to the cart, and in such cases one cart would be sufficient for an indefinite number of latrines.

The cart and latrines, as constructed for Aldershott, were manufactured by Mr. Swan Nash, ironmonger, 253, Oxford-street, and may be seen on application.

The cart may be made to work by manual labour.

## HANTS AND WILTS EDUCATIONAL SOCIETY.

The Annual Meeting of this Society, and the Conference of Institutions in Union, was held at Southampton on Wednesday, Aug. 22, and the proceedings throughout were of the most interesting character. The engagements of the day commenced at twelve o'clock, at the Audit-house (the use of which had been kindly granted by the Mayor), and where a large number of gentlemen assembled together to take counsel as to the best means of furthering the Society's objects, and promoting the general cause of education amongst the people.

The following gentlemen were present, either as members of the Society, representatives of Institutions, or visitors:—

The Rev. Dr. Booth, F.R.S., Chairman of the Council of the Society of Arts.

Edwin Chadwick, Esq. (formerly of the Poor Law Board, and the General Board of Health).

Sampson Payne, Esq., Mayor of Southampton.

John Tyndall, Esq., F.R.S., (formerly Professor of Chemistry at Greenwood College).

The Hon. and Rev. S. Best, of Abbott's Ann, Andover; Wyndham Portal, Esq., of Malshanger, Basingstoke; and the Rev. Thomas Bacon, King's Worthy, Winchester—Secretaries of the Society.

E. W. Faithful, Esq., Winchester—Treasurer.

The Venerable Archdeacon Wigram; Charles Sartoris, Esq.; George Edmondson, Esq., Queenwood College—Members of the Committee.

E. E. P. Kelsey, Esq., Salisbury—Secretary for Wiltshire.

Messrs. J. R. Stebbing (President), T. Falvey (Vice-President), H. Pond (Secretary), and J. Bostock (Curator)—Southampton Polytechnic Institution.

R. B. Critchlow, Esq.—Local Secretary at Southampton, and Secretary of the Southampton School of Art.

Mr. Thomas Beard—Basingstoke Institute.

Mr. F. W. Bushell—Basingstoke Mechanics' Institute.

Mr. J. M. Goodinge—Andover Institute and Library.

Mr. H. Moody—Museum, Winchester.

Mr. J. W. High—Central School, Winchester.

Mr. James Calvert—Alresford Institute.

Mr. Conway Chester—Hayling Island Institution.

Mr. J. K. Kane—Secretary Portsmouth, Portsea, and Gosport Church of England Young Men's Association.

Charles J. Tylee, Esq.—Secretary Romsey Reading Society.

Rev. John Compton—Lyndhurst Literary Institution.

Revs. J. Gray (Dibden), W. D. Morrice (Longbridge Deverill), C. B. Knight, J. Norton (Southampton), W. Brodie (Alresford), J. A. Scott (West Titherley), A. M. Bennett (Bournemouth), E. Simms (Wilton), G. Prothero (curate of Whippingham, I.W.), J. Power (curate of St. John's, Portsea), J. Tanner (incumbent of St. Matthew's, Gosport), J. Williams (Petersfield), N. Smart (Alderbury), G. S. Fitzgerald (Southampton), W. H. Tribe, B.A., Oxon.

J. H. Forbes, Esq., Merry Oak; T. J. Turner, Esq., Worthy Park, Winchester; L. Owen Fox, Esq., Broughton, Stockbridge: A. S. Bennett, Esq., Bournemouth; C. E. Deacon, Esq., Southampton; J. R. Keele, Esq., ditto; Drs. Harvey and Wilmot, ditto.

Messrs. E. R. Baker, Kingsworthy; — Christie, Newport, I.W.; Charles Gedge, Brighstone, I.W.; A. T. Smith, Dunstable; D. Savory, Southampton; G. D. Snow, Farringdon; — Macfarland, Petersfield; S. Stevens, &c.

At twelve o'clock the proceedings commenced by Archdeacon Wigram moving that the Rev. Dr. Booth, F.R.S., Chairman of the Council of the Society of Arts, be requested to take the chair, which was seconded by Mr. Stebbing, and carried with acclamation.

The Rev. Dr. Booth, F.R.S., in taking the chair, gave a brief history of the movement which had resulted in the union of Literary Institutions with the Society of Arts. Following the Great Exhibition of 1851, Mr. Chester and other gentlemen, wishing to bring together the scattered Institutions of the country, took active steps with a view to effect that object, and convened a meeting of representatives in London in 1852, at which great suspicions of centralisation were entertained; but those suspicions had gradually subsided, and, beginning with about thirty or forty, there were now four hundred Institutions in Union with the Society of Arts. (Hear, hear.) All interference with the management and operations of the respective Institutions was carefully avoided, and they

were realising the advantages provided by the union, the principal of which were the procuration of books at reduced prices, the providing lists of lecturers, and lending out collections of photographs, &c., for local scientific exhibitions. Such efforts had previously been attempted to be carried out by means of local unions, but these did not enable them to grasp all the advantages arising from a general union of institutions throughout the country. He would point out why at the present time such an union was especially important, and here he would say that his remarks would be entirely free and dissevered from all political opinions. Twenty-five or thirty years ago the Government of this country, though apparently constituted in the same manner as now, was really very different from its constitution at the present day. Then the Government of the day took up measures on their own convictions, carried them through with a high hand, and their only alternative was resignation in case of failure. But there was a great change now. The Government of this country was more truly called an administration—a collection of official persons, whose duty was not so much to carry out what they themselves thought right as what the people required. They introduced measures, changed them, and modified them, to meet public opinion. They must first agitate before they could legislate. Measures, however important, could not pass through the legislature unless public opinion forced them on. As illustrations of this opinion might be mentioned the passing of the Reform Bill, and the Repeal of the Corn Laws. This rendered the union of literary and educational Institutions most desirable and valuable at the present time, for if any measure came fairly within their sphere of operations, such an organisation would enable them to bring their power to bear upon the legislature, and through the legislature the cabinet of the day. (Hear, hear.) These 400 or 500 Institutions included from 80,000 to 90,000 intelligent men of the middle classes, who would by means of the union be enabled to press any important measure on the Government of the day, and thus this union would be a most important step in promoting the education and improvement of the people. It had been objected that Mechanics' Institutions had not been availed of by the men for whom they were intended. This was partially the case, and arose from the fact of putting the cart before the horse. They ought to educate the young so as to imbibe in them the taste for Mechanics' Institutions when they grew old. (Hear, hear.) With reference to one of the topics on the paper for discussion—the formation of classes, he would mention the movement recently made in the East India Company relative to certificates for attaining official positions in that Company. None were more interested in such a movement than the members of these Institutions, the question being whether positions of importance and influence should be thrown open to every freeman in the community, or, as heretofore, be gifts to the select few,—he might almost say instruments of bribery and corruption. (Hear, hear.) It was the birthright of every freeman to compete fairly and freely for public appointments, and he thought that no measure of greater importance could now be impressed by the united Institutions on the attention of Parliament, than the securing of free ground for all, so that the children of the most humble working man in the country should be enabled to make their way to the highest positions in the State. (Loud applause.) That was the theory of our constitution, but it had hitherto been widely departed from. (Hear, hear.) He would no longer detain the meeting, but would remark that in the Society of Arts they had a very wholesome and excellent rule—to allow five minutes to every speaker (hear, hear), a rule which had always worked well, and which, he thought, if introduced into a higher assembly, would be attended with very beneficial results. (Laughter and cheers.)

The Hon. and Rev. S. Best, one of the secretaries, then read the following report:

In presenting their report for the year ending September 1, 1855, it will not be necessary for your Committee again to refer to the origin and objects of the Society. The prospectus explains the objects; and the List of Diagrams, Models, and Apparatus, indicates the means, or some of the means, by which it is proposed to carry out those objects.

Your Committee congratulate the members on the great success which has attended this first effort to carry into Provincial Districts the advantages which have been hitherto confined to the more central organisation of the Metropolis, and the larger Capitals of Manufacture and Commerce. The improved reports, and more confident and cheering tone of the correspondents of the Society, the removal of prejudices, and the awakening interest of many who long stood apart in distrust, have given courage to your Committee to proceed in a work which they believe to be identified with the best interests of the community, as a very powerful aid to social, moral, and religious improvement.

With the aid of a large and increasing staff of Local Secretaries, your Committee is carrying the operations of the Society into all parts of Hants and Wilts; and with a view of extending its agency, it has now been resolved that of the three ordinary meetings of the year, one shall be held in January, at Salisbury; one in May, at Winchester, and one, the General Annual Meeting and Conference of Institutions in Union, in August, at such place in the two counties alternately as may be thought by the Committee to offer the greatest advantages for re-union, and for the discussion of the interests or wants of the localities and the proposed objects of the Society. Under these regulations the present meeting is held, and your Committee feel bound to tender their best thanks to the Mayor and authorities of Southampton, as well as to their enlightened friends and co-operators, for the kind reception and assistance extended to them.

Referring to the title of the Society, the means proposed for promoting mental improvement are Libraries, Reading Rooms, and Lectures. Taking a review of its operations, in this order, there has been but one application under Rule 9, within the past year, for a grant in aid of the establishment of Libraries, whereas three were made in the preceding year. But the question, as bearing on Libraries has assumed another, and, perhaps, a more satisfactory form; and, the Secretary "for Libraries and Book-purchases" reports "that, during the past year, he has received six orders for books from Institutions in Union, amounting, in the whole, to about 170 volumes. The full price of these books amounted to about £27 4s., but they were supplied to the Institutions, through the Society of Arts, at £20s. 7s.; that is, at a reduction of more than 21 per cent. It is gratifying also to be able to state that, of the 170 volumes ordered, nearly 100 were supplied by the Religious Tract or Christian Knowledge Societies, the remainder being travels, histories, and standard works of fiction."

Your Committee regret that answers have not been received from very many of the Institutions in Union, or they should have been enabled to lay much valuable statistical information on the subject of Libraries before the meeting. From the returns, however, of seventeen Institutions, it would appear that their Libraries, varying from 70 to 4,000 vols., contain 16,189 vols.; and it further appears that during the last year they have added to their Libraries, by purchase or presentation, 1,775 vols. The character of the books read is not so entirely satisfactory; although in many of the returns, "History, Biography, and Travels," indicating a desire for sound and practical information, form a very conspicuous item.

On Reading Rooms, Classes, and Examinations, the Secretary for that department reports that 17 Institutions, many of them reading rooms in the rural districts, have been added to the list of Institutions in Union; and that many others are known to have sprung up since, and, indeed, in consequence of the movement of the Society, some of which have made returns to our circulars, and yet, from some unexplained cause, have not yet placed themselves in Union. With respect to Reading Rooms, it is satisfactory to find how very general they are becoming, and that the want of them as a means of carrying forward the education of those whom our Schools have sent into the world, is generally acknowledged. From one Reading Room, in a small rural population, the Secretary writes that "It consists of 20 young men, whose time, prior to the formation of its Classes, was spent in idleness and mischief. To a certain extent, they have been snatched as it were from destruction." This is typical of the whole class. Others are spoken of as "progressing favourably," as "fairly successful," and as ex-

citing an interest in all classes who are desirous of rendering them equal to the purposes for which they are established."

In 10 out of the 16 Institutions which have returned answers, it is reported that classes have been established with varied success; and in two others, that they hope to establish them this winter. Your Committee respectfully, but earnestly, draw the attention of the members to this subject, as a very important field of the Society's labours.

On the subject of Examinations, your Committee regret that they can refer to no instance of the requisitions of the Society of Arts being complied with; but, confident of the expediency of the proposal which has been made, and of the growing importance of the question, they are very desirous of drawing to this point the attention of the Representatives of the Institutes in Union. It is one of the subjects placed on our list for discussion this day; and it is hoped that its full and temperate consideration will bring out the points of interest by which the measure recommends itself to our adoption.

The Secretary for the Department of Lectures and Diagrams reports that during the past session 18 gentlemen responded to the call of the Society, and kindly placed their talents at the service of the public, by the gratuitous delivery of not less than 95 Lectures before Institutions in Union. The subjects were chiefly of a scientific and literary character; and the lectures were for the most part well attended by mixed audiences, the middle class predominating. The diagrams were in constant request, nearly all the Institutions in Union having profited by them.

The Lecture List for the ensuing Session bears gratifying evidence of the increasing popularity and usefulness of the Society, 35 gentlemen having promised to deliver in all 143 lectures before such Institutions in Union as may claim their services. A large addition has been made to the diagrams and models, and considerable improvement is being effected in their arrangement at the depository.

In consequence of the enlarged operations of the Society, it has been considered expedient to divide the official duties into three departments, as already referred to, and to place the diagrams, models, and apparatus, under the charge of a paid officer, with the title of Assistant-Secretary and Curator. This duty has been confided to Mr. Etheridge, of Jewry-street, Winchester, in whose house the Depository of the Society is established; and, for the convenience of members, a small room has been fitted up, in which the diagrams, &c., can be consulted, and in which pens, ink and paper, fire and candles, will be provided by Mr. Etheridge, at a fixed charge. It is hoped that, in this manner, the convenience of members has been provided for. The Depository is as near as may be to the Railway.

Your Committee would further report, and with great satisfaction, that the principles upon which the Society is based, and its mode of operation, have met with the entire approval of the Council of the Society of Arts; and that, as in the case of the "Berks and Bucks Educational Society," sister societies have sprung up, adopting the same principles, and in furtherance of the same objects.

The report having been received and adopted, the meeting proceeded to discuss the various topics on the programme. 1. Book Hawking and Itinerant Village Libraries. 2. Catalogues of Books for Institutes and Reading Rooms. 3. Classes, School Certificates, and Examinations. The three latter topics included under the third head the Chairman suggested should be taken together; viz.:—"The encouragement of Classes, and the means of promoting them; School Certificates, as preparatory to those proposed by the Society of Arts; Examinations, as proposed by the Society of Arts."

The Hon. and Rev. S. Best said he appreciated at their full value the importance of lectures, as essential means in the progress of education, but they should be considered only as accessories to classes, in which study and real instruction could only be pursued with permanent success.

Mr. CHADWICK, C.B., said he attended upon an invitation arising from a knowledge of the consideration he had given to the bearing of examinations for the public service on educational institutions; but in taking part in this discussion he was only returning to what was to him an old field, for some thirty years ago, before he entered into the public service, the first part he ever took in public matters was in lending humble aid to his late friend Dr. Birkbeck, in the formation of mechanics' institutions; and he was a vice-president of two of the first that were formed, after the chief institution, in the metropolis. In entering upon the subject of public examinations as tests of educational merit for the public service, he did not think he should be obnoxious to the charge of any serious infringement of the understanding not to enter into party politics, for appointment for merit was an admitted principle by the heads of the chief political parties—Lord Derby, Sir E. Lytton, and Lord Stanley on the one side, and Mr. Gladstone and Sir Stafford Northcote and a large body on the other, having expressed concurrence in the principle. The main question was, however, by what means could the principle be best tested and its application enforced? There were few who might not as readers have exercised the faculty of reading on one subject to an audience, and having their thoughts directed at the same time to another; whilst pupils hearing lectures, having the semblance of close attention, have nevertheless their thoughts elsewhere. But when the pupil is to be questioned afterwards as to what he has heard, he gives another sort of attention. The cure of this inattention, the remedy for the failure of lectorial instruction, his friend, the chairman, pointed out in a pamphlet, entitled "Examination the Duty of the State," in which he adverts to the failure of the merely lectorial system of tuition without subsequent examination, and examination of a stricter character anticipated much of the present thoughts on the subject. His (Dr. Booth's) view as to the necessity and importance of public examinations had been recognised by all the affiliated institutions, and by the parent institution as means to insure sound instruction. The commissioners of inquiry into the means of improving the education at the University of Oxford had given a definition of the qualities required for efficient examinations, which he (Mr. Chadwick) begged leave to quote from the report of the Society of Arts on industrial instruction, as showing the progress of concurrent but independent opinions on this subject. Those commissioners say that "to render a system of examination effectual, it is indispensable that there should *be danger of rejection of inferior candidates*, honourable rewards and distinctions for the able and diligent, with examiners of high character, acting under immediate responsibility to public opinion." Now whilst the Chairman and others were showing the necessity of substantial rewards, and stricter examinations of a public character, with prize scholarships, as stimuli for educational institutions; whilst the Oxford inquiry commissioners, and other combatants against ignorance were saying these things, Sir Charles Trevelyan, and Sir Stafford Northcote, Mr. John Wood, of the Customs, he (Mr. Chadwick) and others of the largest experience in office, remonstrants against the evils of ignorance and incompetency prevalent in the public service, were independently saying much the same things as to the nature of the examinations requisite, in the first instance, for the correction of those deplorable evils. Whilst they were contending for open and competitive examinations as the only safe test of educational qualifications for the public service, others out of doors, promoters of educational institutions, were looking to more than honorary distinctions, as real rewards to the diligent, and necessary inducements to attention, and to undergo the requisite ordeal of examinations, and were regarding the appointment to public offices as prizes necessary for the advancement of general education. Here, then, from different starting points, they, with a large body of thinking persons who had hitherto taken no part in public questions of any sort; but, moved to the like conclusions by impressions derived from the extraordinary events of the times, were brought to a common field, for a concurrence of opinion, and it was to be hoped, a union of forces. The attention of all leaders of educational institutions had recently been arrested by the first conspicuous example which we have gained of public competitive examination

for appointments—he meant for the writerships in the Indian service—which, be it noted, were appointments leading to eventual emoluments of £4,000 or £5,000 per annum, equalling the pay of Cabinet Ministers, and having jurisdictions, wider often and more important perhaps than in former times belonged to lords-lieutenant. Every one knew the difficulties under which parents were placed to judge of the positive or relative merits of particular seats of learning. By the new arrangement definite tests were provided from year to year, which would aid their judgment as to where they should send their children. He would ask them to regard the new impulse which these examinations will give to the heads of colleges and others to be wakeful and keep up with each other and with the time, under the sure penalty of immediate desertion? Look next at the aid and relief the examples give to the competent and willing teachers, in the stimulus it gives to the attention of flagging pupils, who could not at present be got to work for distant, indefinite, or uncertain objects, on whom this annual gaining and losing, not only of honours, but of large substantial prizes, must make the strongest impressions. Now, this new power, gained by those competitive examinations for medical appointments, as well as by the competitions for cadetships now going on—a power gained for the educational institutions which were appropriated to the wealthier classes, was of a species which just met the pressing wants of parents, pupils, and teachers, in respect to the schools for the middle and lower portions of our industrial communities. He submitted they met the chief weaknesses and failures in the special class of institutions in this union. Competitive examinations for certificates of competency for school teacherships inducted under the auspices of the committee of Privy Council, afford, by the use made of them, important evidence of the value of competitive examinations as authentic and trustworthy tests of the market value of qualifications for commercial service. The effect of those examinations of competency for school teacherships, of some £70 per annum, or more, had been to call forth qualifications or clerkships of £100, and £150 per annum, in the commercial labour market; and as Parliament, with wasteful parsimony, did not choose to pay the proper market value of tested educational qualifications, the successful competitors have used their certificates as a means of obtaining more lucrative commercial clerkships, or clerkships to engineers and manufacturers; and he was assured that some of these successful candidates were answering so well, that future men of wealth and position in commerce and manufacture would have owed their prosperity to these competitive examinations. The new certificates of competency, obtained upon competitive examinations conducted at the school of practical art at Marlborough-house, between pupils of the local institutions, with the pupils of the central institution itself, and comprehending many of the higher classes of artizans, begin to afford similar promise of success. He was assured there could be no doubt that similar certificates of competency, awarded upon competition by known and responsible examiners, would furnish a means for raising talent from the lowest ranks, and would be of great convenience to employers whose time wss valuable, and whose own means of mutual examination were very limited. Depend upon it, that no office in the public service which is high enough for the labour of pursuit as an object of public patronage, is too low for educational competition. Other considerations on the side of the interests of education will be suggested by the experience and observation of those present. He would advert to the claims of the public to educational scholarships as means of administrative improvement. Lord Wrottesley, the president of the Royal Society, whilst agreeing in the general principle, took exception to what he considers the depreciatory manner in which the qualifications in abstract science had been spoken of. Now, whilst he was still of opinion that we should contend for the special and the practical as against the general and the abstract—and he still thought the subject matter of the examinations for the writerships open to objections as being too scholastic—yet even as they were, he must admit and declare that the evidence was decisive, that they were a great gain to the public and to India. Sir Charles Trevelyan, who himself studied at Haileybury, attested the fact, that the same men who were failures at the college were the same who were failures in office, and "hard bargains" for the public. Mr. Hopkins, the late president of the Geological Society, attested upon thirty years' observation and intimacy with them, that those who gain academical honours are not merely better mathematicians or better classics than those of lower degree, but that they were men of greater intelligence and higher capabilities, and that in habits of accuracy, punctuality, and industry, and in all that distinguished the man who did as much as he could from the man who did as little as he could, they were as a class greatly superior. He, Mr. Hopkins, equally maintained their superiority in moral qualifications. It would, therefore, admit of little doubt that while educational institutions and private individuals have under the new system of competitive examinations gained prizes, the public and the civil service in India have gained prizes also. There will, on consideration, be found, when looked at with a will and a practicable desire to render them available, as little cause for doubt that the same principles were as applicable to appointments to inferior positions, for which your institutions are adapted, to promote qualifications; and that in respect to them your educational institutions would gain, the public service would gain, as well by the sort of persons open competitions would exclude, as by those which they would admit. He would only refer to the public expressions which the heads of private parties have given of adhesion to the principle of appointments for merit, whatsoever hostility is manifested by their tails to the only proved and undoubted means by which merit for the public service can be tested. He would express a confident opinion that whilst inquiring as to the probable intentions of the government, the particular minister who may have the subject in charge will in all probability be looking out and inquiring, with a view to his own course, what are the intentions of his constituents. The patronage secretary, it is known, declares that the patronage is indispensable to his supporters. His supporters, the borough members, many of them declare that they would be glad to be rid of patronage, but that they require it to meet the pressure from their supporters, their constituents. He said the borough members, because it was a mistake to assume that the body of the patronage which would be applicable to general educational institutions such as those now under consideration, or those classes of appointments in respect to which the question of open competition has been raised, are of an aristocratical character. Very little, indeed, of the patronage for the junior appointments to the more numerous vacancies, is given to the county members—the mass of it goes to the borough members. He would say, therefore, it is you, Mr. Mayor—not you, perhaps, individually, but those whom you represent—who are responsible for the continuance of the evils in question, and it is for you, the constituencies of boroughs such as this, to adopt a self-denying ordinance against those foul abominations. Of the patronage maintained by you, it might be said that it is, like party, the occasion of the madness of many for the gain of the few—usually the supposed gain, for commonly it is as injurious to the receiver as it certainly is to the supposed giver, the State. The borough would gain its share of prizes to its schools and educational institutions, and their purifying influence, in substitution for the patronage and the corrupt influence which you would give up. He would ask the meeting to consider whether it would not be a gain, in moral influence at least, that the Queen's uniform worn by the postmen were to denote that it had been won by merit by the wearer, as a prize scholar of a village or a diocesan school, instead of its being the badge of political

partizanship, denoting that the wearer had been a hanger-on to one of an electioneering committee? Did the meeting conceive that the amenities of the Customs officers in your port, or that the despatch of business there would suffer, if the appointments to the Customs were given as prizes to the most attentive and successful students, instead of to the prosecutors of party contests? In the Government dockyards there are foremanships, surveyorships, and places for artizans requiring the qualifications of practical mechanical science, which you are trying at your mechanics institutions to promote, but are failing with those classes for want of sufficient motives. Would not the navy and the public be better served by appointments given for prize scholarships in mechanics than by appointments made as bribes for votes in the way displayed before the committee and the country in the dockyards committee? At no great distance there was the New Forest, and some extensive public lands. If the appointments at least to subordinate offices for their management were given upon competitive examinations for special qualifications in the science of botany or in aboriculture, might we not expect a fairer amount of produce, and better economical results and examples than were displayed before successive Parliamentary committees of inquiry? I believe that there are some 16,000 public places, of various grades, the majority of which are at the same time applicable both to the improvement of almost all grades of educational institutions and to the improvement of a most defective civil service, as several civil servants of extensive experience represented, before any defects were made manifest in extraordinary public disaster. It might be shown that for all which the inhabitants of the borough constituencies gain in occasional patronage, the people, yourselves, are made to pay severely in general taxation. In consequence mainly of this patronage, for the continuance of which the inhabitants of the boroughs are chiefly responsible, in many instances, more is paid for double the number of badly-appointed officers than would suffice under a purer system for the better dispatch of the public business. The maintenance of patronage appointments by popular constituencies he (Mr. Chadwick) must declare were in violation of individual popular rights; for that which is talked of as a new morality is an old statutory right, and a right at common law, declared by Lord Coke in his Institutes, that the most fit individual has a right to fitting office, whilst the State has a right to his services. There are those here who, as local ratepayers, it is known have had experience of the benefits derivable from the adoption of better practice in respect to local appointments. The general poor rates were once 8s. 6d. per head on the population, and increasing. They are now 5s. 6d., and the care of pauper children, the medical relief, and the general administration of relief is improved. The first step to this improvement, by which two millions per annum, and more, has been gained, was the abolition of your local patronage in appointments, your appointments of officers for such causes as that they had failed in trade, or had a large family with small means of supporting it, and the patronage was nearly put an end to by taking practical securities for the improved qualifications of officers, chiefly by competitive examinations. The like results would follow the application of similar means to the general public administration. It seems that the present meeting is understood to be for a conference simply, and that it is not understood that resolutions are to be proposed in a formal manner. I think sufficient facts have been brought before the meeting to enable those present to judge of the course which they ought to take at once. as constituents, and as heads of families, and hereafter as members of educational institutions.

Mr. Falvey said there was certainly a general agreement gaining strength in society of the importance of the views represented that day by Mr. Chadwick. The main difficulty felt at present upon the subject was in the appointment of examiners sufficiently responsible. What securities could be proposed in respect to them?

Mr. Chadwick said that the difficulty was, he apprehended, in great part, and indeed sufficiently, met by making the examinations competitive. It was, in truth, the chief ground of the importance attached to competitive examination by the official supporters of the measure, that the competition was a strong security against misdecision on the part of the examiners. In private and departmental examinations the "leaping bar" might be, and it was not unfrequently, lowered to favour the passage of a particular candidate. In the public and competitive examinations this could not be safely done; the rival candidates and their friends, if not the general public, would be enabled to detect any unfairness, and the decisions, involving comparisons of relative merits, were necessarily of a judicial character, involving judicial securities. The evidence of actual experience would be found complete and satisfactory on that point. He had omitted to mention that the competitive examinations for medical appointments in India, of which no account had yet appeared before the public, had afforded the most valuable, complete, and decisive experience of the dangers of the common "pass examinations" for degrees, which fully justified the objections to the present departmental "pass examinations." The new competitive examinations proved that under the common pass examinations men obtained degrees to practise as surgeons and degrees of doctors of medicine who were in a state of the most dangerous ignorance of the common requisites for the safe practice of their profession. Several doctors of medicine had been plucked for scandalous ignorance. The only protection of the public would be found in the institution of new competitive examinations.

Mr. Stebbing, of Southampton, said that he had no doubt whatever that the borough corporation might be got to give up their political patronage. He would undertake to say that in Southampton there would be little difficulty in the matter. Indeed, it was now very generally felt to be a nuisance.

Professor Tyndall looked upon lectures and classes as complements of each order. Lord Lansdowne had recently remarked, more than once, in the House of Lords, that there was no reserve of power in the country to lift men into office. He (Professor Tyndall) believed that there was, but that the talent was latent, and only required development. The revered Faraday had risen from the humblest ranks, and there were hundreds of Faradays in the country if the proper applications for study were only put in requisition in these Institutions. Examinations ought to bear upon the practical destiny of the student's life, or there would be much waste of power.

Mr. Beard briefly detailed the steps taken by himself and friends at Basingstoke, in the formation of the Mechanics' Institute, and classes for the study of Music, French, &c.

Mr. W. Portal feared that the objection of working men to mix with their superiors in station was one great drawback to the desired full success of Mechanics' Institutions, and suggested, as a thought for the consideration of the meeting, whether their progress would not be facilitated if the wealthier classes gave such institutions all the pecuniary support in their power, but left the management entirely to the working men.

Mr. Pond gave a brief sketch of the evil results arising from the distinction of classes in the past history of the Southampton Polytechnic Institution, in which there was now the most perfect development of liberty of opinion, and nothing whatever was known in its management of creed, party, or difference of social status. Whilst he would deprecate the aristocratic usurpation of management in these institutions which would exclude working men from their fair and legitimate influence, he should equally regret to see such an invasion of the democratic element as would shut out those higher in position. The two must work freely and harmoniously together, and with men of wealth like Mr. Portal on the one hand, and the working men earning their humble weekly stipend on

the other, each struggling for a common educational purpose, society would be benefitted. They could not afford to lose the administrative abilities of such men as Mr. Portal, and he hoped that that gentleman's suggestion would never be adopted.

The CHAIRMAN followed in the same strain, and observed that the whole tendency of society at the present day was to break down the social barriers which had heretofore divided them from each other, and they should do nothing whatever calculated to foster class prejudices.

Mr. STEBBING remarked on the crippled state of the institution in Southampton for want of room, which was felt in many other places, and thought it would be well if the State would provide the means for building lecture-halls, in which classes, reading-rooms, &c., could be formed, so as to offer inducements to working men to quit the beer-shop and the public-house. They had in Southampton recently been compelled to build a new gaol, at a cost of £30,000; if £1,000 had been spent on a reading-room, museum, and library, that huge building, he believed, would not have been required.

The CHAIRMAN asked Mr. Stebbing if he was aware of Mr. Ewart's recent Act, to enable towns to rate themselves for libraries and museums?

Mr. STEBBING said that did not meet his idea; it would ot allow them to erect buildings, or hold lands.

Mr. CHADWICK, the Rev. T. Bacon, Mr. Faithful, Mr. Falvey, and other gentlemen, followed in support of the views to which utterance had been given.

Mr. PORTAL, in reply, expressed the pleasure he felt at the interesting discussion which his suggestion had elicited. He hoped that not a single person in that hall misunderstood him as wishing to keep open the breach between the higher and lower classes; his only idea was, whether working men would not have greater confidence in such Institutions if their own management were not intefered with. He remarked on the awful extent of juvenile delinquency, and mentioned an instance which had recently been brought under his notice, of a boy, only 14 years of age, who had been imprisoned fifteen times. He was sure that no endeavours would be too great to rescue some of these unfortunate boys from the path of crime, and he hoped that the attention of this Society would be partially directed to this benevolent object. A humble attempt had been made by himself and a few friends, by the establishment of a Juvenile Reformatory, at Eling, and he earnestly trusted that their exertions would be productive of some good. He would suggest to the Southampton Polytechnic Institution, and other large organizations in towns, whether they might not attach to their machinery a sort of Ragged Mechanics' Institution, for the education and instruction of those who would not otherwise join them.

On the motion of the Mayor, seconded by Mr. W. Portal, the thanks of the meeting were voted by acclamation to Dr. Booth, for his valuable assistance in presiding over the meeting.

The CHAIRMAN, in returning thanks, expressed his satisfaction at the unanimity which prevailed amongst all parties on the subject. He referred to the report on industrial instruction adopted by the Society of Arts, to re-impress them with the dreary position of the middle class not intended for the universities, whose motives to exertion were as few as they were feeble. The youth of that class knows that he must remain at school for a certain period, and then proceed to business; but he cannot discover how his diligence there can have any perceptible effect upon his future prospects in matters having so few points of resemblance as science or literature with commerce, ignorant of the fact that success in each is achieved by the same instrument. Now, were he certain that on leaving school he must go before an impartial tribunal, and there be subjected to a most searching examination, and compared with boys from other schools, what a powerful motive to exertion would be at once supplied. Baron Liebig, in a communication to the Oxford Commissioners, said, "Without examinations all efforts are useless, and no scheme of instruction has any perceptible effect. I am supported in my assertion by an experience of 27 years, and I can assure you that even amongst our medical students, the study of natural philosophy, of chemistry, and of geology was utterly neglected until we determined to divide the examinations of the students into two, namely, a previous examination in the natural sciences, and a second examination in them proper to the medical department. When I assure you that for twenty years no medical student at Giessen visited the laboratory, this is a full and sufficient proof of what I say. But immediately after the examination was introduced, the students pursued their studies with zeal and ardour." In the magnificent halls of Oxford and Cambridge, men the most eminent in the various departments of law, political economy, history, and natural science, lecture, too often, almost to empty benches. It is not that the pupils are ignorant of the great value of the subjects lectured upon—quite the reverse. Yet they must not attend to them, because they will not tell upon their degree. A brighter day for educational labours was opening upon them, if the members duly supported the views displayed at the meeting.

The members and delegates of the institutions dined together, when the chief subject of the morning's discussion formed the prominent theme of the evening's speeches; in the course of which,

Archdeacon Wigram expressed the great pleasure which he felt, as a minister, in seeing the reception given to Mr. Chadwick's statements by the meeting, and to the confident expectations held out that local patronage would be abandoned, for, apart from the higher educational interests which were involved, it held out the cheering prospect of relief from local party feeling, and great moral and social improvement.

## CLOTHING AND OTHER PRODUCTIONS OF CHINA.

(From the *Daily News.*)

Some packages were received by the Manchester Chamber of Commerce, on Friday, of an interesting character, containing clothing and other productions, forwarded by Sir John Bowring, from China. They were accompanied by some correspondence of an explanatory description, prefaced by two letters, one from Dr. Lyon Playfair and the other from Sir John Bowring. The first of these two letters is addressed to Thomas Boothman, Esq., secretary of the Manchester Chamber of Commerce:—

"Department of Science and Art, Marlborough-house, London, August 16, 1855.

"Sir,—In consequence of a correspondence entered into between Sir John Bowring and some of the manufacturers in Manchester, it was resolved to collect specimens of the ordinary clothing worn by the population in several of the important districts of China to which access could be obtained. This collection, along with certain dye-stuffs and raw materials, has been forwarded to this country by Sir John Bowring.

"I am directed by the Lords of the Committee of Privy Council for Trade to transmit this collection, with copies of the correspondence relative to it, to the Chamber of Commerce in Manchester, in order that they may be inspected by persons interested in the export trade of China. The specimens of dye-stuffs and raw materials require further examination and identification before the descriptions upon them can be thoroughly relied upon, as in some cases they are obviously marked with descriptions inappropriate to the contents.

"I am to request that, after the collection and correspondence referred to have remained with the Manchester Chamber of Commerce a sufficient time for their examination, that you will kindly give instructions to transmit them to the Chamber of Commerce, Glasgow, where it would be desirable that they should arrive

before the 12th of September, in order that they may be examined by those persons who attend the British Association for the Advancement of Science, to be held in that town.

"The collection, after having been examined at Manchester and Glasgow, are to be returned to this department, in order that they may be made part of the general museum.

"I am, sir, your obedient servant,
"LYON PLAYFAIR."

The next letter, from Sir John Bowring to Lord Clarendon, explains the circumstances under which the collection was made—that of clothing being at the suggestion of the Manchester Chamber of Commerce, and that of waxes and other oleaginous substances at the request of the Board of Trade. The letters of the collectors, which are addressed to Sir John Bowring, lose much of their interest to the mere reader, because filled with references to the articles forwarded; the only means of inspecting which by the public at present are those pointed out by Dr. Lyon Playfair at Manchester and Glasgow. The following short extract from the list of goods forwarded will give an idea of the prices at which clothing is effected in China:—

Winter clothing for a man: 2 white cotton shirts, 880 cash; 2 pairs white cotton trousers, 680 cash. [100 cash is equal to 3½d. and 4-14ths of a farthing English.] Summer clothing: 1 grass cloth shirt, 350 cash; 1 pair grass cloth trousers, 280 cash; 2 cotton head wrappers, 240 cash.

Clothing for a woman in the winter: 1 blue cotton gown, 1,000 cash; 2 white cotton shifts, 980; 1 pair white cotton trousers, 380; 1 pair grass cotton trousers, 480; 1 blue cotton petticoat or apron, 620 cash. Summer clothing for a woman: 1 grass cloth gown, 760; 1 grass cloth shirt, 660; 1 pair black grass cloth trousers, 400 cash. Other female clothing: 1 black grass cloth petticoat, 580; 1 pair foot bandages, 70; 1 pair ankle covers, 120; 1 pair of red embroidered shoes, 400 cash.

The following are further extracts from the correspondence, containing some interesting facts:—

No. 21 is a letter from Mr. W. Raymond Gingell, officiating vice-consul, dated Foochow, May 26, 1854, and addressed to Sir John Bowring. It accompanies specimens of cotton garments worn by the laborious classes of Chinese in that district, namely, complete suits of male for summer and winter, as also of female attire, the colours being those ordinarily worn, and contains the following observations:— The cloths made use of in the above specimens are brought principally overland from Suchow and Tsun keang, in the Keanghan province. In former years the transit was effected by vessel, but the sea being so infested by pirates, resort was had to overland carriage, and this has triflingly increased the price. According to information collected from a toll-house, upwards of one million bales annually pass the customs, imported into this city for local consumption, and for distribution among the several prefectures and districts southwards, which all derive their main supply from Foochow. The prefectures and districts northwards are supplied direct from Suchow and Tsing Keang. Each bale contains 20 pieces, and each piece varies in length according to the hong from which it is purchased, each hong having its own determined length, varying however from 19 to 22 covids. Supposing, therefore, each piece to measure 20 covids, 400,000,000 covids of cloth would be the quantity annually comsumed at and about Foochow. The shop measure (as distinguished from that in use by tailors, and the one employed by masons, &c.) is 11¼ inch. Native cloths are about an English foot in breadth, three lengths of cloth, each of three covids, would thus equal one yard of shirting, so that the amount disposed of becomes reduced to 44,444,444 English yards. This at first sight appears large, but the quantity is far from excessive, when the enormous population is taken into account. This is the average annual quantity said to pass the customs, though at the same time it is asserted that nearly one-half as much again finds its way to Foochow without being reported for duty. I cannot arrive at any conclusion as to the proportionate quantity of pieces brought into this city ready dyed; but it is affirmed the greater portion is imported in an unbleached state, red being dyed at Hinghwa, green, blue, and purple, at Foochow. Those brought from Suchow are said to be of a superior dye, and to be of much higher price. Red cloth is sparingly worn by women for petticoats, and by young children, and green is in use by women and children for trousers and frocks. The laborious classes seldom employ white or unbleached cloths in their attire, the principal reason alleged being that the colour so readily soils. A few of the more respectable class make use of foreign long cloths, but this is only to a limited extent. The labouring classes never use it, it being both too white and thin, and possessing neither the durability nor the warmth of their own tissues. I cannot learn the proportion in which the different colours are consumed, but white, blue, and purple, are most in vogue; the white (of which the largest quantity is said to be consumed), however, being confined almost exclusively to the more respectable classes of the community.

A second letter from Mr. Gingell (No. 29), dated the 29th of June, 1854, gives the following information:— 1. The Chung peh lá Shoo, "insect white wax tree," is found in the provinces of Szechnew, Yunnan, Kweichow; the first named, however, is said to be the principal market whence the wax is obtained, but it finds its way into the several other provinces from all three. After searching inquiry no information respecting the tree or the shrub it feeds on, the manner in which the secretion from the insect is collected, and subjected to manipulation, the quantity of wax produced, &c., is procurable at Foochow; neither can specimens of the insect, or of the leaves or berries of the tree be obtained. A small quantity, one tael weight, of the wax, as sold in the shops, is herewith forwarded. The price per tael is 70 copper cash, or about 5 cents. The principal use to which it is here applied is to give a casing to candles, and to impart a glazed surface to note paper. A short description of the tree, and of the insect termed peh la chung, is found in Khanghe's Dictionary: "The chung peh lá tree is an evergreen, and gives forth a white flower in the fifth moon, which yields berries in profusion. The insect is as large as a flea or louse; it gradually creeps throughout the branches or stems, sucks the juice of the leaves, and then ejects a secretion from its mouth. The deposit is scraped off, and when subjected to heat yields wax. 2. Tung Yew.—This oil is produced from the fruit or berry of the tung tree (Dryandra Cordifolia Jatropha Curcas Morrison Dick). The tree grows on mountainous situations; its leaves resemble somewhat those of the woo tung tree (remarkable in China for the regularity of shedding its leaves, and used for making musical instruments), hence its name. The fruit is about as large as a horse chesnut, and contains four or five kernels. The oil when expressed has a disagreeable odour, and if swallowed, produces vomiting and purging. It is not employed as a medicine. Worked up with lime, it is used as a putty to caulk vessels, and is an ingredient in all paints and varnishes. When burnt, the soot from the smoke makes a fine ink. In consequence of its disagreeable properties, it is not employed as an oil for lamps, except by the very poor. Price per catty, 68 copper cash. 3. Tsac Yew.— This oil is expressed from the seeds of this vegetable, a sort of small cabbage, which is grown in a wet sandy soil, and which in season is largely consumed as a vegetable. The oil is used for lamps and in making candles, as also for frying and other culinary purposes. The price is per catty, 96 copper cash. 4. Cha Yew, commonly but erroneously believed tea oil. The leaves and berries, though much larger, resemble in shape the leaf and seed of the tea plant; hence its name. It is plentifully grown on the mountains around Foochow. Its uses are identical with those of the Tsac Yew. Price per catty, 88 cash. 5.

Kin Yew.—The berries of the tree from which this oil is obtained are round and white, growing in clusters. They ripen in winter, after the leaves have fallen. This is a concrete oil. The berries are collected by the villagers, and submitted to a boiling process. The oil is used for making candles, which are burnt in winter, the great heat of summer softening them; hence are they frequently coated with wax to prevent guttering. The tree is very common in all parts. Price per catty, 160 cash. 6. Ma Yew; Hemp-seed Oil.—The seeds are ground to a pulp, and boiling water poured on it, when the oil rises. Its principal use is in culinary purposes. From its agreeable odour the wealthy burn it, as also because it gives a brighter light. It is likewise used in making adhesive plasters. Its properties are said to be cooling. Price per catty, 224 cash. 7. Hwa Sang Yew, or oil from the ground nut.—Its principal use is for lamps. If swallowed it produces purging. Price per catty, 96 cash. 8. Pe Ma Yew; Castor Oil.—Is not made in Fokien province. Its principal use is to mix with vermillion for giving seal impressions, and in making adhesive plasters. Price per catty, 112 cash. With the exception of castor oil, all the above-named oils are common at Foochow. At this season of the year I am unable to procure any oil nuts or oil berries. As regards wax berries, I cannot learn that this neighbourhood produces a single description.

A letter from Mr. Gingell, August 5, 1854 (No. 36), gives the following information in reference to the art of dyeing in China, obtained with much difficulty:—1. Cloth to be dyed a deep black undergoes 18 dips, seven of these are in an infusion of an esculent root named shoo lang, the remaining in a solution of Prussian blue. The cloth is first dipped four or five times in the solution of Prussian blue to impart a ground colour; it is then alternately dipped in the shoo lang and Prussian blue solutions until the colour is perfected. As more labour is required in dyeing this colour, the price of the cloth is dearer. Each piece of 20 covids long pays 360 copper cash for dyeing expenses. When a purple blue is required the cloth is put into an open-bottomed vessel, having bars and a cover, and subjected to steam, which process changes the deep black to a purple blue. The price of shoolang is 26 copper cash per catty.—2. A deep red. The cloth must be of a white colour, and is dipped into a solution of turmeric and hwae hwa (proportions not ascertainable) to give a ground colour. After it is dried, lye water and an infusion of woomei (a species of black plum) is poured upon Hung hwa in order to extract its juice, and in this liquor the cloth is dyed. Deep or light red is produced according as the quantity of the hung hwa used is more or less, and according to the number of dips. The price of the hung hwa being comparatively high enhances the cost of cloth of a red colour. Price of Hwae hwa at Foochow, 96 copper cash per catty. Price of Woo Mei, 48 copper cash per catty. Price of Hung hwa, 1,362 copper cash per catty.—3. Green colour. The cloth is dipped and dried alternately in a solution of luhtang several times, after which an infusion of hwae hwa and alum (proportions not known) completes the green colour. The winter is the season considered best for dyeing green Price of luhtang, 90 copper cash per bundle.—4. Blue colour. Prussian blue is kept in water until it ferments. One dip in this liquor will then impart a light blue, and if a deeper shade is required, four or five dips more will give it. The best indigo is said to be brought from Ting Chow prefecture in Fokien, the next best from Formosa. Price per catty 128 copper cash.—5. Purple colour. A blue or green grounding is required; hence do the Chinese distinguish cloth of this colour into blue purple and green purple. A solution of sapanwood is said to impart this colour.—6. Yellow colour. The cloth is dipped several times in an infusion of turmeric, and the colour brought out by dips in an infusion of hwae hwa with alum. Price of turmeric 80 copper cash per catty. A deep black colour is sometimes produced by a solution of coarse sugar or molasses, in which iron filings are boiled for a long time, some astringent bark being thrown in. This is a cheaper mode, but the durability of the cloth is destroyed. Satins and silks are not dyed at Foochow, but the colours of faded tissues of this nature are badly re-dyed by the above processes. Besides the hwae hwa being used in dyeing cloths it is largely employed at Foochow to impart to tinned-leaf foss paper a yellow hue in imitation of gold. Alum is added to an infusion, and the surface of the paper painted with a brush.

The following remarks by Mr. J. A. F. Meadows, interpreter in charge at her Britannic Majesty's consulate, are appended to a report on the cotton clothes worn by the male and female population in the Ningo district:—The women of the labouring men wear blue inner garments six months, and white cotton inner garments three months in the year, and black or green outer dresses nine months in the year. The green cotton clothes are considered a finer dress than black, but owing to their being easily dirtied, they are less worn than black cotton clothes. About 20 per cent. of the women of labouring men wear green dresses of the kind mentioned about nine months of the year. Green cotton cloths are never worn as chemises or shifts. About 10 per cent. of the women of labouring men wear white cotton cloth under garments during three months of the year, blue inner garments being the kind usually worn. During the three hot summer months the women of labouring men wear a coarse kind of blue or white grass cloth chemises and blue grass cloth trousers. These two articles of dress form all the clothes they wear in the hot weather. About 50 per cent. of the labouring male class wear blue cotton shirts and trousers; 40 per cent. wear white cotton cloth shirts and trousers during nine months of the year. Each shirt, man's and woman's, and each gown and jacket, have attached five brass buttons. In the clothes now sent there are two kinds of buttons used, those made at Souchow and those made at Canton. The Souchow kind is sold for 14 cash per set of five buttons, and the Canton kind is sold for 30 cash per set of five buttons. Those men and women who cannot afford to supply themselves with grass cloth garments for summer wear during three months of the year, use foreign long cloth, generally grey long cloths dyed a light blue colour, dyed in China. The dark blue cotton cloth is coloured in the following manner:—White cotton cloth is dyed 12 times, and each time kept in the dye about 10 minutes. The light blue cotton cloth is coloured by dyeing white cloth six times, and each time kept in the dye about ten minutes. The dye for forming blue cotton cloths is composed of 660lbs. of fresh water or rain water, 133$\frac{1}{3}$lbs. of Chekeang or Formosa indigo, and 7lbs. of cockle-shell lime. These three substances are put into a cauldron, and after they have boiled together for an hour, the preparation is considered fit for dying cloth. 133$\frac{1}{3}$lbs. superior Chekeang, or Formosa indigo is sold sold at Ningpo for ten thousand copper cash. The black cotton cloth is sold in the following manner: white cotton cloth is first dyed a light blue colour, then it is boiled in a preparation made from the fungus or excrescence of a tree, which fungus is named Pei tsye, 2lbs of which is put into the cauldron. After the cloth is dry, one ounce of green vitrol is put in a cauldron filled with cold water, and then put on the fire with the cloth in it, till the water just begins to boil, when the cloth is taken out and dried and washed. Six ounces of papnan-wood is now put in a cauldron filled with water, when the cloth is put in it and boiled for four hours, after which it is dried. Five ounces of rice or flour are put into a cauldron and dried or burnt black; water is then added and boiled till the water is quite black, when the water is strained from the rice or flour. The black water is again put in the cauldron with the cloth, and boiled for one hour, and then the cloth is dried. After this last operation the cloth is of a black colour, and considered fit for use. The green cloth is coloured in the following manner:—A piece of white cotton cloth, 1,166$\frac{2}{3}$ feet English in length, 1$\frac{3}{4}$ feet in breadth, requires the fol-

lowing mixture to dye it a green colour: 41¾lbs. avoirdupois weight of hwae hwa, 8¼lbs. avoirdupois weight of alum, and 666¼lbs. avoirdupois weight of water. The above quantities are boiled together in a cauldron for six hours, when the mixture is in a condition to dye cloth. The cloth is now put in the cauldron, and boiled for four hours, and then sun-dried. It is afterwards boiled and sun-dried once or twice more, as the darkness of the green colour may be required.

## Home Correspondence.

### SANITARY APPLICATIONS OF CHARCOAL.

Sir,—In reference to the sanitary applications of charcoal, permit me to call the attention of the readers of the *Journal* to the following extract from the letter addressed by Dr. Sutherland, Chief Sanitary Commissioner in the Crimea, to Lord Shaftesbury and Sir James Clark:—

"I had almost forgotten about the peat charcoal you refer to.

"We use three deodorizing substances—charcoal, lime, and sand or gravel; we have tried them all. Peat charcoal acts extremely well, and in small quantity. It is, therefore, the best for certain purposes, as, for instance, for deodorizing in the trenches and in the camp, where carriage is an object. Damp or wet immediately destroys its qualities. Lime acts very well, and I think best when wet.

"Sand or gravel, for certain purposes, is as good as either. Dr. Paris first suggested it to me. A large quantity is required, and therefore its use is limited by carriage.

"We used it alone for the worst nuisances—namely, the horrible marsh at the head of the harbour. Six inches of sand spread over it entirely deodorized the soil.

"Any of these substances would, I believe, act as disinfectants, if a proper quantity were used, or, at least I presume so, but I suspect that bulk has more to do with disinfection than chymical composition. Peat charcoal in any ordinary quantity is certainly not a disinfectant; it stops smells, and that is all.

"I may give you the following conclusive experiment:—The steamship *Chester* arrived here several weeks ago laden with charcoal; she lay some weeks in the harbour, close to the wharf, and not far from large accumulations of foul matter, which had been covered up. She began to discharge her cargo in sacks, which were piled up close to her stern, so as to form a lofty wall on the quay. The surface of the quay was covered with charcoal dust; the same dust pervaded the ship and covered the men; so perfect was the deodorizing effect that there was no smell either in the ship or near it, although usually the air was very foul there. In two days six cases of cholera appeared on board, of which five died. We sent the ship outside at once. There were five subsequent cases of diarrhœa, but all recovered; a ship lying next to the *Chester* had no disease.

"The fact is certain and curious, and is confirmed, though not in so striking a manner, by all our experience here. It would, I think, be safe to disuse the word 'disinfectant,' because it leads to undue expectations, and might lead to neglect of other measures."

The views expressed by Dr. Sutherland are not in accordance with those of Dr. Stenhouse and Dr. Forbes Watson, as given in the last two Journals of the Society.

How far the experiment detailed can be considered "conclusive," as the Doctor confidently asserts, appears to me to be questionable. I am not saying he is wrong. It may turn out that he is quite right. The subject is very important, but it requires to be investigated with somewhat more care than it appears the Doctor has hitherto devoted to it.

The Doctor speaks of his views as "confirmed throughout in so striking a manner by all our experience here." After the previous specimen of loose generalization, I confess to little faith in the Doctor's "experience."

The Doctor speaks highly of "lime" as a "deodorizer." Others doubt it. Why cannot we have carefully conducted experiments to settle these important points?

There is plenty of opportunity, which ought not to be lost.

NEMO.

### WHAT IS FOOD?

Sir,—There are many sides to most subjects, and amongst others to the subject of food, of which we have lately heard so much as to its adulteration. As to the morality of a vendor selling a noxious substance under the pretence of its being nutritious, there can be but one opinion, any more than of the fact of selling fourteen ounces weight under pretext of its being a pound avoirdupois, being plain cheating. But to begin at the beginning, we must first settle the question of "What is food?" and thereupon up comes the proverb, "What's one man's meat is another man's poison." Some people eat arsenic in considerable quantities, and if not exactly food, they find it conducive to an enjoying state of existence. Certain tribes of Indians eat a peculiar kind of earth, which if introduced into our workhouses as food would raise an outcry far and wide. In some countries seaweed is food, in others it is manure for land. On the Western coasts of the Pacific the echinus, or sea urchin or hedgehog, is a most delicate shell-fish: in England it is regarded with aversion. Putrid blubber agrees very well with the strong stomach of a Greenlander or Esquimaux: here we use it only for oil. The Bermudians eat whale's flesh, which certainly would be thought a very coarse kind of beef in Leadenhall-market. Originally food consisted only of the productions of nature, unchanged by art, save in cooking. A very large proportion of our food now consists of artificial preparations, or the productions of nature chemically altered. The mandioca root in its natural state is poison; manufactured it becomes arrow-root. Raw potatoes are considered a poisonous substance; but a Frenchman once taught me on the Equator what a very pleasant salad can be made of raw potatoes, in thin slices, and the conviction spread and increased mightily till all the olive-oil was consumed.

It is a probable thing that as our analysis grows into synthesis, many new varieties of food will be produced artificially. But it would be difficult to persuade people to eat them knowingly. Handy Andy, in Lover's tale, thought stewed leather breeches very fine tripe till he lighted on a button, which suddenly convinced him it was unwholesome food; and Sir Joseph Banks—so says Peter Pinder—did not think fleas equal to lobsters, though of the same genus. The Berlin philosophers have for many years been trying to persuade the community that horse-flesh is good beef—unsatisfactorily; and amongst civilised communities it appears to be chiefly in France that people voluntarily eat cats, both as a relish and a vengeance, if we may trust the reports of the Tribunal of Correctional Police; though scandal has long accused innkeepers both in France and Spain of thus feeding their guests as a substitute for rabbits. The three married ladies who lately figured in a trial in Paris ought assuredly to visit London to reap the abandoned spoils of our cat-skinners, who take the shell and leave the kernel. The French are chemists as well as cooks, and waste no food. They have no Mr. Goldner to take charge of their putrid meat. They know better how to deal with it, how to get rid of the putridity and retain the nutritive portion. And there seems no reason why putrid meat should be thrown away if it can be converted into wholesome food. If fetid potato oil can be converted into a delicious scent akin to attar of roses, we may very well imagine that the partridge or venison bouquet may be obtained from other kinds of flesh. It is said that a pair of ladies' gloves have ere now made a ragout; and there is an hiatus in the parchment specifications at the Patent Office caused by an unlucky boy who changed them away for tarts, in order that they might

be stewed down and converted into calves'-foot jelly. The mechanical problems written and graven on them were doubtless not precipitated on the delicate palates of the ladies or gentlemen consuming them at Almack's or elsewhere. It was but carbon gathered by the sheep in the shape of grass from the earth's surface—kid gloves in another form. Possibly chemistry will ultimately enable us to make kid gloves and parchment without troubling goat or sheep for them, and artificial gelatine will become a substitute for calves' feet. It is probable that even now we occasionally eat old wool and hair in our gravy soups as well as make it into what is facetiously called "felt cloth"—the fibres being glued instead of felted together, and in process of time we may prepare gelatinous tubes analogous to wool and hair from carbon converted into gelatine. It certainly seems odd that a man's coat should be convertible into his dinner; but "Imperial Cæsar," according to Hamlet, underwent as strange changes. "Once," say the annals of the Parisian Octroi, it was suspected that the town revenues were defranded by large entries of smuggled milk. Searches were made, and though it was clearly demonstrated that three times the quantity was consumed that paid duty, it was nevertheless not smuggled, and the inference was that it was manufactured largely, as well as diluted. And after all, may not artificial milk chemically well made be better than natural milk unnaturally made from diseased cows by bad artificial food? Are lemon lozenges made from sulphuric acid less pleasant or wholesome than those made from putrid fruit, possibly owing its colour to sulphur?

That the time will come when we shall cease to entomb the lower animals in our stomachs, by the substitution of better food, is highly probable. Nor is it yet demonstrated to what extent the civilisation of man may enable him to improve upon his culinary vegetables. But if a chemist were to bring into the market an artificial food containing the same chemical ingredients as our natural food, but not directly animal or vegetable, the chances are that he would be scouted. He must, therefore, pretend that he has extracted it from beeves, or muttons, or goats, or some known vegetables. He may ring the changes on Ervalenta and Revalenta to make the sale of lentils or bean-meal prevalent-er; but were he to burn a sack of meal and gather back the gases in a tangible shape as food, he would be accused of poisoning, though if he calls it medicine, and advertises it as essence of sea air, he may transact business at pleasure.

There is danger of people being poisoned by quacks; there is danger that the lucre of gain may induce men to sell plaster of Paris for flour; but there is also a danger of stopping progress. Possibly there are more things in the food trade than our philosophy has yet dreamed of,—that some of our adulterated food may be better than the pure. Coal oil is fast taking the place of whale oil as a lubricant for machinery, but nobody professes to sell coal oil direct, save the manufacturers. Corn spirit artificially flavoured matches the grape spirit, and artificial wines grow to be undistinguishable from the genuine. Each day adds something to our knowledge of the aromas and to our power of synthesis, and the skilful chemist will so closely imitate the various articles of food that analysis will fail to distinguish the artificial from the natural. What are called our genuine wines are, in fact, very artificial productions. The most delicate wines do not bear transport from the place of their production, and it is the peculiar province of the chemist to produce them artificially, just as he produces delicate perfumes. But chemists and perfumers will not tell of these things. They will try to sell their artificial commodities under the name and at the price of the natural ones. And the more the outcry is raised against adulteration, the more secret will they keep their proceedings. This is not desirable any more than the adulteration.

The adulteration prevalent in wholesale and retail shops direct is but a small part of the matter. The indirect adulteration is the great quantity. When we make diseased meat by unwholesome feeding and lodging, we engender largely diseases that are conveyed to the human beings who eat it. Consumptive cows, and jaundiced sheep, and born diseased calves, and measly pigs, and manure-fed poultry, are possibly worse than the adulterators of the minor articles of food. And the diseased vegetables and fruits, with their health also destroyed by filthy feeding, subject in succession to epidemics of various kinds—apple-rot, potato-rot, grape-rot—are not these also adulterations growing out of the desire of gain, producing crops of quantity, and not of quality.

To point out to the public what is wholesome food and what is not, and the modes of treating unwholesome food to make it wholesome, should be part of the function of the Board of Health quite as important as pointing out what air they should breathe. This is precisely the work for which Dr. Southwood Smith was fitted; and why he should be pensioned off with a bare maintenance while able to work for an adequate salary, is one of those things that puzzle people not behind the scenes. He really did the essential work of the Board of Health, and established the principles of their sanitary code.

To dictate to people what they shall or shall not eat and drink, would be a hopeless task. All that can be done is to warn them of the evil, and point out immoral vendors. If they refuse to be warned they must kill themselves. No government can take upon itself to watch its people like so many children.

I am, Sir, yours faithfully,
W. BRIDGES ADAMS.

6, Adam-street, Adelphi, Augugst 6, 1855.

## THE VINEGAR PLANT.

Sir,—My sisters constantly brewed their vinegar, at first with, but afterwards without, a vinegar plant. Into a stone jar, holding a gallon of water, a quarter of a pound of raw sugar was stirred, the jar tied down and placed beside, but not near the fire. About the heat at which mushrooms grow on summer mornings, vinegar begins at the hearthstone.

From three to six weeks would elapse before the mould appeared on the sugar and water, and it began to turn sour. Once changing, it required attention to remove the mould, and appropriate the vinegar before it became rankly acid and unfit for use. The mould or plant also, which at first, from a delicate surface, threw down long fibrous threads into the vinegar, was in danger of growing so fast and so rankly, as to fill the whole jar with a powdery overgrown mould, only fit to throw away.

The only difference betwixt vinegar made without the "plant" and with it, was that one was ready more quickly than the other.

The "plant," though much insisted on by the vinegar maker, appeared to me to be merely the accident or product of the fermentation, and to have nothing whatever to do with it; the greater quickness with which vinegar was produced on its introduction to fresh sugar and water being due to the spongelike absorption of a portion of real vinegar, with which it quickened the acetic fermentation. On this I speak modestly, as merely my own impression.

I remain, yours, &c.,
SARAH ELWINS.

Staines, Middlesex, August 29, 1855.

## THE VINEGAR PLANT.

Sir,—Having noticed in your *Journal* of last week an inquiry respecting the vinegar plant, I take the liberty of stating my knowledge of the same.

Two years ago I learnt that the origin of the plant was derived from stale beer. A vessel containing some beer had been standing some time unnoticed, when, on inspection, it was found to be covered with a species of fungus of a light brown colour, and semi-transparent. I have used the plant many times.

I mixed two ounces of sugar and a quarter of a pound of treacle together, with five half-pints of clean water; the

odd half pint is to allow for evaporation. Put this in a clean pan about four inches deep and eight inches over, let it stand for six weeks, and at that time another plant is produced on the underside of the original, which will easily separate.

I have been informed that the parent plant will produce twelve others, and then, as it were, die, but I cannot vouch for the truth. We have many plants here in Portsmouth, introduced originally by the Manchester men coming to work at Portsmouth Dockyard.

I dare say if your correspondent required a plant, I could send him one by paying the cost of carriage.

I am, sir, yours, &c.,

L. M. GREEN.

15, New-row, Landport, Hants, Aug. 31, 1855.

## PORTABLE LATRINES.

SIR,—I am glad to find that some movement is taking place in the matter of portable cesspools. Mr. Bird is fitting some up for the camp at Aldershott, a district which it would puzzle the advocates of water transport to accommodate, even with land ready at all times and seasons to receive the highly-diluted guano. I cannot find what it is proposed to do for dilution storage in those seasons when the land does not require it, but I can readily imagine that without increase of weight and bulk by water, storage may be practicable when deodorised.

Mr. Bird's arrangement is an oblong tank of wrought-iron, about four feet long, twelve inches wide, and eighteen inches deep, widening greatly below. It stands on four feet. There is a folding cover and a swinging handle, so arranged that the vessel can tilt when required. A pair of shafts, or a single shaft, or a pair of wheels and an axle, form a lever by which a man can lift the vessel without touching it, and carry it away. Mr. Bird proposes another arrangement for applying disinfecting powder or fluid, by a handle similar to the ordinary closets.

If this be good for Aldershott, it is good also for other districts where water is scarce, and also when it is desirable to preserve a river from pollution. This is precisely the kind of arrangement that it would be desirable for an agricultural company to take up, and I shall be glad to hear that it has been done.

Our French allies are more precise than ourselves. Their Exhibition has given rise to a kind of vessel called a separator, in which the fluids and solids being kept apart, much poisonous chemical action is prevented, and the bulk of the solids is very materially reduced. This arrangement is well worth the attention of Mr. Bird in his further improvements at Aldershott.

I am, Sir, yours &c.,

W. BRIDGES ADAMS.

August 28, 1855.

## DECIMAL COINAGE.

August 8, 1855.

SIR,—I have read with much interest the various articles in your *Journal* on decimal coinage. I perceive that there are a great many claimants for the essentially same plans; yet there is one plan, which I think might be adopted with advantage, that has not yet been proposed, and as I find that you are preparing "A List of Authorities on the Decimal Coinage Question," I would feel obliged by your allowing me to bring my plan before the public in your pages.

When the Committee had made its report, I concluded that the pound unit had taken such hold, and had got such a start, that to oppose it was to oppose decimal coinage altogether, and in a small work which I wrote on the subject, under the name of "Aslits,"* I advocated the adoption of the pound unit. I now find that the pound has not received that favour I thought it had, and have no scruple, on that head, in now bringing forward another competitor.

* A Straight Line is the Shortest.

The unit I propose is one already as familiar to us "as household words." Considerable sums are daily paid in it, to barristers, doctors, authors, painters, sculptors, civil engineers, architects, surveyors, special jurors, witnesses, &c. These are all paid in guineas of 21s. each, which is the unit I propose. One, two, three, and four guineas a week, are much more common rates of pay amongst workmen and their foremen than one, two, three, or four pounds. The guinea contains 1,008 farthings; the pound 960: in one case only 8 more than the required number, in the other 40 less; in one case 4 per cent., in the other $\frac{4}{5}$,—the pound error being five times as great as the guinea error. In paying tolls below threepence in pound mils, the receiver loses four pounds in the hundred; in guinea mils he gains sixteen shillings. In one case the receiver sustains a serious loss, and the payer receives no perceptible gain; in the other the receiver has a small gain, and the payer a still less perceptible loss. The guinea and pound are reciprocally convertible with great ease. To turn guineas into pounds, divide by two, place the quotient one place to the right, and add.

EXAMPLE.

Guineas.—987654321
4938271605

Pounds.—1037037037·05

Pounds may be converted into guineas very easily after considering the following table—in many instances even at sight.

| £ | | G. | £ | | G. |
|---|---|---|---|---|---|
| 105 | = | 100 | 1155 | = | 1100 |
| 210 | = | 200 | 1260 | = | 1200 |
| 315 | = | 300 | 1365 | = | 1300 |
| 420 | = | 400 | 1470 | = | 1400 |
| 525 | = | 500 | 1575 | = | 1500 |
| 630 | = | 600 | 1680 | = | 1600 |
| 735 | = | 700 | 1785 | = | 1700 |
| 840 | = | 800 | 1890 | = | 1800 |
| 945 | = | 900 | 1995 | = | 1900 |
| 1050 | = | 1000 | 2100 | = | 2000 |

If we look at the numbers in the £ column, we shall find that, leaving out of account ciphers and their effect, the figures in the first part of each number are producible by multiplying the figures in the latter part by two. If we have numbers represented by *ab*, *abc*, *abcd*, where $c = 10\,d$, $b = 10\,c$, and $a = 10\,b$, *by position*, and not multiplied into each other as in algebra, then, if $2\,b = a$, *ab* pounds = to a guinea; for instance, 84 pounds = 80 guineas. If twice $bc = a$; *abc* pounds = a guinea; 525 pounds = 500 guineas. If twice $cd = ab$, then *abcd* pounds = *ab* guineas; 1,995 pounds = to 1,900 guineas. In these cases we have 2 × by 4 = 8, 2 × 25 = 5, 2 × 95 = 19. This may be made clear by the following:—

199517857358452531521 pounds equal
190017007008050030020 guineas.

The figures over the cyphers multiplied by 2 give the figures to the left, and whenever that is the case, these figures being turned into cyphers, give the sum in guineas. A simple process may be derived from the above, which I will not stay to give here.

If we change the value of our large unit, or coin of account, in time to come the question will be continually arising, when reading history, "What was a pound?" We should provide for the question being answered in a simple manner.

If the pound be exchanged, it should be for a unit larger and not smaller. If the United States had had a national debt of £800,000,000, or an expenditure of £90,000,000 per year, as we have now, they would never have adopted a dollar. If the magnitude of a unit should bear any proportion to that of the operations involved with it, then is the pound too small, for only in money matters do we require to speak of hundreds of millions,

if we except distances greater than that of the sun from the earth.

The farthing is rather too small, which accounts for its limited use, and as, wealth increases, it will go out of circulation altogether, even amongst the smallest dealers, with perhaps the exception of tolls for cattle, which are fixed by Act of Parliament. The guinea unit would act favourably in both these respects, if only to a limited extent.

Allow me to say a few words on the general subject. Whatever unit be adopted, the inconvenience will be trifling in comparison to the benefits to be expected from being relieved from our present barbarous system. Whatever unit be adopted, the highest and lowest coins of account should be coins of actual and convenient circulation. It is not necessary that the inconvenience of the change should be a minimum; we must look to the future. The inconvenience of a change makes, in my opinion, but a small part of the whole of what should be considered. We leave our children a debt of hundreds of millions to pay, and I do not see why we should not put ourselves a trifle out of our way to give them the best means of reckoning and dealing with that debt. Let us not be too selfish in the matter. If proper means be adopted to introduce the change, and meet the difficulties, I maintain that within one month after the change the guinea would be pronounced the best unit that could have been adopted.

It is the largest unit proposed; it would enable us to pay every debt within $\frac{8}{10}$ per cent.; it would enable us to keep the whole of our 5,000 tons of copper coin until entirely worn out; it would leave us only one meaning for the word pound; it would entail the inconvenience of the change on those most competent to meet it—the very reverse of the case of the pound unit.

I am, Sir, your humble and obedient servant,

J. SIMON HOLLAND.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette August* 31*st*, 1855.]

*Dated* 7*th July*, 1855.

1523. J. Gedge, 4, Wellington-street South—Photographic glasses. (A communication.)

*Dated* 10*th July*, 1855.

1537. F. Loret Vermeersch, Malines—Looms.

*Dated* 26*th July*, 1855.

1695. J. Beattie, 26, Hans place, Chelsea—Folding mattrass, hut, ambulance, &c.

*Dated* 2*nd August*, 1855.

1753. D. Airey and W. H. Lackabane, Paris—Rotary steam engines.

*Dated* 3*rd August*, 1855.

1755. H. H. Watson, Bolton le-Moors—Coke.
1764. C. Ritchie, New Palace yard, and G. Ritchie, Milbank-street—Cork and other materials for stuffing.

*Dated* 4*th August*, 1855.

1769. H. L. R. Perrot, Chaux de Fonds, Switzerland—Escapement for chronometers.
1771. E. Whiteman, Riverhead, Sevenoaks—Waterproof coats, boots, capes, &c.
1773. E. Hall, Dartford—Gunpowder.

*Dated* 6*th August*, 1855.

1775. J. Gedge, 4, Wellington-street South—Motive power. (A communication.)
1777. J. Avery, 32, Essex-street, Strand—Windlasses. (A communication.)
1779. F. A. Wilson, Islington—Portable cooking apparatus.
1781. H. A. Pradel, Paris—Twisting textile fabrics. (A communication.)

*Dated* 7*th August*, 1855.

1783. J. Hamnett, Broadbottom, Chester—Shuttle tongues.
1785. S. C. Lister, Bradford—Hackling and combing machinery.
1787. J. H. Johnson, 47, Lincoln's-inn-fields—Indiarubber. (A communication.)
1789. W. J. Murphy, Cork—Motive power.

*Dated* 8*th August*, 1855.

1791. W. Hopkinson, Huddersfield—Steam-engine boilers, furnaces, &c.
1793. W. Baron, J. Lang, and H. Liversage, Blackburn—Winding, sizing, and dressing yarns.
1795. J. C. Haddan, Cannon-row—Rifled and other cannon.
1797. P. A. Devy, 10, Old Jewry-chambers—Hair fabrics. (A communication.)

*Dated* 9*th August*, 1855.

1799. J. Sidebottom, Broadbottom, Chester—Shuttles and skewers for shuttles.
1801. E. Cooke, Balsall-heath, near Birmingham—Moulds for casting metallic furniture.
1805. G. H. Bachoffner, Upper Montague-street—Advertising.
1807. W. B. Adams, 1, Adam-street, Adelphi—Locomotive engines.

*Dated* 15*th August*, 1855.

1854. F. May, Tooley-street—Instantaneous light. (A communication.)

INVENTION WITH COMPLETE SPECIFICATIONS FILED.

1902. W. Pitt and E. T. Davies, Birmingham—Cornice poles and picture rods, and in rings and chains to be used in connection therewith.—22nd August, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed August* 28*th*, 1855.

831. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in the production of a felted tissue applicable to replacing leather in the manufacture of cards.
1036. Robert Kanzow Bowley, Charing-cross—Improvements in boots and shoes and other coverings for the human foot.
1222. Richard Coleman, Chelmsford—Improvements in the construction of land rollers, and in implements for ploughing and breaking up or scarifying the soil.
1274. George Green, Mile-end-road—Improvements in sawing machinery.
1339. Samuel Coulson, Sheffield—Improvement in the preparation of sulphate of baryta, and in the manufacture of glass when sulphate of baryta is used.
1374. James Webster, Birmingham—Improved balance.

*Sealed August* 31*st*, 1855.

465. John Johnson, Bow—Improvements in temporary rudders.
469. John Woodley and Henry Herbert Swinford, Limehouse—Improvements in apparatus for indicating and giving alarm in cases of fire.
482. John Gledhill, Congleton, and Robert Gledhill, Halifax—Improvements in the preparation of silk, flax, and other fibrous substances, and in the machinery or apparatus employed therein, part of which is applicable to the preparing of wool for combing.
502. John Kennedy, Liverpool—Improvements in the manufacture of boots and shoes.
516. George Hazaldine, Lant-street, Southwark—Improvements in wheel carriages, and in the wheels thereof.
574. Edmund Johnson Mitchell, Bradford—An improvement in rollers employed in the washing of wool and linen, in the squeezing of sized cotton warps, and other like purposes.
1442. Frederick William Mowbray, Shipley, near Leeds—Improvements in looms for weaving.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY IS PAID.

1852.

181. William Edward Newton, 66, Chancery-lane—Improvements in governors or regulators for regulating the pressure of gas, as it passes from the main or other pipes to the burners.
238. William Gilbert Elliott, Blisworth—Improvements in the manufacture of bricks, pipes, tiles, and other articles capable of being moulded.
269. William Vaughan Morgan, Jewin-crescent—Improvements in the preparation of oils for the purposes of illumination and lubricating machinery.

*Sealed* 4*th September*, 1855.

483. Lewis James Paine, Camberwell, and John Ryan, Hatcham—Improved portable utensils, such as buckets, canteens, baths, and other similar waterproof articles for containing liquids, also applicable for portable life boats, buoys, or land marks, and other compressible articles.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3747 | August 23. | A Reel ........................ | Edmund Israel................ | Milk-street, Cheapside. |
| 3748 | August 31. | A Plough ........................ | John Eddy ........................ | Kenford, near Exeter. |
| 3749 | September 3. | Powder Envelope ........................ | Goodall and Son, and...... Mould and Tod ............ | Camden Town. |
| 3750 | ,, | Tilbury Glove ........................ | Dent, Allcroft, and Co....... | Wood-street, City. |
| 3751 | ,, | The Expanding Envelope.................... | Ths. and Godfrey Binns, jun. | Deighton, near Huddersfield. |

Journal of the Society of Arts.

*FRIDAY, SEPTEMBER 14, 1855.*

## MANUFACTURING PROGRESS IN GREAT BRITAIN.

By Lady Bentham.

The paucity of data relative to the manufacturing progress of Great Britain emboldens me to venture to lay before the Society of Arts a trifling contribution towards supplying the deficiency. This attempt commences in the year 1791, and continues to that of 1813, and although the information be very limited, yet, as it relates to many particulars important to the manufacturing prosperity of the country, as also to the well-being of operatives, it may be hoped that the facts stated will not be devoid of interest; they are taken from official documents, and from notes made at the times they relate to.* As the measures introduced by Brigadier-General Sir Samuel Bentham originated in himself, it may not be deemed irrelevant to premise that he having a decided predilection for naval concerns, was taken from Westminster school at the age of 14, to be apprenticed to a master shipwright in a royal dockyard, afterwards studied in all of the several royal arsenals, and on board of Keppel's fleet, travelled for further information in Europe and Asia, and, soon after his return home in 1791, was prevailed upon by Earl Spencer to re-engage himself in the civil service of the navy.

Sir Samuel Bentham has thus officially recorded, that in the year 1791:—"Steam engines were extensively employed for giving motion to pumps, for raising water from mines, to machinery for working cotton, to mills for rolling, and for some other works in metal, but in regard to the working in wood, steam engines had not been applied to this purpose, as no machinery or engines other than turning lathes, so far as I learnt, had as yet been introduced for the working this material, excepting that some circular and reciprocating saws and boring tools had been applied to the purpose of block-making." This induced him to complete some inventions that he had commenced in Russia, and led to his patents of 1791 and 1793,† and to his construction of several machines of full size for working wood, ivory, stone, &c. These machines, while at actual work, were inspected by several of his Majesty's ministers, and were noticed in the House of Commons, where Mr. Secretary Dundas (afterwards Lord Viscount Melville) in particular bestowed great encomiums on them. The specifications of those patents include most of the operations and means of performing them which have since been introduced in the manufactories of the materials specified.

The Naval Administration, having perceived the savings to be derived from the use of such machinery, had by degrees sanctioned the introduction in the dockyards of several of the various machines from the General's private residence in Queen-square-place.

When, in the year 1802, their Lordships had in view the establishment of an improved ropery in the royal dockyards, as also machinery for working metals, Sir Samuel, feeling satisfied that manufacturing establishments could only be carried on with profit by the introduction of the same kind of management as was essential to the prosperity of such concerns in private hands, verbally submitted his ideas to the Earl of St. Vincent, then First Lord of the Admiralty, and stated the advantages derivable from inquiries on the spot as to the management of private manufacturing concerns. His lordship, persuaded that observations and investigations of this nature could best be accomplished by the individual inquiries of the Inspector-General, informed him that on making an official proposal to the Secretary of the Admiralty, permission would be given him (the Inspector General) to make a journey to the north of England; accordingly, on the 1st January, 1803, he proposed to proceed to Sunderland, to examine certain manufactories for making cordage. This proposal was sanctioned the same day.

Though the journey was thus ostensibly confined to cordage and to ironworks, the Inspector-General was known to have it in contemplation, and with the concurrence of the First Lord, to inquire into many subjects of manufacturing interest. Amongst the most important of these, the following may be enumerated:—The mode of management in factories; the manner of keeping accounts; the rate of pay of operatives; the number of hours they may be employed without injury to health and longevity; the age at which children can be useful in a manufactory; the degree of heat and mode of ventilation most conducive to health in workrooms; the effect of night-work in a sanitary point of view, and in that of personal comfort and happiness of the operative; the effect of furnishing operatives with certain commodities by their employer.

The Inspector-General had the advantage of numbering amongst his friends the Messrs. Strutt, of Derby, and as he was well acquainted with their enlightened views, with the sound principles on which their prosperous manufactories were conducted, of the accuracy with which their accounts were kept, and of their extensive acquaintance, he determined first to visit Derby, and as he had fixed upon Mr. Brunel as his agent to carry out his (the Inspector-General's) projected improved management in dockyard manufactories, that gentleman was taken with him as far as Derby, there introduced to the Messrs. Strutt, who permitted him to acquaint himself with the details of their management, and he had during the journey been instructed in the particulars Bentham was desirous of introducing at Portsmouth. At Derby the General was joined by the mechanist in his office.

The firm of the Strutts, of Derby, afforded a striking example of the advantages derivable from *individual responsibility*, a principle which the Inspector-General was so desirous of introducing in the civil branch of the Naval Department. There were three Strutts, brothers; one of them, Joseph, had the charge of the commercial and mercantile branches of business; Mr. George Strutt undertook the care of the manufacturing concerns at Belper; William Strutt was the engineer, inventor, contriver of all improvements in management, no less than of machinery and the structure to contain it. We were the guests of Mr. William Strutt, and thus Bentham was enabled to profit of every moment that he passed during his two visits to Derby.

The mode of management of the Messrs. Strutt was, as above said, that of individual responsibility; so in all the private manufactories subsequently visited, it was found that the masters of them stood alone, for where a partnership existed, it was one partner only that managed the concern, the others being what is termed *sleeping* partners. The nearest approximation to *joint* management was at the Messrs. Grimshaw's ropery, at Bishops Wearmouth, near Sunderland,—in that instance brothers were engaged in the business of the firm, but, in point of fact, the elder brother was sole manager, the other acting under his direction.

The accounts of work-people at the manufactories at Belper were kept according to prescribed simple forms; the amount of wages was made out weekly, and the particulars of them written on a pay-ticket, to be put into the hands of each operative a day before payment. This regulation was introduced for the purpose of enabling each operative to look over the pay-ticket leisurely; if he found or suspected errors in it, time was thus afforded for correction or explanation; in all cases explanation was

* Having been permitted to accompany my husband on his tour in 1803, the duty of taking notes was confided to me.

† Statement of Services, p. 131. Repertory, vols. 5 and 10.

readily afforded the evening before that of payment, thus delays and alteration at the pay-table were avoided. The accuracy of these pay-notes was, however, rarely even doubted, although they included deductions for lost time, and the cost of coals and milk supplied, and in many cases rent.

The rate of pay of operatives was, of course, widely different in the various factories visited. In one factory, employing about 3,000 operatives, most of them were paid according to the work they had done. In the potteries, not any one was suffered to receive higher remuneration (even for skilled services, pattern-designers included) than two guineas a week, for it had been found that when more was paid, the surplus sum led only to dissipation. At Warrington the chief manufacture was sail-cloth for the navy, and operatives were paid by the piece for weaving; their great earnings in the course of two, three, or four days in the week were found to have a bad result to both masters and men, for the weavers, instead of working the whole week, resorted to the public-house as soon as they had earned enough to pay their score, looms were in consequence left useless for half or more of the week; the master weaver was thereby obliged to sink an unnecessary capital in looms; an extra shilling was in consequence offered for each piece beyond a given number the weaver should weave in a week—a notice of this promise was affixed to each loom in one of the greatest factories. The general result of inquiry on the head of pay was that moderate earnings most conduced to the well-being of the operative; that piece-work enabled men of extraordinary skill or industry to earn the compensation his deserts entitled him to. In some factories apprentices were competent to the greater part of the work, as, for instance, at Mr. Bage's flax mills, at Shrewsbury, and which afforded an example of the advantages of good treatment of them. His apprentices were girls, about and above 14 years old, and the management of them was remarkable. During working hours they of course were under the direction of the overlookers of the factory, at other times of that of a mistress. These girls, without exception, exhibited the appearance of robust health, even exceeding that of any description of operatives seen in the course of this tour. Their business was spreading out flax upon a table; they had just time to do this in a quick walk before the machinery carried away the flax, and on returning to operate on a fresh quantity, they had almost to run, thus traversing many miles during every day; yet they were substantially and abundantly fed at the low sum of 6d. per day on the average, provisions being then at war prices. The Inspector-General could not credit this assertion, the account books were, therefore, produced, and on a careful examination of them he found the average not to exceed that sum. In the evening, these girls had schooling and clerical instruction; they were well lodged, clean in person and dress. Some parish girls at day work in the same factory exhibited a melancholy contrast to the apprentices, the parish fed and clothed children being squalid in countenance and general appearance, dirty and slatternly in dress.

The number of hours during which operatives may work without detriment to health or longevity was anxiously inquired into. The Inspector-General's investigations convinced him that for long continuance and for the average of operatives, whether men or women, 10 hours of actual work in the day is as much as is desirable, though most work-people can for a short time well endure 12 hours of active labour, especially if of a healthy kind, and in the open air or well-ventilated places. It is true that some constitutions admit with impunity of even more hours' employment for a long continuance, and that on a spirt, and with mental excitement as a stimulus, a man can exert himself for a much longer time.

As to the age at which children can be usefully employed in manufactories, it appeared that in several factories children of eight to ten years old were as efficient for some purposes as at a greater age, but it also was evident that at this early age relays of such children would be desirable, for, besides schooling, a child of tender years needs variety of occupation. Much, however, seemed to depend on the *home* of the child; at Belper wholesome habitations were provided for the working classes, and many comforts were brought within the parents' means, so that the youngest children in the mills were healthy-looking. At Sheffield it was far otherwise, for most of the children exhibited symptoms of disease, consequent on poor diet and slothful habits.

The degree of heat most conducive to health in work rooms was specially inquired into. Mr. W. Strutt had bestowed much attention on the subject, and his opinion, confirmed by experience in his factories, was that under about 60° Fahr., the fingers of operatives were so benumbed as to injure their work in quantity and quality, whereas on much elevating the heat the operatives suffered in health. The justness of this opinion appeared to be confirmed on subsequent investigation. A remarkable instance of the detriment of much heated rooms to health, was witnessed in the great establishment of Mr. Lee, at Manchester. In this factory the heat was kept up to at least 70 degrees, as the most favourable for spinning cotton, especially of the finer descriptions of yarn, but the sallow complexions of the women and children denoted the insalubrity of the great heat of the work-rooms. As a general observation, it resulted that less mischief to operatives results from working in a temperature rather too low than where it is elevated much above 60° of Fahrenheit.

Mode of Ventilation.—At the period in question, full half a century ago, little attention was in general given to the due ventilation of manufactories, though in some few instances it was attended to, as, for example, in the cotton mills at Belper. Mr. W. Strutt had succeeded in accomplishing this desirable purpose, combined with an economical apparatus for warming his factories. He had found that air much heated became little fit for healthy respiration; his heating apparatus was therefore so contrived as to warm a very large quantity of air *moderately*, so as not to burn matters floating in the atmosphere. The air in this furnace was supplied from the exterior of the building, consequently was free from contamination; it was carried into the several rooms by a pipe of large diameter, but the quantity admitted to each room was determined by a self-acting regulator, the valve of which opened or closed according to the heat of the room. In addition to this means of supplying heated air, the windows admitted cold air when needful, by simply inclining inwards one or more panes of glass, in a manner that has since become frequent. A similar arrangement of windows had been some years previously introduced by Dr. G. Fordyce, in St. Thomas's Hospital, who also, by changing the direction of the louvre boards in Brodie's stove manufactory, had succeeded in preventing the recurrence of frequent chest disorders amongst the workmen.

The Effect of Night Work in Influencing the Health and Comfort of Operatives.—An important subject for investigation. It appeared in several factories where this was practised, that the health of the night set was materially injured, the comfort and happiness of families still more grievously destroyed. The night set of operatives seemed never to enjoy the same degree of robust health as those who only worked by day, but as no statistical account was then attempted of the longevity and freedom from disease of any description of persons under any circumstances, this opinion could be grounded on nothing better than appearances, nor does it seem that even the late census affords data respecting the effects of night work. That the comfort of families was destroyed there could be no doubt, seeing that, it might be, half the members of it were called to the factory at the time that the other moiety ceased their labours; hence meal times could not be the same for all, nor those of sleep and rest or social intercourse. On the other hand, it was evident that goods could be furnished at much lower cost,

supposing the buildings and machinery subservient to their production were available by night as well as day, thus spreading the interest of capital sunk over a double quantity of work performed by its means.

The Effects of Furnishing to Operatives certain Commodities by their Employer.—The truck system seemed no less injurious to the master than to the employed: too frequently the proprietors of works charged a profit upon the articles so sold; and even where no such concealed gains were obtained, they were uniformly suspected of being so. On the other hand, in manufacturing places there are some articles not to be procured of good quality by the labouring classes at a moderate price. At Belper the Messrs. Strutt supplied their work-people with certain articles at wholesale cost price, with such a small addition as would pay the expense of distribution. Coals and milk and lodging were these articles, but purchase of them was entirely optional with the operatives. Coals were furnished them at cost price; milk was not then procurable at Belper, therefore the Strutts kept cows solely to supply their people's wants; and as at first there was not sufficient accommodation at Belper for the three thousand operatives employed by the Strutts, those gentlemen erected suitable buildings, and let them to their own people at rents which barely compensated for the money sunk. It was a pleasurable sight, that long line of buildings, and broad paved terrace, extending its own length, and infant children basking in the sun upon it.

The observations made on this extensive tour were during its course communicated to the Earl of St. Vincent; the officially announced object of it resulted in a determination of the then Board of Admiralty to erect a manufactory of cordage and sail cloth at Woolwich, and the First and other Lords of the Admiralty became still more strongly convinced that the manufacturing business of the naval department could only be carried on with success and economy by assimilating its management to that of prosperous private manufactories. The Inspector-General was encouraged to introduce the working of machinery by common labourers instead of by skilled workmen, and to manage for the present in his own way, the infant establishments of the since called Wood Mills, Metal Mills, and the Millwright's Shop, all in Portsmouth Dockyard. He continued to do so till on the 10th February, 1805, he officially proposed "the institution of three new distinct establishments, namely, of Millwrights, Wood Mills for working in wood, and Metal Mills for working in metal" (Services, p. 141). He at the same time proposed that three new masters should be engaged, for these establishments respectively, also work-people of different descriptions, enclosing an estimate of numbers and rates of pay, saying that the three establishments were now brought to a state for putting them under the dockyard authorities. This proposal was referred to the Navy Board, who by their reply, 22nd March, 1805, considered the dockyard officers and themselves as totally unacquainted with the management of such concerns, and that the Comptroller and other members on the Committee then on visitation saw no other alternative than that of confiding the whole of these establishments to General Bentham. Their lordships thereupon placed under his sole management and control "the superintendance," to use the words of the Committee, "of works of so great magnitude, "consequently the responsibility attaching to the performance thereof:" and the dockyard officers were directed to "enter, pay, or discharge according to the Inspector-General's certificate, all persons requisite for the Wood Mills, Metal Mills, or for the erecting or repairs of machinery."

Their lordships, in confiding these powers to General Bentham, "did not deem it requisite to furnish him with any instructions, or to lay him under any injunctions or restrictions relating to the management of these establishments."

The General had stated officially, that, "in addition to my hopes of thus ensuring success in these particular establishments for which I had thus been made responsible, I had also in view from the first the far more important object of making them, as far as circumstances should admit, serve as *standards* and *examples*, exhibiting the efficiency of that kind of management which my investigations had shown to be that best suited to a naval arsenal generally."

It will be seen in the sequel of this communication, that these establishments actually have been the examples that have led to various improvements in conducting the business of such arsenals—of the facility with which such improvements may be introduced—of the economy derivable therefrom, and of the benefits resulting to the operatives themselves.

There were at that time many "customs" of trades—indeed, several still remain—which were fruitful sources of *strikes*, particularly those which limit an increased number of skilled hands to the employment of those only who had served a regular apprenticeship, and limiting the number of apprentices. Thus, amongst millwrights, the customs and privileges of the trade were exceedingly injurious; for instance, that of double pay for work done by night, thus afforded a strong inducement for deferring till night what might as well have been done in the course of the day. Millwrights were also so pertinacious of the privilege of not permitting any other description of work-people to assist them, that they would not even allow a labourer to turn a grindstone for them. But, as the General has said,* "it was only by *gradual* steps, by perseverance, and by a continued attention to all the particulars on which the success of my plan depended, that I could have any hope of doing away the prejudicial customs of millwrights."† By degrees, however, under his management, "none but really efficient workmen were retained at Portsmouth. Instead of coming to work or leaving it at their own pleasure, they attend a regular call; they receive no greater pay per hour for work done by night than by day," and none but workmen particularly skilful are paid at so high a rate of pay as millwrights receive indiscriminately from private masters, as the greater part of those employed at Portsmouth receive inferior rates of pay, according to their respective degrees of skill and dexterity. They there not only allow common labourers to assist them, but have also admitted amongst them, under the sanction of indentures of apprenticeship, good artificers of other analogous trades, some of them able to do the best millwright's work, and to keep pace with a good millwright, though they receive but the pay of carpenters and joiners.‡ Besides savings thus obtained in the millwright's shop, was the *profit* of master millwrights, which was then 1s. 4d. for each bare day on each man's time, amounting at Portsmouth to £4 13s. 4d. per diem, or at least £1,400 per annum.

But the most important advantage derived from this institution was the introduction of a knowledge of the principle of mechanics, for "no well-grounded judgment can be formed respecting the need there may be for improvement in the shape, in the mode of putting together, or in the fastening of any of the component parts of that very complicated machine a ship, without a perfect knowledge of the principles of mechanics; and though seamen as well as shipwrights, in consequence of the variety of mechanical operations which they have to perform, acquire all of them some idea of mechanical causes and effects more or less just, yet, as the study of mechanical science does not necessarily constitute any part of the education of any of the persons who are concerned in the business of a dockyard, it seems "highly advantageous that there should be such a person as a master millwright, were it only for the purpose of assisting the operative officers with his mechanical knowledge."

* See p. 144, of "Statement of Services."

† Ditto, p. 147.

‡ There were about 70 millwrights employed in the millwright's shop at Portsmouth. "Answer to Comptroller's Objections."

The general advantage derived from this establishment became soon apparent, both in respect to the diffusion of mechanical knowledge, in officers and men, as also in the introduction of particular machines; for example, in the smith's shop, a boring engine, by which more than half the expense is saved of boring holes, and the savings that resulted from making tools by the millwrights amounted to more than 30 per cent.*

But however great might have been savings of this nature, they have been far exceeded by those resulting from the mechanical knowledge that has been diffused by this institution of millwrights, since it has led to the appointment of a civil engineer at each of the principal dockyards, a consequent improvement in ships of war themselves, and of all the accommodations subservient to their construction, outfit, and provision of stores.

In regard to the wood mills, they, in fact, originated as early as the year 1795, when the First Lord and other Lords of the Admiralty, on visiting General Bentham's machinery,† perceived the economy and various other advantages that would result from its introduction in naval establishments. Their lordships, early in that year, sanctioned verbally the introduction of a part of it at Redbridge, for the construction of experimental vessels; by degrees machines were taken from the General's residence to the dockyards at Portsmouth and Plymouth, where they were employed for various purposes as early as 1797. They were seen at work by the First and other Lords of the Admiralty during their visitation to those dockyards in the summer of 1802, and were honoured by their lordships' approbation, as recorded in their "Minutes of Proceedings," page 45, but, to use Sir Samuel's words,‡ "the savings effected by it at that time were little, if any. No one had the requisite means or motives to make the most advantageous use of it, the wood working business of the dockyard being divided under different masters, and in a great number of distinct shops." By the year 1802, the quantity of that machinery already at Portsmouth and Plymouth was considerable, and justified the sending to those yards the Mr. Burr who had been trained by Sir Samuel in the use of his machinery. Under Burr's immediate direction some day labourers were trained to the use of these machines, and by means of some small extra allowances given to those labourers, they were encouraged to exert themselves, but still no systematic plan of management was effected until the direction of the new establishment was, as above-mentioned, confided to the Inspector-General, in April, 1805.

Sir Samuel then proceeded§ to make arrangements such as would admit of bringing together, under the same management, all works in wood that admitted of being advantageously executed by machinery, and of their being classed under a systematic arrangement of "*operations.*" As, for example, he has said, "in regard to the operation of sawing, the sub-division I looked to was, that all work of one description should be brought together, by which means large and strong saws would be kept to work rough timber, slighter ones for lighter work, as for slitting deals; saws, whether circular or reciprocating, for cutting to fixed depths, or for rebating, tongueing and grooving, and cutting tenons; saws for cutting into lengths, as for block-shells, table-tops, legs, &c.; saws for cutting diagonally, as for cutting off the angles of wood already brought into lengths, as for block-shells, and so on in regard to other operations."

"In regard to working hands," the General says, that, "being fully impressed with the beneficial results that have been found to accrue from the division of labour into certain operations, I considered that, with a view to obtain from those employed the best work, and the greatest quantity of work, it was expedient to confine each individual, as far as possible, to some one particular operation;" and gives, in the way of example, the making of a box, in which there are no less than ten very different operations, each of them requiring a different tool.

But the General's views were much more extensive—he had witnessed the mischievous effects of apprenticeship as limiting the number of operatives available in any craft, as, for instance, in that of the shipwright—and had devised means by which their number might be increased;* in the wood mills, therefore, from the outset, he determined that no apprenticeship should be required. To facilitate this innovation, the establishment itself he designated the *Wood Mills*, and the work-people employed in it, *wood millers*. This establishment also exhibited the facility with which might be introduced most of the improvements that had been suggested by his tour in 1803, not confining himself to the one-sided view of advantage to the master, but at the same time to the justice and to the humanity due to the workman. Hence, "a fair day's work for a fair day's wage" was established in these mills. For the master's interest it was that a day's work should be for the same number of hours in winter as in summer; but for the workman's sake, that (unless except in cases of extraordinary emergency) the day's work should not exceed ten working hours—never more than twelve even in cases of emergency; for should their services for that time not suffice, *continuous* work at the mills was to be carried on by a *double set* of hands. This innovation was exemplified in the metal mills, and will be noticed in speaking of them. Then, as to the times of payment of the people, the then practice in all the dockyards was, the witholding pay for three months. This he considered to be unjustifiable; he knew it to be a source of great expense to the men, as they had to raise cash at exorbitant interest to supply immediate wants; also, in point of fact, it was costly to Government, in consequence of the clerks employed. It seemed to him expedient, on the part of Government, that a week's pay should be kept in arrear, however; though in regard to new comers the reserved sum might take place gradually.

Another great advantage to the operatives in the three establishments, was that of allowing them to work when convalescent, though not yet strong, that work being such as could be paid for by the piece. By piece-work Government could not be defrauded, as they always have been by keeping on infirm artificers at day pay. Little as the convalescent might earn, that little was added to his resources, and in point of morality, it proved an important boon; it kept the operative from the public-house, and sustained a habit of industry. It would seem that this arrangement is applicable to many private establishments. To the use of every machine in the wood mills, two wood-millers were equally instructed and habituated, hence, no machine was worse worked in the absence of a miller, nor on the occasional stoppage of a machine was any man thrown out of work, as every man had other employ.

Another great innovation in dockyard business was the introducing piece-work, though piece-work by the job, as it was called, had nominally been sanctioned and was practised in the dockyards, but in reality the earnings of operatives were confined to a certain sum per day. The dockyard officers were bound not to suffer a shipwright's earnings to exceed a certain amount per day, dockyard officers were consequently led to falsification in various and most mischievous shapes, especially as the prices fixed on by the Navy Board often far exceeded the value of the work done; for instance, the price of a middling repair to a 34-feet launch was more than for the building of a new boat of the same description. In some yards the shipwrights took advantage of this, and when they had completed work to the amount of the allowed day's pay, refused to strike another stroke. In other yards officers managed to conceal the prices allowed by their superiors.

* "Services." † Patented 1791 and 1793. ‡ Statement of Services, page 151. § Ditto, page 153.

* S. B., Secretary, Admiralty.

Not so in the three establishments, for in them, after care had been taken that an operative "shall have done sufficient work to make his pay for it by the piece amount to a fair day's work, whatever more work he did than that, by *extraordinary* dexterity, or *extraordinary* exertion, however contrary to dockyard usage, he is allowed to receive without limitation." Job work has been abolished, and the benefit to both master and man resulting from the adoption of the example afforded in Portsmouth Mills has been just now exemplified; for, there being need to forward the Baltic fleet with the utmost expedition, the Admiralty, as the most effectual means of attaining this end, gave orders that operatives should be allowed to work without stint, and that every man should be paid for the work he had really done. What has been the consequence? Evidently that this powerful fleet has been prepared for sea service in so short a time as to have far exceeded all former precedent, and to excite the wonder and the admiration of the nation.

As to the amount of savings obtained in the wood mills, those from the saw mills, introduced by Sir Samuel, amounted to several thousands per annum; they were proposed by him 21st December, 1797, as were saws, both reciprocating and circular; some of those in the wood mills were the *identical* machines that had been seen at work, in the year 1794, at his brother's residence; they have, from their first erection at Portsmouth, been in constant use from that time to the present day. Mr. Burr, in his evidence to arbitrators, instituted by the Act of the 52 Geo. III., deposed that nine-tenths of the usual expense was saved by Sir Samuel's machinery for rebating, and the quantity of work done by his machines has always been immense. So early as the year 1812, his saws were doing between nine and ten thousand feet of work per week, including four and five inch plank. The savings of work done by other machinery of Sir Samuel's invention there are now no means of knowing, but as they were, besides rebating and sawing, for cutting dovetails and tenons, also for boring, for cutting mortices, for forming mouldings, &c., the savings cannot but have been immense: for instance, on the making the trifling article of deal tables for the fleet, the savings were ascertained to be upwards of £700 a year.

The credit and the pecuniary advantages derived from machinery in the wood mills, still continues to be ascribed to Sir Isambard Brunel, but a reference to Sir Samuel Bentham's patents of 1791 and 1793, would alone prove that nearly the whole of Brunel's is described in the specifications of those patents, which is confirmed by official documents; the way in which Sir Isambard was employed in the wood mills appears in Sir Samuel's official "Statement of Services.*

But however great may have been the savings in the wood mills, they are insignificant in comparison with the national prosperity that has resulted from their institution. The machinery therein and in the metal mills, visited, as it has been, by multitudes, has given a practical impulse to manufacturers of wood and metal, for when engines were seen actually performing operations that theretofore required great skill, energy was aroused, and the practicability of introducing similar machinery in private works became apparent. There are few operations in the working of wood and metals that had not been described in Bentham's patents of 1791 and 1793, yet it was not till they were seen in practice in the wood and metal mills that they excited general attention.

The difference in the duration of copper sheathing, and the costly mode of freeing old sheathing from dirt and scale, led the Inspector-General to call the attention of the Admiralty to these subjects before the end of the last century, but it was not till the 12th of April, 1800, that he proposed the manufacturing of copper sheathing in the Royal dockyards, and then, principally, with a view to scientific observation of the particulars on which the goodness of that article depends; but, as he says,* "proceeding in my investigations, it appears that the profits derived by the few manufacturers who monopolised it were so great that at my representations the proposed manufacture in Portsmouth dockyard was extended." At the first outset, at his suggestion, a skilled superintendent of works was engaged, as also several skilled operatives at high pay, but by April, 1805, the metal mills had been brought to a state in which they also could be placed under the regular management of the Navy Board. That Board having declined the task, as above mentioned, this establishment was also placed under the Inspector-General's sole management. The contractors for copper sheathing were powerful, and from the first endeavoured to avert the impending cessation of their gains, by representations in the House of Commons, to the Admiralty, as by other means, direct and indirect; but though the General had to combat this powerful opposition, consequent investigations led to a triumphant disclosure of the many advantages derivable from manufacturing such articles on Government account. After the most minute inquiry, it turned out that copper sheathing rolled in the metal mills was in every respect of superior quality to that obtained by contract, and that it was furnished from these mills at a reduction of 200 per cent. on the contract price, so that the savings that arose from sheathing alone amounted, in 1812, to £39,096 4s., and on all the several works executed in these mills to £40,954 12s. 8d.

Accounts exhibiting profits may be so drawn up as to exhibit more or less favourable results. Those which showed the above results were made as if the concern had been that of a private individual, undertaken with a view to profit. The amounts of expenditure and returns were carried on from half-year to half-year, from the first erection of the mills to the end of 1811, and as if from the outset a private proprietor had borrowed capital at the rate of 5 per cent. interest, both for the capital sunk in buildings and machinery, and for current expenses in carrying on the works, so that the debt was increased half-yearly by those current expenses, by the capital sunk as it increased, and by the interest on capital borrowed; a balance was struck at the end of each half-year, and carried forward to the next half-year, so that the debt was shown to have increased half-yearly by the interest and compound interest on money, as also by a further charge of 5 per cent. on buildings and machinery to cover wear and tear and the chance of disuse.

The amount of savings by manufacturing copper sheathing, together with the superiority of that rolled at the metal mills, occasioned all other branches of metal work to be subservient to sheathing, and that although the savings on copper bolts would have far exceeded those on sheathing. Some smaller articles were, however, produced at those mills, the savings on which amounted to above £1000 per annum. Enough of iron was recast to show the economy that would result from re-manufacturing it in a naval arsenal. Mixtures of metals here introduced fitted them for purposes heretofore made by hand of copper; as, for example, bolt nails, 8 or 10 inches long, were cast of a mixture so tough as to be driven into both oak and fir, without splitting the wood, though holes had not been bored for their reception; and a contractor for certain articles could not fulfil his engagement without recourse to the metal mills for instruction as to the improved mixture. The bolt nails in question still supersede the use of bolts, &c., in various parts of a ship, especially for laying decks and fastening plank on to the bottom and sides of a vessel.

From the above particulars it appears that those three establishments have served as models for the manufacturing business of a naval arsenal, and by which the business may be carried on with advantage to the operatives employed, and, at the same time, with great saving to the public. The operatives in the three establishments

* Page 126 and sequel to 126 of the published Statement.

* Statement of Services, p. 68.

worked whenever possible by the piece, and were paid the full amount of their earnings, however great. A remarkable instance of this occurred in the metal mills, in the week ending 22nd June, 1811. John Newey in that week worked 5¾ days in casting brass, for which his pay amounted to £6 4s. 8¾d., being £1 1s. 6d. per day. This great amount of course caused the circumstance to be particularly inquired into; the result of the investigation was, that Newey having been brought up in an iron foundry had acquired much dexterity in moulding, so that his castings of brass came out unusually clean, and he was also remarkably industrious and steady. The particulars obtained from the master of the metal mills not satisfying Sir Samuel, he went to Portsmouth himself, there found that the rates at which Newey's work was calculated were somewhat less than those allowed by Jellitoe, a great manufacturer at Gosport, and that they would not be considered otherwise than reasonable. Newey was paid the £6 4s. 8¾d. for his five and three-quarter days' work, and with the gratifying knowledge that Government were in fact gainers by this payment, since loss of metal on re-casting was saved by the uniform perfection of Newey's castings, as also the fuel that would have been expended for re-castings. By a note made at the time, it appears that Sir Samuel took measures for the instruction of men in the metal mills to multiply competitors, thereby to avert the need for paying so exorbitantly for similar work. He considered that although extraordinary skill well deserves compensation, yet that in most cases, in addition to the customs of apprenticeships, it is a deficiency of workmen of particular classes that enhances the price of labour. These conjoint causes he laboured to defeat during the whole of the seventeen years he was in the public service; even in the year 1795, when he was authorised to construct experimental vessels at Redbridge, finding that shipwrights could not be spared from the Royal Dockyards, and that others from the Thames, though out of employ, would not engage themselves for less than 12s. per day, he, in addition to lads, engaged good artificers in trades analogous to shipwrights, binding them as apprentices to himself, and engaging to pay them at the rates of remuneration to carpenters and joiners, from which handicrafts they were taken. The practicability of this measure as to shipwrights was subsequently exemplified in Portsmouth Dockyard* without any consequent inconvenience. The millwrights at Portsmouth struck on account of his introducing a similar measure in respect to them, and sent a deputation to his residence to state that by such means men of other callings would soon rival them, and throw them out of employ. Sir Samuel replied that he was far from wishing to discharge them, but being determined to carry his point, all of the present millwrights were at full liberty to quit the yard, and he would *do without them.* But the millwrights soon gave way and returned to work.†

Among the contrivances of the Inspector-General, that arrangement may be considered of first-rate importance which enabled factory work to be carried on by night without injury to the health of operatives, or to their comfort.‡ This was effected by the simple expedient of making the change of working hands at one or two o'clock in the day, instead of at 6 in the evening. He first induced the Messrs. Grimshaw to try this scheme at their patent ropery. It is true one set worked later at night than usual, the other set came earlier to work in the morning, but both sets had a sufficient portion of the night for sleep. In point of fact, Messrs. Grimshaw's people were delighted with the arrangement, for not only it enabled them to spend part of every day in other than factory work, as tending their own gardens, for instance, but also on alternate weeks to make long excursions, for as the sets were changed weekly, those who quitted work at one o'clock on the Saturday had not to resume it till the afternoon of Monday. The health and domestic comfort of the operatives was thus preserved. Incessant work is of importance in manufactories of every description where buildings and machinery are requisite, for it enables capital sunk upon them to double their products, and consequently diminishes by half the per centage necessarily charged to them in the way of interest upon capital so sunk. In the metal mills at Portsmouth incessant work was carried on by the Inspector-General in this manner, and the saving thereby produced, reckoning only that of interest on capital expended on buildings and machinery, amounted to no less than £5,000 per annum. Sir Samuel stated officially that the making a similar double use of the accommodations in naval arsenals generally, "would be found an expedient which might go far towards obviating the need of any additions to the dockyards." Truly a consideration of importance, seeing the millions that have been sunk in new works, for which the nation is paying interest now, and will continue to pay interest for ever.

By degrees most of the above-mentioned innovations have come to be introduced in the civil establishments of the naval department more or less generally; many of them, it is true, are practices borrowed from private concerns, but others of them, devised by him, are applicable to private manufacturing concerns, such as that of continuous work without injury to operatives; that of doing away apprenticeships and increasing the number of skilled workmen,—since by such means *strikes* and their mischievous effects could not fail to be greatly diminished, if not altogether avoided.

As to the means of keeping accounts in the three establishments under his direction at Portsmouth, he introduced a mode which furnished all useful particulars at little expense. There was no clerk in any of the three establishments; the accounts were kept by the master of each, assisted by a cabin keeper. In the wood-mills, for instance, the cabin-keeper was a lad at the pay of 1s. 2d. per day; the accounts were sent up weekly for Sir Samuel's inspection, and their accuracy was examined into by a clerk in his office. The time of this clerk expended for examination and calculation of the accounts of the wood-mills amounted to no more than £25 per annum. Yet the accounts in these three establishments were detailed as to essential particulars, even to the recording a single pound of iron consumed, and the work of a single hour of each man employed.

September, 1855.

* Services, p. 14.

† Letter to the Comptroller of the Navy.

‡ Services, p. 15.

## ADVANCEMENT OF SCIENCE.

At the meeting of the British Association for the Advancement of Science, about to be held at Glasgow, the Parliamentary Committee of that body will present their Report on the question—"Whether any measures could be adopted by the Government or Parliament that would improve the position of Science or its Cultivators in this Country."

The Committees, by this report, appear to have received answers to the above question from several eminent men of science, and they divide the subject under the three following heads:—

"1st. How can the knowledge of scientific truths be most conveniently and effectually extended?

"2nd. What inducements should be held out to students to acquire that knowledge; and, after the period of pupilage has expired, to extend it, and turn it to useful account?

"3rd. What arrangements can be made to give to the whole body of competent men of science a due influence over the determination of practical questions, dependent for their correct solution on an accurate knowledge of scientific principles?"

"For the purposes of this inquiry," under the first head the Committee report that, "the community may be divided into those who resort to the Universities for education, and those who do not. As to the former, we know of no step that would be more effectual than that which we have already recommended in our Report of last year, viz.,—that a certain amount of knowledge of physical science should be required from every candidate for a degree. The expediency of this course is strongly urged by Professor Phillips and Mr. Grove, in answer to our query, and also by distinguished witnesses, who gave evidence to the University Commissioners. Your President, in his late address at Liverpool, has stated it as an undeniable proposition, 'that those who administer the affairs of the country ought at least to know enough of science to appreciate its value, and to be acquainted with its wants and bearings on the interests of society.'

"Mr. Grove observes, 'that it is melancholy to see the number of Oxford graduates who do not know the elementary principles of a telescope, a barometer, or a steam engine. The contempt of anything manual or mechanical, which Bacon so strongly reproved, still prevails, to a large extent, among the upper classes.'

"It must be remembered, also, that there is scarcely any profession or vocation in life in which some amount of knowledge of physics may not be a desirable or even necessary acquisition. The legislator, statesman, and even legal tribunals, through ignorance of the principles of natural science, become the prey of charlatans; and vast sums of money may be squandered on impracticable, unnecessarily costly, or useless projects. In legal and medical, as well as in the naval and military services, a knowledge of scientific principles is most essential, and should be imparted to all; but this is too wide a field to enter upon here."

Now there can be no doubt, that if science be made an essential condition for obtaining a degree, it will be taught more extensively at schools, and at the University itself.

While the Committee recommend "that physical science should be required from all candidates for a degree," they "admit that a discretion should be left to the University authorities as to the extent to which this desirable change shall be at first carried ito effect, in full confidence that studies so attractive and useful will eventually obtain from all candidates for University degrees that share of attention to which they are so justly entitled."

As to that portion of the population who do not resort to universities for instruction, it is to be hoped that University Reform will diminish the number of this now very numerous class. In the opinion of the Committee, the best mode of imparting to them instruction in science seems to be that suggested by Mr. Grove and others in their replies to the Circular; that is, "that professors, paid, either wholly or in part, by the State, should be appointed to deliver gratuitous, or very cheap lectures, illustrated by philosophical apparatus, to institutions in London and at the principal provincial towns, whose rules of admission and management should have been duly approved; and, when the system has been well organized, it might even be still further extended."

"Such lectures would be successful only in proportion as they were followed by examinations and rewards to diligent hearers, who might thus be induced to extend their studies, and assist in the diffusion of sound knowledge."

On this subject, Professor Phillips, whose skill and experience in imparting oral instruction are so well known and appreciated, has forwarded to the Committee the following remarks. He observes, "that success in teaching depends not merely, nor even mainly, on the ability of the teacher; it is much more the effect of his standing *in the right relation to his audience.* For conversational, *i.e.* tutorial teaching, *one* class of mind, for public teaching of large audiences, *another* is required. Again, a teacher, whether by conversation or lecture, must *lead by short strings*. You cannot explain the precession of equinoxes to a man who does not know what the rotation of the earth means. ........... University men should be employed for university work; local men for local work. No man can take away from others the ignorance which he has never felt, or sympathised with."

The professor then proceeds to urge the employment as teachers of persons in the same grade of life as those to be taught.

Sir Charles Lyell contrasts the state of Germany with that of this country in reference to the teaching of physical science. He says, "that in the former country, not only in cities were there are Universities, but almost everywhere, in places where there exists a school of considerable size for boys under the usual university age, there is at least one teacher to be found whose business it is specially to give instruction in natural philosophy and history, and who has charge of a collection of natural objects. Frequently these teachers are so much devoted to some one of the branches in which they give instruction, as to be authors of original papers in scientific periodicals. So far is this from being the case in England, that I have visited large cities where three are richly endowed ecclesiastical establishments, where I have in vain inquired for a single individual who is pursuing any one branch of physical science or natural history. Hence it happens that if the townspeople, assisted by some of the gentry and clergy of the neighbourhood, establish a museum, they cannot obtain any scientific aid towards its arrangement and superintendence."

Sir Charles suggests that laymen should be almost invariably selected to fill those professorships which relate to the departments of science represented in the Association. He suggests, also, that if provincial lectureships should be established, five or six towns should be first selected, which have exhibited their taste for scientific knowledge by the foundation of museums and the appointment of curators, such as York and Bristol. The Government might enter into an arrangement with the latter to double their salaries, so as to secure to them a continuation of the local patronage already afforded them, and prevent the new grant from becoming merely a substitute for it.

Mr. William Tite, M.P., in his reply, observes:—"The practical course to be adopted, and which has, I believe to some extent, been carried out by private efforts, or the tardy intervention of the State, seems to me to consist, for instance, in the formation of schools of mining in such places as Cornwall, &c.; of schools of arts and sciences in such places as Manchester, &c.; of schools of navigation, in Liverpool, &c.; of agriculture, in York, &c. Perhaps in all it might be found advisable to found thirty schools or colleges of this description, with (it may be) on the average six professors in each. I would propose that these professors should only be appointed after a severe examination before a competent Board, the Board *not* named by the Government, but by the Councils of the Universities, and of the different recognised and chartered scientific institutions. They should be paid by a small fixed salary from the State, but principally by the fees from students, the latter being regulated by the examining Board, or by any municipal council which would undertake to defray the fixed charge, or the cost of the buildings and apparatus necessary. The united body of the professors should be entitled to confer honorary degrees, which should in no case convey any description of exclusive priviledge. .........

"An annual vote of between £18,000 and £27,000 would suffice to carry out this system,—surely a very small sum to be devoted by a country like England, to the practical scientific education of the people."

"The only measures," continues Mr. Tite, "I should at present wish to see adopted to connect science with public affairs, would be by attaching eminent men to the various Government Boards."

Sir Charles Lemon, whose experience in these matters is well known, decidedly objects to any plan under which *itinerant* lecturers should be employed.

The Committee consider that the scientific character of the nation suffers from this cause, that our English system offers so little inducement to mathematicians and physicists to pursue their researches. Young men of twenty-one arrive at a marvellous state of proficiency for their age and then entirely abandon the exact sciences for various professions; a foundation is laid upon which a superstructure worthy of the countrymen of Newton might well be reared, and then the work is abandoned; the student must earn his subsistence, and he cannot earn it by geometrical or physical researches."

The Committee are of opinion that much might be done by the Committee of Privy Council and the Department of Science at Marlborough House, under the direction of the Board of Trade, towards diffusing a knowledge of physical science among the pupils of primary and secondary schools.

They are also of opinion, "that means should be adopted for encouraging the foundation of Museums and Public Libraries, accessible to all, in our principal towns; and by degrees all imposts should be abolished which enhance the cost to the public of scientific publications. Donations should also be made to public libraries and educational establishments, of works published at the expense of the nation; such, *e.g.*, as the Geological and Ordnance Surveys."

On the second point, the Committee feel that the measures above described will not alone be sufficient to effect the object in view. Admitting the attractiveness of Natural Science (and it is impossible to over-estimate the pleasure which its study affords to the majority of minds), it cannot be expected that many men will pursue it to any extent, so long as fellowships and other university prizes continue to be almost exclusively bestowed upon their students in other departments of knowledge. In Oxford more particularly, to use Mr. Grove's words, "the ἦθος, which has been eulogised by some, is peculiarly antagonistic to the study of physical science. It is true that by the recent statutes physics are recognised, but they are not made compulsory or necessary............ From what I saw when resident in Oxford, the *genius loci* is so far removed from such studies, that, unless they are made compulsory, or tempting prizes are held out, the minds of young men will not, for an indefinitely long period, be directed into that channel, and thus, though the examination papers will look very well to the public, science will form no integral part of a university education.

Lord Rosse, again, in his last address to the Royal Society, has added his testimony to that of the many eminent men who have deplored in common the neglect of these studies at Oxford. "A man," says he, "having taken a first class *in literis humanioribus*, may be ignorant of physics in the most elementary form, and be incapable of comprehending the first principles of machinery and manufactures, or of forming a just and enlarged conception of the resources of this great country."

And lastly, the Chancellor of Oxford himself has lately advocated the extension of these studies in an eloquent appeal addressed to the University authorities on the occasion of founding the new museum.

That important and instructive public document, the Report of the Oxford University Commissioners, shows how little the rewards now held out to students in mathematics at that university deserve to be denominated "*tempting;*" they are in truth utterly insufficient; and unless the changes about to be introduced, under the auspices of the Parliamentary Commissioners, shall remedy this defect, the Committee fear that the anticipations above expressed by Mr. Grove will only be too well realized.

They are "convinced that the well-being of the nation would be greatly promoted by an extension of scientific knowledge among all classes, and that more encouragement in the shape of reward for successful exertion must be provided before that desirable end can be accomplished."

More numerous prizes ought to be provided at the universities; and other rewards and inducements, both to study and to the prosecution of scientific research, should be held out by the State.

The Committee advert to the inadequate remuneration of Professors, and quote the following suggestion of Sir John Herschel:—"As one of the most directly beneficial steps which can be taken by Government for the advancement of science itself, as well as for the general diffusion of its principles: viz., to increase the number, and materially improve the position, of the Professors of its several branches in all our Universities and public educational establishments; and to erect Local Professorships in the chief provincial towns, independent of any University; and more especially to make better, and indeed handsome, provision, in the way of salary, for the Professors of those more abstract branches, which cannot be rendered popular and attractive and therefore self-remunerating in the way of lectures."

The Committee regret the unsatisfactory manner in which pensions have hitherto been distributed, and quote the views of the late Professor Forbes as follows:—"It might be considered, whether it would not be desirable to found a number of scientific pensions, to be assigned, not for *relief*, but for *reward* of good service, like the good-service pensions in the army. They would often help to free the man of science from drudgery and potwork, and give him the leisure for original research. They would be better rewards than ribands or stars, or other labels, upon the coats of philosophers."

The expediency of resorting to orders, or decorations, or any extension of the present system of bestowing medals as a means of encouragement to the prosecution of physical researches, is doubted, except in certain special circumstances.

Professor Phillips is of opinion that medals should never be bestowed except for work done and published; and that they should never be given for mere mental proficiency; they should be rewards for public service, rather than proofs of *personal merit*.

Professor Faraday, after speaking of the distinctions, both national and foreign, which may even now be earned, writes, "I cannot say that I have not valued such distinctions; on the contrary, I esteem them very highly, but I do not think I have ever worked for, or sought after them."

The late Professor Moll, of Berlin, in his excellent pamphlet on the State of Science in England, has some remarks on the distribution of orders and medals abroad, which are not calculated to enhance the estimation in which they may be held by any one in this country.

The *juxtaposition* of the principal scientific societies in some central locality in the metropolis is discussed as a question which has lately excited great interest among the cultivators of science.

Lord Rosse, in his address to the Royal Society in 1853, observes, "The interests of Science appear to me to be deeply involved in the question of providing a suitable building for the scientific societies..........If a man, naturally gifted, and well-educated, attends scientific meetings, he will feel himself constrained to work, and therefore it is so important for the advancement of knowledge, that able men should be induced to join and attend the different societies; but nothing I think would have greater attractions than a building in a convenient central situation, where the business of Science would be transacted, where there would be access to the best libraries, and where that kind of society most valued by scientific men would always be within reach."

The advantages of this juxtaposition are also shortly set forth in the memorial on this subject presented to Lord Aberdeen, and are considered so obvious that they

need not be re-stated at length. Mr. Grove, on this subject, observes, "It should be borne in mind that scientific men have but very limited means of acting on Government; they are politicians in a less degree than any class of her Majesty's subjects; they consist of men belonging to various classes of society, and whose ordinary occupations differ greatly. Most of the great measures of reform or progress which are effected in this country result from a strong pressure of public opinion, urged on by agitation; and as men of science are peculiarly unfitted for this process, Government might not unreasonably be asked to step out of its usual habits, and to lend science a helping hand."

Professor Forbes observes, "Science must have a local habitation, and be something more than a name, ere it can make a permanent impression on the somewhat material mind of John Bull. As a man without a home, or, if houseless, without a club, is a doubtful and suspicious personage in the opinion of English householders, so is science a questionable myth whilst unprovided with a visible habitation. A first step, then, towards securing a due and wholesome reverence for science in the minds of the masses, educated and uneducated, is the congregation of the more important Scientific Societies in a central and convenient public edifice, where they shall be lodged at the cost, and by the authority, of the State. The *prestige* thus accorded to the Societies would soon extend to their members."

The Astronomer Royal, on the other hand, conceives that the advantages of juxtaposition have been overrated; but admits that if the measure, recommended hereafter under the third head, be adopted, the propriety of such a Capitol of Science would be more evident.

Having, however, considered this question in all its bearings, the Committee cannot too strongly express their conviction, "that the juxtaposition of the principal scientific societies would confer a most important benefit on Science; and almost all concur in this opinion."

Of late years, considerable encouragement has been extended to practical Science, and this is praiseworthy, provided that abstract science receive its due measure of support; but the genius of our countrymen is so eminently practical, that there is great fear that the less showy branch may be comparatively neglected. Mr. Grove observes, that in that case, "not only will practical science itself suffer, but the country will lose its position in the scale of nations in all that most exalts them." It would be, in fact, to use a common phrase, a beginning at the wrong end.

The Committee conceive this is a subject on which much misconception prevails, and that the following statement, therefore, may not be deemed wholly uncalled for:—"It is not uncommon to hear, or even to read, remarks in which the practical application of scientific truths is lauded at the expense of Science itself, so that it might be inferred, that those from whom such observations proceed were completely ignorant—1st, of the extent to which the most abstract scientific investigations have often led to the most useful industrial applications; and 2ndly, of the many instances in which observations and experiments, seemingly trivial, and likely to lead to no useful result, have, sometimes after the lapse of years, and after having been submitted to a succession of master minds, been elaborated into discoveries of the greatest importance to the progress of civilization, and which do honour to human nature.

These objectors to pure Science have either forgotten, or never learnt, that, in the words of an eminent writer, "the modern art of navigation is an unforeseen emanation from the purely speculative, and apparently merely curious inquiry, by the mathematicians of Alexandria, into the properties of three curves formed by the intersection of a plane surface and a cone."

The steam-engine itself, so simple in its origin, and yet so fruitful of great results, derived its most important improvements from the abstract investigations, by Dr. Black and others, into the nature of heat;—though it required the genius of a Watt to make them available in practice.

Some curious properties of chemical substances, when acted on by light, were noted, and then arose the art of Photography, the applications of which both to Science and Art are in course of continual extension. Marvellous properties of light, called its "*polarization*," led to the invention of instruments by which submarine rocks may be discovered, to new modes of detecting the nature of chemical liquids, and to improvements in the art of refining beet-root sugar.

Observations of the magnetism of iron, and on the elasticity of steel and relative expansions of metals, were the origin of the compass and chronometer, without which navigation and commerce (and how many countless blessings follow in *their* train!) would now be in almost as rude a state as in the time of the ancients.

The examination of the properties of gases passing through narrow apertures, showed us how to shield the miner from destruction; and other chemical investigations, how to preserve the sheathing of ships from corrosion—an invention which, from unforeseen and remarkable causes, failed at first, but is now successful.

To say nothing of Astrology and Alchemy, the experiments on the leg of a dead frog were the primary source of the electric telegraph, electro-plating, the power of producing submarine explosions, and of blasting rocks with greater facility and safety, and the other invaluable applications of voltaic electricity to the arts.

The labours of our Geologists teach us how to avoid useless expenditure in searching for minerals where none can by possibility be discovered, and where to seek for materials for our buildings.

Those of the Botanist minister to our health; and the Meteorologist will, in addition to the other important applications of his science, soon be enlisted in the service of navigation. Nor is Science less necessary to excellence in the arts of war than in those of peace; the construction and use of arms, fortification, surveys, rapid locomotion, screw steamers, and so forth, all depend on it for their success. Nor is this all; the calamities and failures in war may often be traced to the inefficient means possessed by governments of distinguishing the really scientific man from the ignorant pretender."

Professor Mill, in his Political Economy, writes:—"No limit can be set to the importance, even in a purely productive and material point of view, of mere thought. The labour of the savant, or speculative thinker, is as much a part of production, in the very narrowest sense, as that of the inventor of a practical art; many such inventions having been the direct consequences of theoretic discoveries, and every extension of knowledge of the powers of nature being fruitful of applications to the purposes of outward life."

On this subject Professor Liebig observes, in a letter to Professor Faraday, dated February, 1845, and cited in Lyell's Travels in North America:—"What struck me most in England was the perception that only those works that have a practical tendency awake attention and command respect; while the purely scientific, which possess far greater merit, are almost unknown. And yet the latter are the proper and true source from which the others flow. Practice alone can never lead to the discovery of a truth or a principle. In Germany it is quite the contrary. Here, in the eyes of scientific men, no value, or at least but a trifling one, is placed on the practical results. The enrichment of Science is alone considered worthy of attention. I do not mean to say that this is better; for both nations the *golden medium* would certainly be a real good fortune."

Almost all who have replied to the Committee's circular, or favoured them with suggestions, are opposed to the establishment of Institutes or Academies; nor is there any wish expressed that men of science, as such, should be appointed to high political offices in the State. As assessors, however, or advisers to executive boards,

the services of scientific men would be highly valuable; and in foreign countries such services are believed to be much in request.

Promotions in the Church have been occasionally made avowedly on the ground of literary merit; but if such claims be admissible, it would seem that scientific acquirements should not be overlooked in an age in which scepticism has been nourished by mistaken views of physical phenomena.

The inadequacy of the remuneration of men of science filling public offices is remarked upon, and it is suggested that "not only ought the present scientific offices to be placed on a more eligible footing in respect of remuneration, but that there is need for the institution of others answering to that description, which do not now exist."

The Committee remark, "that the Government has already taken very important steps in the right direction, and has supplied very pressing wants by the establishment of the department of Practical Geology, and of the Marine Department of the Board of Trade, and its office for the discussion of nautical and meteorological data. Much yet remains to be done; but these and other acts, having a like tendency, such, in particular, as the £1,000 grant to the Royal Society before referred to, are an earnest that a disposition is not wanting "*to lend to science a helping hand.*"

The Committee point with pleasure to the fact that in regulating the studies of candidates for employment in India, Physical Science was not forgotten by the eminent men whose signatures are appended to the report thereon.

It appears to the Committee "that the question of the propriety of instituting public examinations, by which the degree of proficiency in knowledge of all candidates for public employment might be tested, is one of great interest, and that its right determination must exercise an important influence on the progress of education in any country."

Finally, under both the above general heads may be classed all measures for facilitating the circulation of scientific publications both at home and abroad—an object the importance of which it is difficult to over-estimate.

Under the third head the Committee report that late events have shown that a disposition is not wanting in Government to give additional encouragement to Science.

The committee observe that the Board of Visitors of the Greenwich Observatory has, in the proper discharge of its duties, been often compelled to recommend large outlays upon that establishment, and matters connected with astronomy; and it is believed there is no instance on record of the measures recommended being rejected, or even postponed, whatever might be the condition of public affairs, or whatever party might be in power. This the committee conceive to arise from the confidence reposed in the Astronomer-Royal and Board of Visitors, and instance the late Board of Longitude as another example of a like kind.

These considerations suggested the question, whether some Board could not be organised, somewhat after the model of these Boards, but with improvements, which should distribute Government grants, perform for the whole domain of Science the functions which two of the above-mentioned Boards still discharge for Navigation and Astronomy, and moreover act as a referee and arbitrator in matters connected with science brought under its cognizance by Government. At present, in Science, as in Art, Government has no responsible adviser, and the acceptance or rejection of any proposal of a scientific character, or of one for the proper determination of which some knowledge of science is required, depends upon the fiat of those who preside over the several public departments by virtue of qualifications, high it may be for the general purposes of the State, but wholly inadequate to the proper solution of the particular questions at issue.

Professor Forbes says, "I do not think anything like an Institute desirable, ......... but I think that some Board, having at once authority and knowledge, should be constituted for the regulation and disposition of Government grants for scientific purposes, such as the assistance and endowment of scientific expeditions, the publication of their results, &c.; matters at present disposed of by capricious, often extravagant, oftener parsimonious, and sometimes pernicious methods. An approximation towards a right course is already made in the case of the disposal of the £1,000 grant for assisting scientific researches. Now, I would work all Government grants for such purposes as the above-mentioned, by a modification of that scheme, viz., through an unsaleried committee, constituted much as the Recommendation Committee is at present, combined with an *endowed staff*, consisting of a salaried representative (always a man of distinguished eminence and authority in his line of research) of each of the following departments:—

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|---|---|---|
| Mathematics. | Mechanics. | Botany. |
| Astronomy. | Physiology. | Geology. |
| Physics. | Zoology. | Chemistry." |

Colonel Sabine considers that the working of the Board of Longitude, whilst Dr. Young was its secretary, affords a model which, with a few and slight modifications, might be extremely suitable for a Board, which should be constituted with a more extended scientific scope.

Admiral Smyth writes, "Now for Science a real boon would be the establishment of a proper Board of Longitude, organized on clear principles, and armed with power tantamount to its responsibility. This great step gained, the cultivators of science would necessarily advance. ......... A good Board of Longitude is meet for a maritime nation, and would, *de facto*, form its great synod of knowledge." Again, he writes, he does not mean a Board constituted as the former one so called, but "a useful institution, resembling the French Bureau des Longitudes, a Board managed by unequivocally qualified men, both in talent and vocation, with regular salaries, who are personally responsible for their public proceedings, whether regarding opinions, rewards, or publications. This Bureau is composed of Géomètres, Astronomes, Anciens Navigateurs, Géographes, Artistes, and Adjoints; and there is no doubt but that the model may be improved."

Sir Philip Egerton describes the evils which result to Science from the want of system in entertaining and deciding upon projects, and carrying out the determinations of successive Governments in reference to questions of science. He complains that applications have to be made sometimes to one department, sometimes to another; that Governments are prone to give ear not to propositions in relation solely to the acquisition and furtherance of pure Science, but to the economic application of scientific principles to the improvement of arts and manufactures; a most essential matter, indeed, and properly confided to the Board of Trade, but which ought not to be confounded with the more intellectual process of scientific research. Sir Philip thus proceeds: "The toil and labour of the latter are too apt to be left to the unaided exertions of the scientific drudge, and the Government steps in and reaps the benefit,—the osprey catches the fish, but the sea-eagle appropriates it. The remedy I would propose for this state of things is, the establishment of a Board of Science, to which all questions of a scientific nature might be referred by the Government for consideration. The constitution of this Board might be easily made such as to command the confidence both of the Government and the public; but it should be provided, that only a portion of the members should be dependent on the existence of the Ministry of the day. Certain funds might be placed yearly at the absolute disposition of the Board; but all recommendations for the application of large funds would of course require the sanction of the Government."

The Astronomer Royal considers a restriction of the functions of the Board desirable; he thinks that it should *initiate* proposals and *urge* them on the Government; but

he objects to its acting as a *general* referee and arbitrator in *all* matters connected with science.

There is an expression in the letter of Professor Forbes quoted by the Committee as describing, with great propriety, what ought to be the characteristics of the future Board; he says, "*it should have at once authority and knowledge*;" and after weighing all the above suggestions, and considering the constitution of other Boards established for carrying out nearly similar objects, the Committee think "that the new Board should be composed of a certain number of persons holding high official situations in the State, more or less connected with science and education; and others holding scientific offices under the Government; together with the most eminent men in every department of science. With respect to the official class, there can be no necessity that they should be as numerous as in the late Board of Longitude, of which about fourteen persons answering to that description were members. Lord Rosse, the Astronomer Royal, and Admiral Smyth, have expressed opinions unfavourable to the admission of great Officers of State as *ex-officio* members of the proposed Board. Admiral Smyth is even opposed to *ex-officio* members altogether, and would have all the members of the Board elected." In these views of the Admiral the Committee cannot concur, but the expediency of admitting the great officers at all admits of some doubt.

Whatever determination, however, may be adopted in reference to these matters, the Committee are anxious that a principle of stability and permanence should have place in constituting a body which is to exercise such important functions. A certain proportion of the members might perhaps hold their offices for life, as is now the case in the Board of Visitors at Greenwich; but some provision should be made for the retirement of a sufficient number, to ensure the ranks being recruited occasionally by the election of young and rising men in the various departments of science. It may not perhaps be advisable to endanger the success of an application to Government for the establishment of this Board, by adopting the suggestions of those who desire that salaries should be given to several of its members, as such.

It will be necessary that a secretary, with a salary, should be appointed to the Board, and that a place of meeting and deposit for papers should be assigned.

Professor Phillips suggests that the proceedings of the Board should be embodied in an annual report to Parliament, which should be widely circulated; a suggestion in which we entirely coincide.

It will probably be thought right that the functions of the Board should be rather strictly defined in the instrument which constitutes it.

If the working of the Board be satisfactory, and the confidence of Parliament and the public be really acquired, it is hardly taking too sanguine a view to anticipate,—1st, that there will be greater assistance and encouragement given than heretofore to science, and scientific researches and the reduction and publication of such researches, in cases where such aid is required; 2ndly, that the necessary funds will be more directly and easily obtained; and, 3rdly, that the influence and authority of such a body of distinguished men will ensure the adoption of all suggestions made or approved by them for the benefit of science, check improvident and reckless schemes, promote those that are deserving of encouragement, and generally give to science its due weight and importance in the councils of the nation.

It may be that the union in one Board, of men holding high executive offices in the State, and others who, however distinguished in their own departments of knowledge, have in the course of their pursuits acquired habits of abstraction, which are supposed by some to be unfavourable to the development of administrative capacity, will be attended with beneficial results to the working of the Institution in question, the members of which will learn by degrees to appreciate all that is valuable in the characteristics of each of the sections of which it will be composed.

In the opinion of the Committee, "the new Board ought not to consist of less than about thirty-five members; and, if it be objected that this number is too large for business, it must be borne in mind, that most of the work will be done by standing sub-committees for the various departments of science, organised somewhat after the model of the Sections in the British Association, reporting to the general body, who will revise their proceedings. The late Board of Longitude, though presiding over only one department of science, contained about twenty-seven members.

Lord Rosse is doubtful as to the expediency of constituting the new Board of Science, on the ground, principally, that the duties here assigned to it might equally well be performed by the Council of the Royal Society, enlarged for the purpose; and that the Society would be in fact so far superseded by this new body. In this view the Committee do not concur.

The Government again are never likely, as has been before fully explained, to extend as much of their confidence to any one Society, however eminent, as to the proposed Board.

In conclusion, the Committee have the gratification of discovering that none of the suggestions offered, or changes proposed, are of such a nature as to impose any serious difficulty on Government, Parliament, or the Universities, were they at once to concede all that is asked.

Such of the above suggestions as are deserving of the serious and earnest attention of Government, Parliament, and the Universities, and which we may term the desiderata, the Committee consider may be summed up in the following propositions:—

1st.—That reforms shall take place gradually in the system of any of our Universities which do not at present exact a certain proficiency in physical science as a condition preliminary to obtaining a degree.

2ndly.—That the number of Professors of Physical Science at the Universities shall be increased, where necessary; but that, at all events, by a re-distribution of subjects, or other arrangements, provision should be made for effectually teaching all the various branches of physical science.

3rdly.—That Professors and Local Teachers shall be appointed to give lectures on Science in the chief provincial towns, for whose use philosophical apparatus shall be provided; and that arrangements shall be made for testing by examination the proficiency of those who attend such lectures.

4thly.—That the formation of Museums and Public Libraries in such towns, open to all classes, shall be encouraged and assisted in like manner as aid is now given to instruction in the principles of art; and that all imposts shall by degrees be abolished that impede the diffusion of scientific knowledge; and such donations of national publications be made as above mentioned.

5thly.—That more encouragement shall be given, by fellowships, increased salaries to Professors, and other rewards, to the study of Physical Science.

6thly.—That an alteration shall be made in the present system of bestowing pensions; some annuities in the nature of good-service pensions be granted; and additional aid be given to the prosecution, reduction, and publication of scientific researches.

7thly.—That an appropriate building, in some central situation in London, shall be provided at the cost of the nation, in which the principal Scientific Societies may be located together.

8thly.—That scientific offices shall be placed more nearly on a level, in respect to salary, with such other civil appointments as are an object of ambition to highly-educated men; that the officers themselves shall be emancipated from all such interference as is calculated to obstruct the zealous performance of their duties; and that

new scientific offices shall be created in some cases in which they are required.

9thly —That facilities shall be given for transmitting and receiving scientific publications to and from our colonies and foreign parts.

10thly, and lastly.—That a Board of Science shall be constituted, composed partly of persons holding offices under the Crown, and partly of men of the highest eminence in science, which shall have the control and expenditure of the greater part, at least, of the public funds given for its advancement and encouragement, shall originate applications for pecuniary or other aid to science, and generally perform such functions as are above described, together with such others as Government or Parliament may think fit to impose upon it.

It will be observed, that the majority of the above desiderata may be described rather as suggestions on behalf of national education than as privileges to be conferred on science. Three of the propositions, however, the 6th, 7th, and 8th, involve the establishment of privileges and rewards not now enjoyed by those who make science either their profession or pursuit. Still it must be borne in mind that the encouragement thereby afforded to the cultivation of science, and not the boon to the individual, is the principal object in view.

The 10th proposition, the establishment of the Board, is not advocated as a means of increasing privileges and emoluments, but as the best mode of accomplishing an important national object.

Of the value of Science no one surely can doubt who has received any mental training worthy of the name of education; and, notwithstanding any seeming indifference to an object of such vital importance, we believe that a feeling does pervade the community at large, that our country's welfare, and even safety, depend upon its due encouragement and fostering; and this is evidenced by the readiness with which the House of Commons accedes to demands when made on its behalf. Owing, however, to the system which prevails in this country, of each successive Government striving to outvie its predecessors in popularity by the reduction of public burdens, there is a temptation sometimes to withhold grants which may swell the total outlay of departments in which reductions are contemplated. This it is more particularly which, in the opinion of the Committee, renders the creation of the new Board, or some analogous measure, necessary.

The Committee, in conclusion, state that, whatever may be the result of this appeal, or of any other measures which it may adopt in the discharge of its duty of watching over the interests of Science, it will never cease its endeavours to diffuse a sense of what is due to Science, and to those who make great personal sacrifices for the sake of a pursuit on which the happiness and welfare of mankind so materially depend.

July 14, 1855.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette September 7th*, 1855.]

*Dated 10th August*, 1855.

1809. A. Heaven, Longsight, Manchester—Machinery for embroidering fabrics.
1811. W. H. Lancaster, and J. Smith, Liverpool—Gas.
1813. J. Betteley, Liverpool—Ships' chain cables.
1815. E. Finch, Chepstow—Loading and unloading coal vessels.
1817. J. L. Stevens, Fish-street-hill—Steam boilers.
1819. P. Lagergren, Stockholm—Paddle wheels.
1821. E. and W. Ullmer, Fetter-lane—Cutting paper and millboards.

*Dated 11th August*, 1855.

1825. J. Gardner, Plaistow—Salt.
1827. W. Brown, 5, Catherine-street, Lambeth—Sheet metal casks and kegs.
1829. A. C. Morrison, 3, Acacia-place, St. John's-wood—Compound for feeding horses, &c.

*Dated 13th August*, 1855.

1831. L. Normandy, 67, Judd-street—Circular weaving machine. (A communication.)
1833. W. Hancock, Upper Chadwell-street—Casks, barrels, and linings of same.
1835. E. D. and G. Draper, Massachusetts, U.S.—Can for oiling machinery. (A communication.)
1837. T. Butler, Willenhall, Staffordshire—Locks.

*Dated 14th August*, 1855.

1839. T. Kempson, Birmingham—Steam engine and boiler.
1841. G. Sanders, Dublin, and R. E. Donovan, Castleknock, Dublin—Gas meters and steam boilers.
1843. M. Mellor, Hyde, Chester—Self-acting mules.
1845. J. C. Haddan, Cannon-row—Cannon.

*Dated 16th August*, 1855.

1856. J. A. Stocqueller, Regent-street, and W. J. B. Saunders, Southwark—Mechanical means for obtaining elevations.
1858. C. Joyner, Birmingham—Stopcock.
1860. F. Paget, Vienna—Penholder. (A communication.)
1862. J. Atherton and W. Boyes, Preston—Looms.
1864. W. and F. B. Fawcett, Kidderminster—Carpets.
1866. W. Maynes, Stockport—Self-acting temples.

*Dated 17th August*, 1855.

1868. I. J. Danduran, Paris—Driving apparatus.
1870. D. Brown, Smethwick, and J. Brown, Kingswinford—Bayonets.
1872. T. Edge, Great Peter-street, Westminster—Gas meters.

*Dated 18th August*, 1855.

1874. W. Sangster, 75, Cheapside—Umbrellas and parasols.
1878. F. Tavernier, Paris—Combing wool, &c.

*Dated 20th August*, 1855.

1880. A. Dubrulle, Lille (Nord), France—Safety lamps.
1882. F. Journeaux, Mount Shannon Mills, Dublin—Drying grain.
1884. W. Avery, Smethwick—Bands for transmitting power.
1886. P. Goutier, Paris—Treating linseed, poppy, and other oils, &c.

*Dated August 21st*, 1855.

1888. R. Longsdon, Queen street-place—Removing property into and out of strong rooms, &c.
1892. C. L. A. Meinig, Piccadilly, and F. X. Kukla, Raven-row, Mile-end—Ornamenting surfaces.
1894. L. Paige, Vermont, U.S.—Railway breaks.
1896. J. Wormald and G. Pollard, 2, Bridge-foot, Vauxhall—Ratchet braces.

*Dated August 22nd*, 1855.

1898. C. V. Bergh, Lacken, Belgium—Packing pistons.
1900. W. Spence, 50, Chancery-lane—Finishing cloth. (A communication.)

*Dated August 23rd*, 1855.

1904. T. E. Wyche, Camberwell—Propelling vessels.
1906. C. Clauss, Liverpool—Removing hairs from hides and skins.
1908. E. Parod, Paris—Steering vessels.
1910. W. Denton, Addingham, Yorkshire—Drawing wool, &c., off combs.
1912. W. Kidman, Poplar—Tillers or yokes.

*Dated August 24th*, 1855.

1914. F. S. Archer, Great Russell-street—Photography.
1916. H. Frooms, Manchester—Pianofortes.
1918. T. De la Rue, Bunhill-row—Printing inks.
1920. P. Effertz, Aix-la-Chapelle—Bricks, tiles, pipes, &c.

*Dated August 25th*, 1855.

1922. J. Avery, 32, Essex-street, Strand—Handles for augers, gimlets, &c. (A communication.)
1924. J. Avery, 32, Essex-street, Strand—Automatic attachments for gates and doors. (A communication.)
1926. W. Brown, Wandsworth—Paper bags.

INVENTION WITH COMPLETE SPECIFICATION FILED.

1969. J. and T. Hope, Rhode Island, U.S.—Machine for engraving the surface of a calico printer's roller, preparatory to its being etched.—31st August, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed August 31st*, 1855.

489. John Lewis, Elizabethtown, U.S.—Improvements in rigging and sparring vessels.
504. Joseph Cooper, Birmingham—Certain improvements in joiners' braces, and in the mode of forming or partially forming the various bits to be used with such or any other kind of brace.
519. John Taylor, Spring-grove, Isleworth—Improvement in packing and preserving eggs and other articles of food.
520. Henry Gilbert, Kensington—Improvements in hurdles.
552. John Gilbert, Boston-street, Hackney—Improved pump or pumping apparatus.
588. George Grignon, 13, Sutherland-square, Walworth—Improvements in the means of launching or detaching boats from ships' sides or davits, and in the apparatus and tackle to be used for that purpose, that the operation may be speedy, spontaneous, and safe.
630. Alfred Vincent Newton, 66, Chancery-lane—Improved machinery for forming moulds for casting.
636. Matthew Semple, Plymouth—Improvements in railway breaks.
646. William Young, Queen-street, Cheapside—Improvements in stoves or fire places.
689. George Hall Nicoll, Dundee, N.B.—Improvements in laundry stoves.
698. James Porritt, Stubbins Vale Mills, near Ramsbottom—Improvements in steam engines.
1016. Johnson Hands, Epsom—Improvements in boiler, and other furnaces and flues.
1081. John Dupre, Plymouth—Improvements in the construction of ovens.
1203. John Avery, 32, Essex-street, Strand—Improvements in apparatus for conveying heavy weights for bridge building and other purposes.

Journal of the Society of Arts.

*FRIDAY, SEPTEMBER* 21, 1855.

## FREE PUBLIC LIBRARIES AND MUSEUMS.

The following Act of Parliament, relating to the establishment of Public Libraries and Museums, was passed last Session of Parliament, and the attention of the Institutions and others is called to its provisions.

### CAP. LXX.

An Act for further promoting the Establishment of Free Public Libraries and Museums in Municipal Towns, and for extending it to Towns governed under Local Improvement Acts, and to Parishes. [30th July, 1855.]

Whereas it is expedient to amend and extend the Public Libraries Act, 1850: Be it therefore enacted by the Queen's most excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1. The Public Libraries Act, 1850, is hereby repealed; but such repeal shall not invalidate or affect anything already done in pursuance of the same Act, and all libraries and museums established under that Act or the Act thereby repealed shall be considered as having been established under this Act, and the Council of any Borough which may have adopted the said Act of one thousand eight hundred and fifty, or established a museum under the Act thereby repealed, shall have and may use and exercise all the benefits, privileges, and powers given by this Act; and all monies which have been borrowed by virtue of the said repealed Acts or either of them, and still remaining unpaid, and the interest thereof, shall be charged on the Borough rates, or a rate to be assessed and recovered in the like manner as a Borough rate to be made by virtue of this Act.

II. In citing this Act for any purposes whatever it shall be sufficient to use the expression, "The Public Libraries Act, 1855."

III. In the construction of this Act the following words and expressions shall, unless there be something in the subject or context repugnant to such construction, have the following meanings assigned to them respectively; that is to say, "parish" shall mean every place maintaining its own poor; "vestry" shall mean the inhabitants of the parish lawfully assembled in vestry, or for any of the purposes for which vestries are holden, except in those parishes in which there is a select vestry elected under the Act of the fifty-ninth year of King George the Third, chapter twelve, or under the Act of the first and second years of King William the Fourth, chapter sixty, or under the provisions of any Local Act of Parliament for the government of any parish by vestries, in which parishes it shall mean such select vestry, and shall also mean any body of persons, by whatever name distinguished, acting by virtue of any Act of Parliament, prescription, custom, or otherwise, as or instead of a vestry or select vestry; "ratepayers" shall mean all persons for the time being assessed to rates for the relief of the poor of the parish; "overseers of the poor" shall mean also any persons authorised and required to make and collect the rate for the relief of the poor of the parish, and acting instead of overseers of the poor; "Board" shall mean the Commissioners, trustees, or other body of persons, by whatever name distinguished, for the time being in office and acting in the execution of any improvement act, being an Act for draining, cleansing, paving, lighting, watching, or otherwise improving a place, or for any of those purposes; "improvement rates" shall mean the rates, tolls, rents, income, and other monies whatsoever which, under the provisions of any such improvement act, shall be applicable for the general purposes of such Act.

IV. The mayor of any municipal borough the population of which, according to the then last census thereof, shall exceed five thousand persons, shall, on the request of the town council, convene a public meeting of the burgesses of the borough, in order to determine whether this Act shall be adopted for the municipal borough, and ten days' notice at least of the time, place, and object of the meeting shall be given by affixing the same on or near the door of every church and chapel within the borough, and also by advertising the same in one or more of the newspapers published or circulated within the borough, seven days at least before the day appointed for the meeting; and if at such meeting two-thirds of such persons as aforesaid then present shall determine that this Act ought to be adopted for the borough, the same shall thenceforth take effect and come into operation in such borough, and shall be carried into execution in accordance with the laws for the time being in force relating to the municipal corporation of such borough: provided always, that the mayor, or, in his absence, the chairman of the meeting, shall cause a minute to be made of the resolutions of the meeting, and shall sign the same; and the resolutions so signed shall be conclusive evidence that the meeting was duly convened, and the vote thereat duly taken, and that the minute contains a true account of the proceedings thereat.

V. The expenses incurred in calling and holding the meeting, whether this Act shall be adopted or not, and the expenses of carrying this Act into execution in such borough, may be paid out of the borough fund, and the Council may levy by a separate rate, to be called a Library Rate, to be made and recoverable in the manner hereinafter provided, all monies from time to time necessary for defraying such expenses; and distinct accounts shall be kept of the receipts, payments, and liabilities of the Council with reference to the execution of this Act.

VI. The board of any district, being a place within the limits of any Improvement Act, and having such a population as aforesaid, shall, upon the requisition in writing of at least ten persons assessed to and paying the improvement rate, appoint a time not less than ten days nor more than twenty days from the time of receiving such requisition for a public meeting of the persons assessed to and paying such rate, in order to determine whether this Act shall be adopted for such district, and ten days' notice at least of the time, place, and object of such meeting shall be given by affixing the same on or near the door of every church and chapel within the district, and also by advertising the same in one or more of the newspapers published or circulated within the district seven days at least before the day appointed for the meeting; and if at such meeting two-thirds of such persons as aforesaid then present shall determine that this Act ought to be adopted for the district, the same shall thenceforth take effect, and come into operation in such district, and shall be carried into effect according to the laws for the time being in force relating to such Board.

VII. The expenses incurred in calling and holding the meeting, whether this Act shall be adopted or not, and the expenses of carrying this Act into execution in any such district, shall be paid out of the improvement rate, and the Board may levy as part of the improvement rate, or by a separate rate to be assessed and recovered in like manner as an improvement rate, such sums of money as shall be from time to time necessary for defraying such expenses; and the Board shall keep distinct accounts of their receipts, payments, credits, and liabilities with reference to the execution of this act, which accounts shall be audited in the same way as accounts are directed to be audited under the Improvement Act.

VIII. Upon the requisition in writing of at least ten ratepayers of any parish having such a population as aforesaid, the overseers of the poor shall appoint a time, not less than ten days nor more than twenty days from the time of receiving such requisition, for a public meeting of the ratepayers in order to determine whether this

Act shall be adopted for the parish; and ten days' notice at least of the time, place, and object of the meeting shall be given by affixing the same on or near the door of every church and chapel within the parish, and also by advertising the same in one or more of the newspapers published or circulated within the parish, seven days at least before the day appointed for the meeting; and if at such meeting two-thirds of the ratepayers then present shall determine that this Act ought to be adopted for such parish, the same shall come into operation in such parish, and the vestry shall forthwith appoint not less than three nor more than nine ratepayers, Commissioners for carrying the Act into execution, who shall be a body corporate by the name of "the Commissioners for Public Libraries and Museums for the Parish of          in the County of          ," and by that name may sue and be sued, and hold and dispose of lands, and use a common seal: Provided always, that in any parish where there shall not be a greater population than eight thousand inhabitants by the then last census, it shall be lawful for any ten ratepayers to deliver a requisition by them signed, and describing their place of residence, to the overseers or one of the overseers of the said parish, requiring the votes of the ratepayers at such meeting to be taken according to the provisions of the Act passed in the fifty-eighth year of the reign of King George the Third, chapter sixty-nine, and the votes at such meeting shall thereupon be taken according to the provisions of the said last-mentioned Act of Parliament, and not otherwise.

IX. At the termination of every year (the year being reckoned from and exclusive of the day of the first appointment of Commissioners) a meeting of the vestry shall be held, at which meeting one-third or as nearly as may be one-third of the Commissioners, to be determined by ballot, shall go out of office, and the vestry shall appoint other Commissioners in their place, but the outgoing Commissioners may be re-elected; and the vestry shall fill up every vacancy among the Commissioners, whether occurring by death, resignation, or otherwise, as soon as possible after the same occurs.

X. The Commissioners shall meet at least once in every calendar month, and at such other times as they think fit, at the public library or museum, or some other convenient place; and any one Commissioner may summon a special meeting of the Commissioners by giving three clear days' notice in writing to each Commissioner, specifying therein the purpose for which the meeting is called; and no business shall be transacted at any meeting of the Commissioners unless at least two Commissioners shall be present.

XI. All orders and proceedings of the Commissioners shall be entered in books to be kept by them for that purpose, and shall be signed by the Commissioners, or any two of them; and all such orders and proceedings so entered, and purporting to be so signed, shall be deemed to be original orders and proceedings, and such books may be produced and read as evidence of all such orders and proceedings upon any judicial proceeding whatsoever.

XII. The Commissioners shall keep distinct and regular accounts of their receipts, payments, credits, and liabilities with reference to the execution of this Act, which accounts shall be audited yearly by the poor-law auditor, if the accounts of poor-rate expenditure of the parish be audited by a poor-law auditor, but if not so audited, then by two auditors not being Commissioners, who shall be yearly appointed by the vestry, and the auditor or auditors shall report thereon, and such report shall be laid before the vestry by the Commissioners.

XIII. The expenses of calling and holding the meeting of the ratepayers, whether this Act shall be adopted or not, and the expenses of carrying this Act into execution in any parish, to such amount as shall be from time to time sanctioned by the vestry, shall be paid out of a rate to be made and recovered in like manner as a poor-rate, except that every person occupying lands used as arable, meadow, or pasture ground only, or as woodlands or market-gardens, or nursery-grounds, shall be rated in respect of the same in the proportion of one-third part only of the full net annual value thereof respectively; the vestry to be called for the purpose of sanctioning the amount shall be convened in the manner usual in the parish; the amount for the time being proposed to be raised for such expenses shall be expressed in the notice convening the vestry, and shall be paid, according to the order of the vestry, to such person as shall be appointed by the Commissioners to receive the same: provided always, that in the notices requiring the payment of the rate there shall be stated the proportion which the amount to be thereby raised for the purposes of this Act shall bear to the total amount of the rate.

XIV. The vestries of any two or more neighbouring parishes having according to the then last census an aggregate population exceeding five thousand persons may adopt this Act, in like manner as if the population of each of those parishes according to the then last census exceeded five thousand, and may concur in carrying the same into execution in such parishes for such time as they shall mutually agree; and such vestries may decide that a public library or museum, or both, shall be erected in any one of such parishes, and that the expenses of carrying this Act into execution with reference to the same shall be borne by such parishes in such proportions as such vestries shall mutually approve; the proportion for each of such parishes of such expenses shall be paid out of the monies to be raised for the relief of the poor of the same respective parishes accordingly; but no more than three Commissioners shall be appointed for each parish; and the Commissioners so appointed for each of such parishes shall, in the management of the said public library and museum, form one body of Commissioners, and shall act accordingly in the execution of this Act; and the accounts of the Commissioners shall be examined and reported on by the auditor or auditors of each of such parishes; and the surplus money at the disposal as aforesaid of such Commissioners shall be paid to the overseers of such parishes respectively, in the proportion in which such parishes shall be liable to such expenses.

XV. The amount of the rate to be levied in any borough, district, or parish, in any one year for the purposes of this Act shall not exceed the sum of one penny in the pound; and for the purposes of the library rate all the clauses of the Towns Improvement Clauses Act, 1847, with respect to the manner of making rates, to the appeal to be made against any rate, and to the recovery of rates, shall be incorporated with this Act; and whenever the words "Special Act" occur in the Act so incorporated they shall mean "The Public Libraries Act, 1855;" the accounts of the said Board and Commissioners respectively with reference to the execution of this Act shall at all reasonable times be open, without charge, to the inspection of every person rated to the improvement rate, or to the rates for the relief of the poor of the parish, as the case may be, who may make copies of, or extracts from, such accounts, without paying for the same; and in case the Board or the Commissioners, or any of them respectively, or any of their respective officers or servants having the custody of such accounts, shall not permit the same accounts to be inspected, or copies of, or extracts from, the same to be made, every person so offending shall for every such offence forfeit any sum not exceeding five pounds.

XVI. For carrying this Act into execution the Council, Board, or Commissioners respectively may, with the approval of her Majesty's Treasury (and as to the Commissioners, with the sanction also of the vestry and the poor-law Board), from time to time borrow at interest, on the security of a mortgage or bond of the borough fund, or of the rates levied in pursuance of this Act, such sums of money as may be by them respectively required; and the Commissioners for carrying into exe-

cution the Act of the ninth and tenth years of her Majesty, chapter eighty, may from time to time advance and lend any such sums of money.

XVII. The clauses and provisions of "The Companies Clauses Consolidation Act, 1845," with respect to the borrowing of money on mortgage or bond, and the accountability of officers, and the recovery of damages and penalties, so far as such provisions may respectively be applicable to the purposes of this Act, shall be respectively incorporated with this Act.

XVIII. The Council of any borough and the Board of any district respectively may from time to time, with the approval of her Majesty's Treasury, appropriate for the purposes of this Act any lands vested, as the case may be, in a borough, in the Mayor, Aldermen, and Burgesses, and in a district in the Board; and the Council, Board, and Commissioners respectively may also, with such approval, purchase or rent any lands or any suitable buildings; and the Council and Board and Commissioners respectively may, upon any lands so appropriated, purchased, or rented respectively, erect any buildings suitable for public libraries or museums, or both, or for schools for science or art, and may apply, take down, alter, and extend any buildings for such purposes, and rebuild, repair, and improve the same respectively, and fit up, furnish, and supply the same respectively with all requisite furniture, fittings, and conveniences.

XIX. "The Lands Clauses Consolidation Act, 1845," shall be incorporated with this Act; but the Council, Board, and Commissioners respectively shall not purchase or take any lands otherwise than by agreement.

XX. The Council, Board, and Commissioners aforesaid respectively may, with the like approval as is required for the purchase of lands, sell any lands vested in the Mayor, Aldermen, and Burgesses, or Board, or Commissioners respectively, for the purposes of this Act, or exchange the same for any lands better adapted for the purposes; and the monies to arise from such sale, or to be received for equality of exchange, or a sufficient part thereof, shall be applied in or towards the purchase of other lands better adapted for such purposes.

XXI. The general management, regulation, and control of such libraries and museums, schools for science and art, shall be, as to any borough, vested in and exercised by the Council, and as to any district in and by the Board, and as to any parish or parishes in and by the Commissioners, or such Committee as such Council or Board may from time to time appoint, the members whereof need not be members of the Council or Board or be Commissioners, who may from time to time purchase and provide the necessary fuel, lighting, and other similar matters, books, newspapers, maps, and specimens of art and science, for the use of the library or museum, or school, and cause the same to be bound or repaired when necessary, and appoint salaried officers and servants, and dismiss the same, and make rules and regulations for the safety and use of the libraries and museums, and schools, and for the admission of the public.

XXII. The lands and buildings so to be appropriated, purchased, or rented as aforesaid, and all other real and personal property whatever presented to or purchased for any library or museum established under this Act, or school, shall be vested, in the case of a borough, in the Mayor, Alderman, and Burgesses, in the case of a district in the Board, and in the case of a parish or parishes in the Commissioners.

XXIII. If any meeting called as aforesaid to determine as to the adoption of this Act for any borough, district, or parish shall determine against the adoption, no meeting for a similar purpose shall be held for the space of one year at least from the time of holding the previous meeting.

XXIV. The Lord Mayor of the City of London shall, on the request of the Lord Mayor, Aldermen, and Commons of the City of London, in Common Council assembled, convene a public meeting in manner herein-before mentioned of all persons rated and assessed to the consolidated rate in the City of London, in order to determine whether this Act, shall be adopted in the said City; and if at such meeting two-thirds of such persons then present shall determine that this Act ought to be adopted for the City of London, the same shall thenceforth take effect and come into operation in the City of London, and shall be carried into execution in accordance with the laws for the time being in force relating to the City of London: provided always, that the resolution of such public meeting, signed by the Lord Mayor, shall be reported to the said Lord Mayor, Aldermen, and Commons, in Common Council assembled, and entered on the minutes thereof, and such entry shall be evidence; the expenses incurred in calling and holding the meeting, whether this Act shall be adopted or not, and the expenses of carrying this Act into execution in the City of London, shall be paid out of the consolidated rate, and the Commissioners of Sewers of the City of London may levy a part of the consolidated rate, or by a separate rate, to be assessed and recovered in like manner as the consolidated rate, all monies from time to time necessary for defraying such expenses, and distinct accounts shall be kept of the receipts, payments, and liabilities of the said Lord Mayor, Aldermen, and Commons with reference to the execution of the Act.

XXV. The admission to all libraries and museums established under this Act shall be open to the public free of all charge.

XXVI. This Act shall not extend to Ireland or Scotland.

## MALLEABLE IRON ORDNANCE.

A wrought-iron gun has been manufactured by Mr. Dundas, at Paragon Works, North Britain, on a principle maintained by him to be the only practicable method by which guns and mortars of that material and of large calibre could be made sound and trustworthy; the difficulty of procuring dense and solid forgings of great bulk being well known to every practical engineer. This gun, a 9-pounder, was sent down to Woolwich to be proved. Two heavy charges, of 9lb. of powder and a ball, the usual proof charge of a cannon of this size, were first fired from it. These produced no change in the gun, nor displacement of its parts. Fifty rounds of ordinary service ammunition were then rapidly fired from the cannon, causing no change whatever. The gun was then sent down to Shoeburyness for a further trial, and as 36 ordinary service rounds more were fired from it without any remarkable result, the charge was gradually increased to four, five, and lastly to six pounds of powder and two balls. Under this application the gun at length began to yield, and it finally became unserviceable at the third round of the last series,—six pounds of powder, two balls, and a wad. In all 152 rounds were fired from it. The following is a brief description of the method of the construction of this gun. Four bars of iron, about an inch thick, five inches broad, and the proper length of the gun, are put up longitudinally into segments of a circle, which if placed edge to edge, form the rough outline of the bore. The edges of these bars are then accurately planed. The bars or staves are then hooped temporarily as a cylinder by means of two rings at the extremities, and turned in a lathe to a surface perfectly true and cylindrical. A series of iron rings, three inches broad and three-quarters of an inch thick, carefully welded, are bored to a size slightly smaller than the barrel or cylinder; these, being afterwards expanded by heat, are one by one placed on the cylinder, and plunged into cold water. Instant contraction ensuing, the staves are compressed more powerfully than could be done by any artificial means, and no appearance of a joint in the staves is perceptible. The exterior surface of the mass is again turned perfectly cylindrical, and a second series of rings placed

in like manner over the first "breaking band." In the lathe the iron now assumes the exterior of a cannon, the trunnions having been previously placed on forged on a centre ring. To bore the gun with great perfection is very simple, as the boring bar can be supported at both ends, and the breech end of the gun being, for a few inches, bored slightly conically with a shoulder, into which fits a solid plug introduced from the muzzle, the cannon is now complete. Since this gun was made many improvements have suggested themselves to the inventor, who was much in doubt as to the proper proportions required by the separate parts of the cannon, and who, perhaps too confidently, made his gun much slighter than service ordnance of the same calibre, this being one-third lighter than a cast iron 9-pounder gun. By the substitution of tilted cast steel for iron staves further strength is expected, while, by corrugating the cylinder to the extent of from one-eighth to one-sixteenth of an inch, and turning the rings to fit these corrugations when shrunk on, great additional tenacity will be gained.

## Colonial Correspondence.

### BRITISH HONDURAS.

Belize, British Honduras,
August 16th, 1855.

SIR,—In my last letter I gave you a description of the mode of cutting mahogany in Honduras, which I thought might be interesting to some of the readers of your journal. There is, perhaps, nothing very curious, or worthy of especial consideration in the felling of a tree. Two men, black as ebony, naked to the waist, and armed with huge axes, having handles five feet in length, station themselves one on each side of a tall mahogany tree; stroke after stroke descends with terrific force and steady aim; the bark flies—deeper and deeper become the clefts—another blow, and the Titan of the forest is seen to sway gently like a drunken man,—one more and it takes an inclination—then, with a slow and stately motion at first, it descends,—then more and more quickly, until at last it falls to the earth with a tremendous crash, which resounds like thunder, and evokes a shrill response from thousands of frightened birds, and low and sullen growls from the puma and the tiger, whose lairs are not far distant. There is nothing, perhaps, very particular in this, but the circumstances which accompany the operation, the individuals who perform it, the situation, and the fact that the very table at which we are sitting, quietly sipping our bohea, or quaffing our Lafitte, was one of those same trees growing in the midst of a tropical wilderness, amongst beasts of prey and birds of extraordinary plumage and strange notes, do, I think, invest it with a certain interest, which the cutting of a beech, or an oak, in an English wood does not possess. I have sent by this packet, as a contribution to your museum, a model of a mahogany truck, on which is placed a log of that wood, supposed to be twenty feet in length. Yokes for fourteen oxen accompany it.

There is at present a great demand for fibres of every description, a demand which is more likely to increase than diminish. Jamaica is rich in materials from which this article is capable of being made. I believe, however, that Mexico, Yucatan, and Honduras, possess plants of spontaneous growth, from which a superior fibre may be produced to that which is made from the plaintain stalks and penguins of the island above mentioned. I have forwarded to you a specimen of fibre which is made from a species of aloe, which grows spontaneously in great abundance in the forests of this country. The Indians of Yucatan use it for ropes, hammocks, and other purposes. In a book descriptive of the Isthmus of Tehuantepec, "being the results of a survey for a railroad to connect the Atlantic and Pacific oceans, made by the scientific commission under the direction of Major J. G. Barrow, U. S. Engineer," the plant of which I have been speaking is thus noticed:—"Among the spontaneous products is the *bromelia pita*, or ixtle of the Isthmus, which differs in some respects from the *agave Americana* of Europe, the *pulgue de maguey* of Mexico, and the *agave sisalana* of Campeachy. Of this prolific plant there are numerous varieties, all yielding fibres, which vary in quality from the coarsest hemp to the finest flax. Nor is the value of the plant diminished by its indifference to soil, climate, and season. The simplicity of its cultivation, and the facility of extracting and preparing its products, render it of universal use. From it is fabricated thread and cordage, mats, bagging, and clothing, and the hammocks in which the natives are born, repose, and die. The fibres of the pita are sometimes employed in the manufacture of paper; its juice is used as a caustic for wounds, and its thorns serve the Indians for needles and pins."

I observe in your *Journal* of the 25th of May, a quotation from a letter of Mr. Thomas Hancock, published in the *Gardeners' Chronicle*, in which he inquires whether caoutchouc may not be cultivated in Jamaica or the East Indies. I cannot say whether it may or may not be cultivated in Jamaica, but in British Honduras, the India rubber tree—as it is here called—is a spontaneous product. This tree is to be found in every part of the settlement. It does not grow in rows and clumps like the cahoun, but is is scattered about and interspersed with other trees in the bush. The caoutchouc which is produced from it is, I believe, of a superior quality. The manner in which it is extracted is extremely simple. A bottle is placed at the root of the tree at sunset, and a perpendicular incision is made in the bark in a line with the neck. In the morning the bottle is full of a white liquid caoutchouc, which in a short time becomes black and solid. When an accident happens to a woodcutter's inexpressibles,—uninitiated in the mysteries of thread and needle, he inflicts with his machete (a kind of cutlass) a wound upon the indian rubber tree; instantly gushes out in a stream, like blood from the human subject, the thick milk-white sap, and with this adhesive fluid he repairs his rent habiliment. As soon as I am able to procure a specimen of the caoutchouc of this country, I shall forward it to your Society.

I have sent you by this packet two more bottles of the juice of the prickly pear. I feel firmly persuaded that this extract, if not equal to the cochineal, would be in many cases an excellent substitute for that dye. The cochineal insect is only crimson because it feeds upon the cactus; if it fed upon a different plant, it would doubtless be of a different colour. There is this distinction between the crimson of the prickly pear and that of the cochineal; the former is elaborated by natural, the latter by artificial, means. What change the sap of the cactus (for it is upon the green leaf that cochineal feeds) undergoes by the deglutitive and digestive process of the insect, to render the animal dye superior to that of the vegetable, I am unable to say. But supposing the cochineal to be superior to the juice of the prickly pear, in what consists that superiority? Certainly not in the brilliancy of the colour. It must consist, then, in the permanency of the dye. If it be so, it would not, I apprehend, be very difficult to fasten the colour of the prickly pear by some chemical process which would not be injurious to the fabric. The prickly pear is not an unwholesome fruit,—the juice of it would therefore be very useful in confectionery, to colour jujubes, bon-bons, and the various preparations of sugar,—and also in cookery, to give either a rich glowing crimson or a delicate roseate tint to jellies, blanc-manges, ices, and such like dainties. The *honest* wine merchant also might find his account in it. It would communicate to his twenty-years' old Port, or his vin de Bordeaux, or Chambertin, of the Philpot-lane vintage, or grown in the rural solitudes of Farringdon-without or Bishopsgate-within, a hue far preferable and more wholesome than that of logwood, of which the world is becoming somewhat weary.

I have the honour to be, sir, yours, &c.,

R. TEMPLE.

## Home Correspondence.

### DECIMAL COINAGE.

Sir,—I have had in my possession for some time the enclosed reply, written by the same "London Merchant" as furnished the original article. I hope you may still consider it worthy of a place in the *Journal* of the Society.

Yours very truly,
J. E. GRAY.

British Museum, August 15, 1855.

Sir,—In Professor De Morgan's "*reply to statements in favour of a tenpenny unit*," addressed to the honourable member for South Lancashire, and directed to members of the Legislature, and distributed by the Decimal Association, which statements appeared in the *Times* City article of 3rd May, there is a remarkable display of small wit at the expense of sound reason. On a question of so much importance, about to be submitted to the consideration of the Legislature, the latter is the ingredient with which we have to deal; and in desiring to separate the "chaff" from the wheat, we shall give a preference to the practical over the sentimental. It is only, therefore, to some of the paragraphs, which the Professor has numbered, that any answer is required.

2, 3, and 5.—The Professor contents himself with denying the necessity for using three decimal places to express in mils an equivalent to a farthing, but he forgets that the prices of many commodities are *smaller* than a farthing, and although he might adopt 1m. instead of ·001 to denote a single mil, he will find a lower decimal (equivalent to the 8th, 16th, 32nd, or 64th of a penny) somewhat difficult to express clearly in mils without the risk of mistake. He denies that our present mixed system affords any superior facilities for mental processes, and challenges the advocates of the tenpenny to produce their calculations in contrast with those of the £ and mil. We accept it—and shall take his own figures in illustration. What is the freight on 1632 cwt. of cotton at $\frac{5}{16}$d. per lb? Mr. Brown will inform the learned Professor that calculations like this are of constant occurrence in Liverpool.

| By the Mental Process. | By the £ and Mil Scheme. |
|---|---|
| Every clerk knows that $\frac{1}{16}$d. per lb. is equal to 7d. per cwt., therefore $\frac{5}{16}$d. = 2s. 11d.<br>1632 × 2s. 11d., = 136 × 35s.<br>Or £136 + £102 = £238. This result being obtained in less time than we take to read it, by memory alone. | 1632<br>112<br>———<br>3264<br>1632<br>1632<br>———<br>182784<br>$1\frac{1}{3}$ mil*<br>———<br>182784<br>60928<br>———<br>£243.712 |

Again, taking the Professor's figures, "What is the value of 1632 articles at £1 17s. 9d.?"

| By Mental Process. | By £ and Mil Scheme. | By the Tenpenny Process. |
|---|---|---|
| 1632 at £1$\frac{7}{8}$ths + 1632 + 3d.<br>Or £3060 + 408s., or £20 8s., = £3080 8s. This result a clerk of less than average ability can arrive at immediately, without putting pen to paper. | 1632<br>1·8875<br>———<br>8160<br>11424<br>13056<br>13056<br>1632<br>———<br>£3080·4000 | 1632<br>45·3<br>———<br>4896<br>8160<br>6528<br>———<br>xdy 73929·6 |

It requires no additional evidence to establish the fact, that a *high* unit for a decimal system of coinage is quite impracticable for calculations by mental processes.

The learned Professor is unquestionably a high authority on subjects of science, but with all possible respect to his opinions and authority, practical men will consider that he is but imperfectly acquainted with the details of commercial affairs (and this is a question rather of details than results), in supposing that 8ths of a penny are not now employed in quoting the prices of articles. If Mr. Brown replies candidly to the learned gentleman's letter, he must correct him upon this point, by informing him that cotton is sold in the market at as low as 16ths of a penny per lb., that the freights in this commodity are calculated as low as 32nds, and that many articles manufactured of the material are reckoned even as low as 64ths of one penny. The official lists of imports and exports will enlighten the Professor as to the proportion of our commerce directed to this article and its products alone, without reference to other innumerable branches of manufacture, and to the consequently extended use of small divisions in our money system, and the necessity for preserving them in all their simplicity, which the *tenpenny* admits of, but the £ and mil do not. These minute subdivisions of the £ are employed likewise in the quotations of prices of hides, timber, spices, haberdashery, and in freights of such commodities as coffee, &c., &c.

4.—The great gist of the question lies under this head, and the Professor, apparently knowing the weakness of his position as the advocate of the pound unit, states it clearly. His words are:—"We do not contend for £1 as *the* unit, but for £1 as the *highest* unit [Italics sic]. The decimal system makes passage from one unit to another much more easy, but it does not bind us to think in terms of one unit when another would be more convenient, &c." There is an obscurity in this definition. The £ is or is not to be the ruling unit. Our decimal system of coinage, to be effective, must comprehend the *most convenient* unit. We contend that the submultiples or descending decimals of one pound are *inconvenient*, and that the united multiples and submultiples of *tenpence are* convenient, and overcome every possible difficulty. Here lies the question between us.

6.—The Professor is here at fault—he says the tenpenny unit "*displaces both the shilling and the pound*," but he admits that the "shilling would exist under a tenpenny system as 1.2, *but it could never be a coin.*" Without criticising the paradox, we say, that every existing coin being formed of $\frac{1}{10}$ths of tenpence, or a certain number of pence, may always exist, if the public require their use, *as coins of circulation although not coins of account*, and this is the great advantage the tenpenny possesses over the pound as a unit for decimal coinage. This statement is the more disingenuous, because, in referring to one of these coins in connexion with the £ and mil scheme, he observes, "In the plan we propose the shilling, though thrown out of *account*, remains unaltered, and may be used both in thought and in speech as at present."—(See Preface to Report of Dec. Assoc. 129.)

The learned Professor is facetious on the point as to the fixed price of standard gold. He reminds one of the philosopher who told his son, "My dear boy, when your antagonist adduces an argument you cannot answer, laugh at his absurdity;" or to the advice given to a newly-inducted judge, "Be decided; pronounce your judgment; but, remember, never give a reason for it." He objects to the price of gold as being *too small* for illustration! We answer,—add your £50, £75, or even your £100 to the £3 17s. 10½d., and the result by the £ and mil scheme will still appear at disadvantage. Here it is—

| By £. s. d. | By £ and Mil. | By Tenpenny. |
|---|---|---|
| 3 17 10½ | 3·89375 | 93·45 |
| 28 17 10½ | 28·89375 | 693·45 |
| 53 17 10½ | 53·89375 | 1293·45 |
| 78 17 10½ | 78·89375 | 1893·45 |
| 103 17 10½ | 103·89375 | 2493·45 |
| 269 9 4½ | 269·46875 | 6467·25 |
| 47 Figures. | 43 Figures. | 33 Figures. |

* The nearest equivalent, if our opponents allow us to employ a fraction so favourable to them, but which is not decimal.

If he wishes a higher comparison, and will take the trouble of increasing the £3 17s. 10½d. by the decimal of £100, ascending to £1,000,000, he will find the results (including the addition of the 5 lines) produced by £ s. d. in 66 figures, by £ and mils in 62 figures, and by tenpennys in 50 figures only.

These illustrations are given *on his own invitation*, and he will doubtless make the best of them, but the point still remains unchanged as to the price of standard gold. He cannot state it millesimally in less than 6 figures, while in tenpennies it can be expressed in 4.

But let us leave the *fixed* value, and take the *fluctuating* price of bullion:—

| | £ s. d. | £ and Mil. | Xdy. |
|---|---|---|---|
| Price of Foreign Gold in Bars, per oz....... | 3 17 9 | 3·8875 | 93·30 |
| Mexican Dollars ......... | 4 10⅞ | ·2453125· | 5·887$^{5}$ |
| Silver in Bars (Standard) | 5 0⅝ | ·2526041·6 | 6·062$^{5}$ |

The learned Professor, we suspect, will somewhat resemble the Irish deserter; hit him *high*, or hit him *low*, there is no pleasing him.

His criticisms on the calculations of the division of £100, between 3, 6, 7, 8, and 9 persons, are singularly uncharitable. His knowledge of figures must have told him that the error was in the press, but as each of the lines of division is unquestionably correct, (each making the £100) his idea of pocketing a commission of £12 2s. 2d. by the transaction is *clever—very!*

15. The Professor's conceptions of a "*unit*" are somewhat remarkable. He says, "A pound *is* the large unit—a shilling *is* the small one." Perhaps, arithmetically, it would be most correct to say, that *one penny* is the unit of our present coinage. But when (desiring to have the pound and florin) he says, "Show us any proportion to the comparative value of commodities which the florin would not procure and the 10d. would," we feel ourselves challenged, and we reply, that by his scheme the florin contains 100 cents. (or mils of £1), while by the tenpenny system, 240 such cents. would be contained in the florin. He seems to have a virtuous sort of horror at small change, but every poor woman who has to buy salt or soda, several pounds of which are sold for a penny, or the thousand other articles of small value, will speedily enlighten him as to the comparative usefulness of the smallest coins.

## DECIMAL SYSTEM FOR BANKERS AND MERCHANTS.

Sir,—By legalising the *hundredth of a pound* as the elementary unit of cash and accounts, the *real* currency of the nation, namely, the silver and gold, would at once be decimalised.

There would not even be any immediate necessity for a new coin, as the present currency would effect all payments with sufficient accuracy for the business of bankers and merchants. A hundred "cash" might still be termed a pound for convenience, and five "cash" a shilling. £149 14s. 7¼d. would thus be written £149·73 cash, and the odd cash might be paid with fourteen shillings, a "sixpence," and a penny. Also, 69½ cash would be paid with thirteen shillings and eleven pence.

It is obvious that reduction from the present system to that proposed would be accomplished by merely multiplying pence and shillings by five. And since the proposed unit is equivalent to the quarter-franc, multiplication by four would reduce French money to English.

Should it be thought advisable to coin the silver unit, it would be necessary to have the fifth of a penny in copper, which might be termed a "doit." Therefore, two pence and two doits would be exchangeable for one "cash." Accounts would be kept by tradesmen and shopkeepers in pounds, cash, and doits; the third column being used by them for twelfths of a *cash*, as at present for twelfths of a *shilling*.

Thus the relative value of pound, shilling, and penny, would remain undisturbed, and we should have the most convenient coinage in the world. *Twelfths* are decidedly more convenient than *tenths* in petty dealings.

TABLE.

| *Cash.* | | *s.* | *d.* | |
|---|---|---|---|---|
| 1 | value | 0 | 2⅖ | |
| 2 | ,, | 0 | 4⅘ | |
| 5 | ,, | 1 | 0 | (shilling). |
| 10 | ,, | 2 | 0 | (florin). |
| 20 | ,, | 4 | 0 | |
| 50 | ,, | 10 | 0 | (half sovereign). |
| 100 | ,, | 20 | 0 | (sovereign). |

I remain, Sir, your obedient servant,

SAMUEL A. GOOD.

H.M. Dockyard, Pembroke Dock, Sept. 17, 1855.

## CHARCOAL AS A DISINFECTANT.

Sir,—I beg leave to trouble you with a few remarks in reference to charcoal as a disinfectant, which now justly engages considerable attention.

Charcoal has rarely been employed, in modern times, as a therapeutical agent, although its qualities as such, in particular cases, can scarcely be equalled, and is not, perhaps, surpassed by any other substance. In the interior provinces of Mexico, where no drugs were procurable save those "simples" which the ingenuity and the experience of the Indian herbalists have devised, I found vegetable charcoal, freshly burnt, of inestimable value. Reduced to powder, and given in a water vehicle, it removes, within a few hours, offensive odours from intestinal and renal discharges, and from the breath; and it also purifies offensive exhalations from the feet, and from any other part of the human body, either given in water or in the form of pills, made up with wheat-flour and water, or gum mucilage. Given in the same form, it removes those local pains about the right shoulder which are usually attributed to temporary obstruction of the liver, and this within forty-eight hours. It is not less efficacious, in combination with rhubarb, in diabetes, I believe, although I have had only two cases in which it was tried. As an antacid, either alone or combined with rhubarb and carbonate of soda, it removes heartburn speedily and permanently.

In the case of a man bit by a *rattlesnake*, the individual was restored to health by immersing the body in a running stream, at intervals, in order to keep down the circulation, and by administering to him charcoal pills every four hours during two days and nights.* In this case the pills were made up with an equal weight of common soap and charcoal; at the same time the wound inflicted by the reptile was sufficiently lanced, and sliced pieces of the *Cactus cylindricus* were applied to the place. This, changed occasionally, brought on a considerable discharge of clear, yellow lymph.

In ordinary cases of diarrhœa, administered in a water vehicle it speedily removes the affection.†

But animal charcoal is also of the highest importance in certain cases. The preparation which I was accustomed to give in Mexico was one long gone out of use, although held in high estimation and constantly prescribed in former days by Sydenham, Boerhaave, Ettmuller, Willis, Morton, Baglivi, Mead, and others. This remedy was *the lining membrane of a chicken's gizzard*, charred in an oven, but not burnt to a charcoal. The charred skin, re-

* *Vide* Travels in the Interior of Mexico during the Years 1825, 1826, 1827, and 1828, by Lieut. R. W. H. Hardy, R.N.

† The method of using and preparing charcoal for this purpose I forwarded to the Right Hon. Sydney Herbert, then Secretary-at-War, by whom it was sent to Dr. Andrew Smith, director-general of the medical department, from whom I had the honour to receive suitable replies.

duced to a coarse powder, is given in water in dysentery, diarrhœa, cholera morbus, and discharges of blood by stool, or by the mouth. In external hemorrhage the part requires only to be dusted with the powder; the bleeding is almost immediately arrested.

The science of medicine is one of experiment and experience, nor can any fixed principles be laid down for it till the chemical action of different substances upon the system shall have been accurately determined by proper tests, applied to the several matters discharged from the entire system of the human body. Every recommendation therefore which is founded on experience, is worthy of further investigation; and if any of your subscribers are desirous of further information upon the subject treated in this letter, I shall be happy to do so through the medium of your *Journal*.

I am, sir, your obedient servant,
R. W. H. HARDY.

## CORT'S INVENTIONS.

### No. II.

SIR,—My late father, in his work on Iron and Steel, published in 1840, gives the following as "the grand epochs in the manufacture of this metal:"—

"1. The invention of the blast furnace.

"2. The use of pit coal and pit coal coke in the smelting and manufacture of iron.

"3. The invention of puddling and rolling bar iron by Mr. Cort.

"4. The introduction of Mr. Watt's double blast engine.

"5. And, though last, not least important, is the application of heated air to blast furnace operations."

As from the year 1785 to his decease in 1847, my father had constantly given his indefatigable and intelligent attention to every question connected with the subject of this great manufacture, and was the first person who in this country applied the discoveries of modern chemistry to a philosophical explanation of its highly interesting processes, these words offer a strange, but an authoritative, contrast to the following passage of the report of the Committee of the House of Commons in 1812:—

"Your Committee have not been able to satisfy themselves that either of the inventions claimed by him (Mr. Cort), one for subjecting cast iron to an operation termed puddling during its conversion into malleable iron, and the other for passing it through fluted or grooved rollers, were so novel in their principles or their application as fairly to entitle the petitioner to a parliamentary reward."

This resolution, as is shown by Mr. Richard Cort's narrative, was based on the adverse evidence of two ironmasters, who, to the astonishment of the whole trade, singled themselves out from that body, to oppose the petitioner's claim, and contradict the universal testimony, placing themselves in a position, rendered more extraordinary by the fact that one of them in person, and the partners of the other had joined in passing, a year before, at a meeting at Gloucester, a unanimous resolution "that the iron trade was greatly indebted to Mr. Henry Cort for his inventions of puddling and of grooved rollers, and that a subscription should forthwith be commenced for the relief of his widow," and to which fund and resolution Mr. Samuel Homfray, the principal witness *against* the novelty and value of the inventions, *had subscribed*.

For the better understanding of the merits of Mr. Cort, and the demerits of his opponents, I propose to give a brief sketch of the practical processes in use at the date of Mr. Cort's discoveries.

The earliest known process for the manufacture of iron was that of the bloomery. Only the richest descriptions of ores were adapted to this operation, and during the unnumbered centuries when it prevailed, the accessible parts of veins above the water mark were ransacked for their richest produce, leaving those vast excavations which in some districts, as for instance, in the Forest of Dean, fill the mind with astonishment at the amount of iron which must have been manufactured by so slow and limited a manipulation. The oldest form of this furnace was the air-bloomery, where the heat was maintained without the aid of blast, the lumps of rich ore stratified with wood-charcoal were gradually deoxidised, and as they sank to the bottom of the furnace, became aggregated into malleable iron. This is the *rationale*, however varied in the detail, identical with the proposition for making malleable iron direct from the ore by Mr. Renton, described in Professor Wilson's valuable paper read at your meeting in March last. This process was afterwards, at some unknown date, expedited by the application of bellows; a greater heat was obtained, and in consequence, besides greater rapidity of manipulation, the earthy particles were fused and separated, and a purer and more homogeneous quality of iron brought under the hammer. The use of the blast bloomery led by degrees to the invention of the larger structure of the blast furnace, and to the product of cast iron, where the metal is not merely deoxidised, but further combined with a portion of carbon, which imparts its fusibility and fluidity. A metal was thus obtained more completely freed from earthy particles, ores of much less richness could be operated upon, and a vast accession was made to the extent of the manufacture, permitting the erection of numerous blast furnaces in Sussex and other districts for the reduction of ironstones combining a large per-centage of earthy mixture. To convert the cast product to the malleable form a modification of the blast-bloomery had to be adopted. The object was now to remove the carbon from the pig iron by the action of the blast, and not, as before, to remove the oxygen from the ore by the action of the charcoal. A wider and shallower description of bloomery furnace was planned, that the iron might be merely fused with the smallest contact with charcoal, and exposed before the blast until the carbon was burnt away, and the mass aggregated in the less fusible condition of malleable iron. This was the process in general use at the date when Mr. Cort, with an intuitive sagacity far beyond the chemical knowledge of his age, imagined and perfected the process of puddling.

At this time the gradual diminution of forests and woodlands had reduced to a very low ebb the manufacture of pig iron with charcoal; the manufacture with pit coal coke, patented by Dudley in 1619, had slumbered until about 40 years prior to the inventions of Mr. Cort. During this period it had sensibly progressed, the superior applicability of pit coal pig iron to the purpose of castings, for artillery, &c., &c., had aided the scarcity of wood fuel in giving this branch of the manufacture an impetus, and numerous furnaces were being erected in England and in Scotland, where the juxta-position of the coal and the ironstone afforded such economical facilities.

When Mr. Cort directed his attention to ironmaking, the works of these districts had already substituted pit coal coke for wood charcoal in the decarbonising or malleableising furnace I have described, called the refinery, or hollow fire. The charcoal refinery was retained only for special uses which required great purity and toughness, such as wire, or tin-plates, which were then commencing to be introduced as a staple manufacture. But whether the coke or the charcoal refinery was used, the process was the same,—the pig iron melted down was exposed to a stream of blast directed downwards on its surface, until the deprivation of carbon destroyed its fluidity, and the metal cohered in the less fusible malleable state.

The idea of producing the same effect in a more convenient and economical manner, by the flame of pit coal acting upon the metal exposed on the wide floor of a reverberatory furnace, was conceived by Mr. Cort; and to his sagacity in conceiving and perfecting this idea, and in devising further processes in aid of it, to substitute the tedious

and imperfect action of the forge-hammer, England owes her crystal palaces, her vast artillery, her iron ships, her railways,—in a word, her present wealth. Though his inventions were *immediately* addressed to the production of wrought iron, they have indirectly as much contributed to the production of cast iron, for neither of these forms of metal are used without a large accompaniment of the other form.

The operations I have described were purely empirical. What chemical changes took effect in their progress were wrapped in total darkness. The phlogiston of Scheele then reigned as the only explanation of the processes of combustion. and in a very interesting letter, written by Mr. David Hartley, upon an inspection of the new operations of Mr. Cort, he ascribes the blue flame emitted by the pig iron in the puddling furnace, during its progress to malleability by combustion of its carbon, to the *expulsion of sulphur*. It would be most interesting to have some record of the views of Mr. Cort upon his own operations, but I cannot understand that he has left any. Certain it is he could know nothing definite of the combinations and decompositions going forward, for Lavoisier had not yet unlocked the whole arcana of modern chemistry by revealing the nature of oxygen and its agencies. It was nearly 20 years later that my father, in his publications, first applied these discoveries in a clear explanation of the details of the various processes of ironmaking. Mr. Cort's success must, therefore, have been achieved by that practical instinct which has mainly invented and established every useful art, for we are bound to confess that science has come in most frequently as a mere commentator on the works of practical genius, teaching us less how to do what is useful than explaining the *modes* after it has been done.

During the manipulations of the malleableising refinery it was a common practice with the workmen to hasten their operation by tapping out a portion of the yet liquid metal from the hearth, and, when set, throwing it on the top of the fire to be remelted. This served two purposes; by diminishing the thickness of the fluid stratum under the blast, its decarbonization was more rapidly effected, and at the same time, by using the waste heat at the top of the fire, to re-melt a portion of the metal, it passed the blast again in its descent, still further promoting the decarbonisation of the whole.

When the large Welsh works adopted the process of Mr. Cort, which under the master-eye of the inventor was so conducted that his produce, even when puddled from common ballast, was equal in quality, as proved in the trials at the Royal Dockyards, to the best Swedish iron, purchased at the enormous price of £35 to £40 per ton! they found some difficulty, having lost the benefit of Mr. Cort's personal instructions, with which they commenced, in maintaining the quality of their iron to the high mark which the navy required, and which Mr. Cort himself had fully met. Iron bottoms to the puddling furnace, invented many years afterwards by, I think, the Harfords, of Ebbw Vale, were not dreamed of at that early stage, and it was found that in the rough adoption of puddling in works going for quantity more than quality, a considerable portion of silica from the sand bottoms (as very early pointed out by my father) united with the iron and impaired its quality. And the longer the iron was kept exposed on the floor of the reverberatory, the greater was of course the tendency to such alloy. Therefore, to *shorten* the operation of puddling, and thereby improve the product, it occurred to some of the ironmasters who had the refineries for the old process remaining erected at their works, to turn them to account by melting pig iron in them as before, and running out the whole of the metal when it arrived at the last stage of fluidity previous to malleableisation. This metal, the same which the old refiners were in the habit of casting back into the finery, as I have described, was called "finer's metal." Deprived of a considerable part of its carbon, it was far advanced toward the malleable stage, and by introducing this substance instead of the more carbonised raw pig iron into the puddling furnace, the operation was greatly shortened and improved. The labour and wages of the puddler were diminished, the waste by oxidation under prolonged exposure to flame was diminished, the absorption of silica was diminished, and greater yield and better quality of yield obtained from a given weight of pig iron.

The "finery," therefore, so extraordinarily perverted before the Committee as *superseding* the merits of Mr. Cort, thus became a useful *adjunct* in the early stages of the adoption of puddling by the common mass of manufacturers, who were not to be expected to possess that critical skill which had been distinctively acquired by the inventor of the operation. Subsequent improvements have comparatively dismissed the expediential use of the refinery, and a large portion of the iron of this kingdom is now manufactured by *puddling alone*, without the intervention of the other stage. The use of iron bottoms is one of these improvements. The introduction of the wide hearth, four or five times its previous area in the blast furnace, with the other improved modifications created by Mr. John Gibbons, of Corbyn Hall, rendered the production of white or forge iron from the blast furnace a less hazardous and more regular attainment, and it is now a practice to run white iron approaching to finer's metal from the blast furnace, and carry it to the puddling furnace direct. The adoption of the highly metallic cinder of the forge and mill as a decarbonising medium in the puddling furnace, called "boiling," and the kindred process of my father for using the pure oxide of hæmatitic ores for the same purpose, have further tended to the exclusion of the finery, and the establishment of the puddling furnace *alone*. In short, the refinery, used as a *cheval de combat* in the astonishing opposition to Mr. Coningsby Cort's petition, is becoming more and more a thing of the past, leaving the puddling process to remain sole and paramount. It has gone on increasing in utility and perfection, as must inevitably be the march of a sound invention based on economical principle; and puddled iron is now employed in a variety of choice uses, for which at one time it was supposed that only the produce of the most careful manufacturers, with wood charcoal, were admissible. In another letter I propose to offer some remarks on the second great invention of Mr. Cort, the grooved or fluted roller, for the merits of which the Committee of 1812 could not satisfy themselves that the inventor had any claim.

Before proceeding further in the practical consideration of this important subject, I cannot refrain expressing my great vexation at the questionable appearance of Mr. William Crawshay, in Mr. R. Cort's review of the report of the Committee of 1812. Intimate with my late father, it is extremely painful to see one of my father's friends standing in an ambiguous light. We must, perforce adopt the apology and explanation advanced by Mr. Richard Cort, that Mr. W. Crawshay was at the time young and inexperienced in the details of ironmaking. What if we assume that iron-kings are subjected to the destinies of other monarchs, where the heir apparent habitually leads the opposition against the sovereign regnant—an assumption which will leave it less difficult to account for Mr. William Crawshay's appearance in opposition to the experienced seniors of his own domain. I think it was not until after 1812 that Mr. W. Crawshay became regent at Cyfartha, after the commencement of which rule my father was for some years extremely intimate, passing much time at those works in prosecuting various patent processes. I am quite sure that in this period my father would lose no opportunity in doing justice to the origin of the transcendant gifts bestowed by Mr. Cort on the iron trade in his inventions of puddling and rolling; and it is impossible to doubt that Mr. Crawshay is now correctly informed, and disposed to look with regret on the serious position into which he was betrayed by the misguided energies of Mr. Samuel Homfray before that unfortunate Committee. Mr. W. Crawshay is a known

advocate of plain dealing, the duties and the advantages of honesty have ever been a prominent theme in his public addresses on various occasions. Though rapid in decision, there is no want of the element of generosity in his character, but rather a lively admiration for romantic acts of public spirit. Did he not start forward the first volunteer with £500 to head a subscription for preserving inviolate the asylum of the Hungarian Norsemen from the brute menaces of Austria and Russia? Where there is public spirit there must inevitably be public justice, and I am sure no one more than himself now mourns the errors of the proprietor of Pennydarran, who in 1811 subscribed an acknowledgment of the claims of Mr. Cort on the iron trade, and in 1812 exerted himself in persuading a legislative Committee that Mr. Cort never had any claims upon the iron trade at all. A man who could thus turn himself quite round in one year, showing a white face to his compeers at Gloucester, and, after a twelvemonth, a black one to his young friend Mr. W. Crawshay, in London, ought to have been set upon a pivot and kept in violent rotation all the rest of his life, to realise to the eye a uniform neutral tint, which might conceal such pie-bald patches of character from the vulgar gaze. It was sad indeed for the man who had erected his puddling furnaces and rollers 23 years before, under the direct instructions of Mr. Cort's workmen, "as the best and cheapest plan," and had profited by 20,000 tons of iron made out of them during the ten years the patent contract with Mr. Cort remained in force, though uninforced by the corrupt officials of the navy, and for 13 years more, up to 1812, had profited at an increasing rate of manufacture, to say as he *actually did* to the Committee that he did not know one furnace in existence working on Mr. Cort's plans. Are we to suppose that he acted from one sole mercenary motive—irrespective of honour, decency, and truth—a desperate terror to avoid a call for payment of the £10,000 due under the contracts on 20,000 tons of iron, at the royalty of 10s. per ton as contracted for. We may easily conceive Mr. William Crawshay as a young man who knew nothing of these things. The paymaster of the navy had clapped his extinguisher on Mr. Cort so long before, that the real facts were lost in darkness. It is even possible that his father, Mr. Richard Crawshay, knew the truth but imperfectly, though he also was a contracting party to Mr. Cort's patents for 10s. per ton; for in a letter to the Earl of Sheffield's secretary, dated 1808, he states that Cort and Jellicoe had ruined themselves by attempting the processes which he himself had profitably perfected under his own personal superintendence. This statement exhibits an entire ignorance of the facts. Cort and Jellicoe did not ruin themselves by their attempts; they had perfected the process to the highest degree, producing iron tested successfully in all the royal dockyards against the best Swedish iron. They had erected then successful furnaces and rollers at Cyfartha. Mr. Samuel Homfray had erected exact copies of these by the same workmen at Pennydarran; 10s. per ton was agreed to be paid for the use of them, and other ironmasters had likewise so erected and agreed to royalties, which would have realised to the holders of the patents £187,000 in ten years. The way in which Mr. Cort was ruined was this. Mr. Alexander Trotter, paymaster of the navy, had delivered to Mr. Adam Jellicoe, chief clerk in the office of the treasurer of his Majesty's navy, the sum of £27,500 and upwards, to be paid in discharge of the wages of the officers and seamen of his Majesty's navy, which sum said Adam Jellicoe, representing it as his own money, lent to Mr. Henry Cort, who had already expended a large private fortune in completing his works, at five per cent. interest, half the profits of his trade and patents, and an appointment for his son as manager of the works. I know nothing of the routine of Government offices; it is for those who do to explain how the officers and seamen of the navy could contentedly go without their wages whilst Jellicoe was lending their money to Mr. Cort. But I presume there was a way of doing it. One would have supposed the complaints of those in deficit would have reached the vigilant paymaster's ear, long before death revealed Mr. Jellicoe's default. That event rendering it clear, Mr. Alexander Trotter lost no time in protecting himself by issuing an extent in aid, under which Mr. Cort's works and private effects were sold for £15,334 14s. 0¼d. Had the goodwill of the premises been also sold, for which Mr. Cort had paid £19,548, considerably more than enough would have been realised to discharge the whole claim to the Crown. But had that been done *the patents could not have been locked up in the office of the Crown solicitor.* They must have been delivered to the patentee, *and he would have received the royalties due upon them.* However, for the balance of the default, a little over £10,000, *they were locked up* by this just and upright paymaster, and the public treasury remained defrauded of this sum, whereas if the exemplary functionary had exacted payment from the ironmasters of their contracts, little more than one year would have cleared the balance of defalcation, and a three years' receipt of those royalties, in the first instance, would have satisfied the treasury debt, *without the destructive and cruel sale of Mr. Cort's effects.*

Why the paymaster preferred the pleasant alternative of crushing Mr. Cort, and why one of the contracting parties whom that paymaster so liberally favoured, should have so strenuously exerted himself in 1812 to prove that the processes, for the use of which he had contracted with Mr. Cort twenty-three years before, *were of no value*, is likely now to rest unexplained, *except by conjecture.*

Watt's patent for the condensing engine was extended after its expiration for a further term of fourteen years; Cort's inventions were to the full equally deserving ot such an extension, but Watt was fortunate enough to find a private gentleman for his colleague, and thus avoided having his fortune and his honour swallowed up in the intrigues of the mäelstrom of official corruption.

From an ignorance of these, the real and baser features of the case, we may account for Mr. W. Crawshay following the dictation of Mr. Samuel Homfray, and asserting that "if his family had pursued the plans of Mr. Cort, they would have been ruined," which, by implication, meant the plan of trusting the deputy paymaster would certainly have brought ruin. In the other sense Mr. Cort made the fortunes of all the iron-trade, and of the whole kingdom by his inventions, and would have regained his own and something more, had not a public servant seen reason to make a sacrifice of the inventor to the contractors for the invention.

I am anxious by every possible view to vindicate Mr. William Crawshay, pointing out in what manner his youth may have been misled, by the interested Mr. S. Homfray, into an unfortunate opposition to the opinions of the senior partners of his father's concern. No one is likely now to regret more than himself the injustice which others rendered him an unconscious instrument in assisting them to effect.

Mr. Benjamin Hall, his father's partner, was most urgent in advocating the claim of the petition. What the other members of the committee were thinking of it is impossible to say. They probably left themselves in the hands of the chairman, trusting in safety to his scientific reputation, and it was, therefore, doubly unfortunate that a gentleman whose qualifications were sufficient to raise him subsequently to the chair of the Royal Society proved incapable of maintaining the rights of a scientific invention against miserable and truculent misrepresentation. We might have expected that as a mathematician he would have been struck with the beautiful effect and principle of the grooved roller, that he would have been anxious, as a point of abstract interest, to ascertain the origin of so effective a simplicity, combining numerous dynamical and mechanical refinements. It was to be expected that his love of science, with such a *chef-d'œuvre* before him, would have followed up the investigation, and

if a doubt were raised as to Mr. Cort's paternity, that he could not have rested until he discovered the true father, instead of deserting the achievement, as *nulli filius*, in an illegitimatised condition. To say the best of it, never was a more slovenly examination. No caution, no sense of the importance of the business, was exhibited; no adjournment to complete the evidence to meet unlooked-for attacks; they seemed as if in haste to do injustice. The Comptroller of the Navy, the Secretary to the Admiralty, the Secretary to the Treasury, all three on the Committee, were, though they might know nothing of Mr. Trotter, of course *ex-officio*, as a point of duty, opponents to any demand on the public purse. I wish it were on record who actually drew the report. I was too young to know Mr. Davies Gilbert myself, but have been intimate with his near friends, who considered him amiable. But I never heard it said he was " a strong-minded man ;" and equally strange with his signing such a report is the fact, that he never moved the house, though as chairman it was his office so to do, to carry out the report which he had signed, and vote the petitioners as was recommended, a sum in discharge of the expenses of their petition. He left them to pay the costs of Mr. Homfray's malignant calumnies.

It is a truly painful case. We read, over and over again, in every kind of publication, for youth or for age, the names of our public benefactors. Now the nation owes her spinning mills to Arkwright, her canals to Brindley, her philosophy to Bacon, steam-engines to Watt, steam-boats to Fulton and Miller, railways to Stephenson; the names of these men and others are familiar in our mouths as household words; we for ever meet them employed " to point a moral or adorn a tale," besides their permanent achievements. It is time that the name of Cort should be no longer excluded from its authentic position in the catalogue of national worthies; though we love honour, we must not shrink from dishonour where it is due, nor hesitate to place this right benefactor's memory in the right place because the tale is associated with acts of public ignominy. The truth cannot longer be concealed—the wisest course will be for all who are in the slightest degree implicated or liable to implication, to shake off from their characters at once—and unhesitatingly—all possibility of the imputation of persevering in dishonour.

I am, Sir, your obedient servant,

DAVID MUSHET.

September 1st, 1855.

## Proceedings of Institutions.

LONDON.—The half-yearly meeting of the members of the Jews and General Literary and Scientific Institution was held in their premises in Sussex Hall, Leadenhall-street, on the evening of Monday, July 30th. The chair was occupied by Mr. Montefiore, the President of the Institution. The attendance was numerous. The half-yearly report was read, approved of, and adopted. It is gratifying to be able to state that during the by-gone half-year the Institution has prospered, as well in the acquisition of lecturers as in the state of its funds, the latter of which is not a little owing to the munificent donation of £100 from the President. The issue of books from the library during the past half-year was nearly 5,000, many of those sought by the younger subscribers being historical or scientific. It was mentioned, on behalf of the Managing Committee, that the prosperity of the Institution was in a great measure promoted, and their own labours greatly relieved, by the valuable aid afforded by the Auxiliary Committee. The office of Secretary having become vacant, the Committee reported that they had appointed Mr. James Coutts, late Secretary to Mr. W. M. Thackeray, to perform the duties of that office. —Votes of thanks to the Auditors, to those gentlemen who lectured gratuitously, and to the Stewards at the anniversary dinner, were respectively moved, seconded, and carried, and a cordial vote of thanks was given to the President. The following are the Lectures which were delivered on the Thursday Evenings of the Session :—" On the Products of the Forests of the Globe, in their Relation to Commerce, the Arts, and Manufactures."—By P. L. Simmonds. " On the Advantages resulting from the Study of Science."—By the President. " A Drawing Room Entertainment."—By the Members of the City Elocution Class. " On the History of the Jews in Spain, under the Moors."—By Francis H. Goldsmid. " On the Life and Writings of Thomas Ingoldsby."—By Henry Thomas. " On Pope and his Writings."—By Morris S. Oppenheim. " On Old English Travels in Russia."—By the Rev. J. Llewelyn Davies, M.A. " On the Piano Forte, its Origin, Progress, and Development."—By Charles Salaman.

## PATENT LAW AMENDMENT ACT, 1852.

### APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette September 14th*, 1855.]

*Dated 15th August*, 1855.

1847. L. A. Pouget, Paris—Moderator lamps.
1849. G. Napier, Glasgow—Furnaces.
1851. J. Avery, 32, Essex-street, Strand—Apparatus to be applied to drawers to secure them. (A communication.)
1853. J. Barber, Manchester—Steam engines.

*Dated 16th August*, 1855.

1855. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury —Jacquard machines. (A communication.)
1857. T. Williams, Liverpool—Breech loading fire-arms.
1859. A. Shanks, 6, Robert-street, Adelphi—Machines for shaping nuts.
1861. C. Rowley, Birmingham—Elastic bands.
1863. S. Monk, Smethwick—Bricks.
1867. W. E. Baker, Cannon-street West—Sewing machines.

*Dated 17th August*, 1855.

1869. J. Fenton, Lancaster—Moderator lamps.
1871. G. Collier, Halifax—Weaving plush by power.

*Dated 18th August*, 1855.

1873. E. Heys, Hulme, Manchester—Flyers used in spinning.
1877. A. Savage, Eastcheap—Mechanism for treating tea, sugar, coffee, and chicory.

*Dated 20th August*, 1855.

1879. A. R. Le Mire de Normandy, 67, Judd-street, Brunswick-square—Soap.
1881. A. Bain, Westbourne Park-road—Apparatus for distributing liquids.
1883. W. Soelman, 3, Bennett-street, Fitzroy-square—Propellers.
1885. H. Knighton, Stamford—Portable drill.
1887. J. H. Brown, 4, Trafalgar-square—Ball cartridges.

*Dated 21st August*, 1855.

1889. G. Lewis, Leicester—Taps and cocks of glass.
1891. J. Cornes, Swan-lane—Consuming smoke.
1893. J. Orange, Nottingham—Covering yarns or other cores.
1895. E. Field, Drury-lane—Machinery for embossing and colouring.

*Dated 22nd August*, 1855.

1897. D. de Bussac, Brussels—The combination of hydriodic acid, watery or oily, or salts of iodine with tannic acid, the constituting parts of cinchona, or of sarsaparilla, or of the leaves of the walnut tree and iron, or with one or several of these bodies.
1899. M. Blum, Ilzach, Ht. Rhin, France—Hood.
1901. J. J. Lownds, New York—Extension pen and pencil case.

*Dated 23rd August*, 1855.

1903. J. T. A. Zinkernagel, Paris—Mosaic work.
1905. W. Jones, Pendleton—Printing woven fabrics and paper hangings.
1907. V. Fouchier, 39, Rue de l'Echiquier, Paris—Mill stones.
1909. J. G. Martien, Newark, New Jersey, U.S.—Oxydes of iron.
1913. T. Bartlett, Chambery, Savoy—Machinery for drilling or boring into stone.

*Dated 24th August*, 1855.

1915. W. Wood, Monkhill, near Pontefract—Pile and other fabrics.
1917. W. S. Gooding, Manchester—A tailor's clay cutter.
1919. T. A. Radiguet, Longjumeau—Dynamical apparatus for motive power.
1921. C. Schlickeysen, Berlin—Pipes, bricks, and tiles.

*Dated 25th August*, 1855.

1923. J. Avery, 32, Essex-street, Strand—Apparatus for exhausting and closing vessels. (A communication.)
1925. J. Avery, 32, Essex-street, Strand—Improvements in sewing machines. (A communication.)
1927. C. F. Stansbury, 67, Gracechurch-street—Mill for grinding. (A communication.)
1929. E. Carless, East London Works, Mile-end—Artificial leather.

*Dated 27th August*, 1855.

1932. F. Rualem, 29, Rue de Paris, à Belleville, France—Fuel for household and general purposes.
1933. C. E. Capron, 4, South-street, Finsbury—An improved cupping apparatus.

1934. J. Woordsworth Robson, 23, Grundy-street, Poplar New Town —Water closets.
1935. T. A. Cooling, Temple-chambers, Whitefriars—Pumps.
1936. C. Humfrey, jun., 14, Terrace, Camberwell—Fatty and oily acids.
1937. E. C. F. Sautelet, Paris—Impermeable cloth.
1938. J. Smith, Bristol—Perambulator and invalid carriages.
1939. S. Ludbrook, Mile-end—Railway wheels.
1940. W. Johnson, 47, Lincoln's-inn-fields—Rolling or shaping metals. (A communication.)
1941. W. Johnson, 47, Lincoln's-inn-fields—Railway breaks. (A communication.)
1942. C. Humfrey, jun., 14, Terrace, Camberwell—Candles.
1943. C. Esplin, 21, Windmill street, Lambeth—Gas regulator.
1944. A. V. Newton, 66, Chancery-lane—Separating substances of different specific gravities. (A communication.)
1945. A. E. L. Bellford, 32, Essex-street, Strand—Percussion guns. (A communication.)
1946. B. Moore, New York—Sewing machines. (A communication.)

*Dated 28th August*, 1855.

1947. J. Hopkinson, jun., Huddersfield—Furnaces.
1948. E. N. Fourdrinier, 22, Percy Circus, Pentonville—Machines for cleaning table knives.
1949. R. A. Brooman, 166, Fleet-street—Umbrellas. (A communication.)

*Dated 29th August*, 1855.

1950. J. Booth, Manchester—Machinery for drilling and boring.
1952. C. F. Stansbury, 67, Gracechurch-street—Seed planter. (A communication.)
1954. C. Radcliffe, Sowerby Bridge—Moistening textile fabrics for finishing.

*Dated 30th August*, 1855.

1955. J. More, Glasgow—Marine and surveying compasses.
1957. J. Gedge, 4, Wellington-street South, Strand—Casks. (A communication.)
1958. C. F. Stansbury, 67, Gracechurch-street—Plane-iron. (A communication.)
1959. C. F. Stansbury, 67, Gracechurch-street—Changeable lock. (A communication.)
1960. C. F. Stansbury, 67, Gracechurch-street—A machine for splitting leather. (A communication.)
1961. J. Juckes, 18, Baker-street, Islington—Furnaces.
1962. H. C. Jennings, 8, Great Tower-street—Medicine for cholera and diarrhœa.
1964. P. E. Charton, Troyes, France—Metallic manometer.

*Dated 31st August*, 1855.

1965. W. R. Palmer, New York—Writing-desks.
1966. R. Schramm, 6, Warwick-cresent, Harrow-road—Obtaining oil. (A communication.)
1967. J. Gedge, 4, Wellington street South, Strand—Kilns, ovens, or furnaces. (A communication.)
1968. G. F. Rose, Birmingham—Lithographic and copper-plate printing presses.
1970. J. White, East-street—Machinery for cutting soap. (A communication.)

*Dated 1st September*, 1855.

1972. R. W. Winfield and J. Jackson, Birmingham—Metallic bedsteads, &c.
1976. A. I. Austen, Belmont, Vauxhall—Candles and night lights.
1978. T. Bentley, Margate—Heating water or other fluids by gas.

*Dated 3rd September*, 1855.

1984. T. J. Larmuth and J. Smith, Salford—Printing machinery.
1986. E. G. Jones, Smethwick—Flattening cylinders of sheet glass.
1988. W. H. Zahn, New York—Machinery for making covered or plated twist and cord.
1990. H. E. Flynn, Retreat, Ranelagh, Dublin—Communications between guards and drivers of railway trains.
1992. W. A. Gilbee, 4, South-street, Finsbury—Carburetted hydrogen gas. (A communication.)
1994. G. H. Golding, Maidstone, and T. Paine, Blackheath—Boots, shoes, clogs, &c.

*Dated 4th September*, 1855.

1996. W. Woodcock and T. Blackburn, Over Darwen, and J. Smalley, Blackburn—Pistons.
1998. W. H. James, Camberwell—Steam engines.
2000. D. G. Foster, Pentonville—Training plants.
2002. W. De la Rue, Bunhill-row—Treating Burmese naphtha.
2004.—A. Morel, Roulaix, France—Preparing fibrous materials to be combed or spun.
2006. J. H. Bull, West-Farms, Westchester, U.S.—Fountain inkstands.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed August 31st*, 1855.

1431. William Teall, Wakefield—Improved method of treating and working soapy or greasy waters in order to obtain the greasy substances therefrom.
1451. Sydney Smith, Hyson Green Works, near Nottingham—Improvements in apparatus for insuring the correct action of the safety valves of steam boilers, and for regulating the action of the dampers of steam boilers.
1505. John Inglis and Archibald Cowie, Glasgow—Improvements in moulding or shaping metals.
1562. James Caldow and James Bainden Affleck McKinnel, Palmerstone Iron Works, Dumfries—Improvements in machinery or apparatus for cutting or reducing vegetable substances.
1572. Robert Cochran, Verreville Pottery, Glasgow—Improvement in the preparation of clay for potters' use.
1578. Louis Roch, New York—Improvements in machines for making pulp from wood and vegetable fibrous substances.

*Sealed September 7th*, 1855.

505. William Weild, Manchester—Improvements in looms or machinery for weaving pile fabrics.
507. John William Sloughgrove, and James Henry Wheatley, Windsor-street, Islington—Improvements in smoke-consuming furnaces.
521. John Aitken and Servetus Aitken, and John Haslam, Bacup—Improvements in machines used for preparing, spinning, and doubling cotton, wool, flax, silk, and other fibrous materials.
525. Julian Bernard, Club Chambers, Regent-street—Improvements in the manufacture of boots and shoes, or other coverings for the feet, and in the machinery or apparatus to be employed therein.
541. Alexander Clark, Gate-street, Lincoln's inn-fields—Improvements in the construction and manufacture of celestial and terrestrial globes for the study of astronomy and geography.
544. Charles Heaven, Hull—Improvements in machinery used for embroidering fabrics.

PATENT ON WHICH THE THIRD YEAR'S STAMP DUTY IS PAID.
1852.

103. Charles Lungley, Poplar—Improvements in ship-building.

*Sealed September 10th*, 1855.

556. David Macaire, Paris—Improvements in casks and taps.
568. Robert Neale, Cincinnati, U.S.—Improvements in copper and other plate printing.
571. Jonas Marland, Sun Vale Iron Works, Walsden—Improvement or improvements in the manufacture of rollers for drawing, spinning, doubling, and preparing cotton, wool, flax, and other fibrous materials, a part or the whole of which improvement or improvements are applicable to shaping metals for other purposes.
575. Joseph Turner, Farringdon-street—An improvement in coffin furniture.
625. Benjamin O'Neale Stratford, Earl of Aldborough, Stratford-lodge, Wicklow—Improvements in aerial navigation, and in the application of the same to warlike purposes.
629. Isaac Rogers, North Haverstraw, U.S.—Improvements in the mode of treating iron ores.
653. T. F. E. Clewe, Paris—A new construction of locomotive engines, tenders, and railway carriages.
661. John Britten, Birmingham—A new or improved machine for sweeping or cleaning chimnies.
691. William Henry Gauntlett, Banbury, Oxfordshire—Improvements in apparatus for cutting or pulping turnips and other roots.
693. Frederick William Mowbray, Shipley—Improvements in bearings for the axles of railway wheels, and of other axles or shafts; which improvements are also applicable to axles or shafts, and other like rubbing surfaces.
869. Charles McIlvaine Congreve, New York, U.S.—Improvements in the manufacture of iron when oxide iron ores are used.
937. Julius Jeffreys, Kingston-hill, Surrey—Improvements in engines or machines for raising, diffusing, or injecting fluids.

PATENT ON WHICH THE THIRD YEAR'S STAMP DUTY IS PAID.
1852.

87. Robert Robertson Menzies, Glasgow, N.B.—Improvements in the manufacture of carpets and other fabrics.

*Sealed September 12th*, 1855.

558. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand —Improvements in musical wind instruments.

*Sealed September 14th*, 1855.

576. Julian Bernard, Club chambers, Regent street—Improvements in the manufacture of boots and shoes and other coverings for the feet, and in the machinery connected therewith.
579. Abraham Davis, Tottenham Court-road—Improved polishing powder.
580. John Hetherington, Manchester, and Archibald Vickers, Bristol—Improvements in machinery for preparing, spinning, and doubling cotton and other fibrous materials.
583. Nathan Robinson, John Lister, and Henry Stevenson, Bradford—Improvements in looms for weaving cocoa nut matting and similar fabrics.
634. James Biden, Gosport—Improvements in marine steam engines.
723. William Henry Balmain, St. Helen's—Improved methods of or processes for recovering oxide of manganese after it has been used in the manufacture of chlorine.
935. François Joseph Anger, 16, Stamford-street, Blackfriars-road —New metallic alloy.
1087. James Buchanan, Glasgow—Improvements in the manufacture of heddles or healds for weaving. (Partly a communication.)
1104. Edward Pellew Plenty and William Pain, Newbury—Improvement in ploughs.
1190. Robert William Waithman, Bentham-house, York, and Joseph Waithman, Manchester—Improvements in machinery or apparatus for the manufacture of lint or similar substances.
1219. John Whitehead, jun., and Robert Kay Whitehead, Elton, near Bury—Improvements in finishing woven fabrics.
1475. Simon Davey, Tucking Mill, Illogen, Cornwall—Improvement in the manufacture of safety fuzes for mining and military purposes.
1535. Alfred Vincent Newton, 66, Chancery-lane—A new manufacture of fire and burglar proof glass.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

4. James Hodgson, Liverpool—Improvements in constructing iron ships and vessels.
6. Moses Poole, Serle street—Improvements in the manufacture of guns and pistols.
16. Moses Poole, Serle-street—Improvements in the manufacture of telescope and other tubes.
19. Moses Poole, Serle-street—Improvements in moulding articles when india rubber combined with other materials are employed.
24. Moses Poole, Serle-street—Improvements in the making covers for and in binding books and portfolios, and in making frames for pictures and glasses.
28. Moses Poole, Serle-street—Improvements in coating metal and other substances with a material not hitherto used for such purposes.
29. John Daniel Ebingré, Brussels—Improvements in the manufacture of animal charcoal.
30. Moses Poole, Serle-street—Improvements in the manufacture of trunks, cartouche and other boxes, knapsacks, pistol-holsters, dressing, writing, and other cases, and sword and other sheaths.
33. Moses Poole, Serle-street—Improvements in the manufacture of pails, tubs, baths, buckets, measures, drinking and other vessels, basins, pitchers, and jugs, by the application of a material not hitherto used in such manufactures.
36. James Hare, Birmingham—Improvements in expanding tables and music stools.
37. Moses Poole, Serle-street—Improvements in covering and sheathing surfaces with a material not hitherto used for such purposes.
43. Moses Poole, Serle-street—Improvements in harness, and in horse and carriage furniture.
123. Richard Whytock, Green-park, Zibberton, Mid Lothian—Improvements in the manufacture of fringes, and in pleat for these and other ornamental work.
163. Moses Poole, Serle-street—Improvements in the manufacture of tables, sofas, bedsteads, stands, chairs, and other articles of furniture, and the frames and bodies of musical instruments.
275. Alphonse René le Mire de Normandy, Judd-street—Improvements in obtaining fresh water from salt water.
335. Robert Cochran, Glasgow—Improvements in kilns.
376. Henry McFarlane, Lawrence-lane—Improvements in constructing metal beams or girders.
510. John Tayler and James Slater, Manchester—Improvements in machinery, apparatus, or implements for weaving.
761. Samuel Holt, Stockport, Cheshire—Improvements in weaving cut-piled fabrics.
785. Peter Carmichael, Dens Works, Dundee—Improvements in machinery for winding yarn or thread.
798. Jean Joseph Jules Pierrard, Paris—Improvements in preparing wool and other fibrous substances for combing.

*Sealed September 18th*, 1855.

613. Philippe Roehrig, Paris—A new or improved alimentary substance.
614. Louis Henry Crudner and Frederic Louis Koebrig, Tottenham Court-road—Improved apparatus for purposes of ventilation.
615. John Smalley, Bishopgate—Improvements in railway carriage axles.
621. William Taylor, Poolstock—Improvements in the construction of "pickers" for power looms.
622. Thomas Mara Fell and Francis Squire, 74, King William-street—Improvements in balance levers and apparatus for weighing, and modifications thereof for the purpose of detecting base coin.
624. Charles Marsden, Kingsland-road—Improvement in tent-poles.
628. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—A new and improved governor for engines and machinery.
631. William Miller, North Leith—Improved apparatus for the prevention of smoke and promoting ventilation.
654. Griffith George Lewis, C.B., Major-General Royal Engineers, Woolwich, and Joseph Gurney, St. James's-street—Improved construction of knapsack, convertible when required into a bed, a litter, or a tent.
686. William Dray, Swan-lane—Improved gear for communicating power from horses or cattle for the purpose of driving machinery.
701. Alexander Dalgety, Deptford—Improvements in steam-engines.
702. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in anchors. (A communication.)
705. Anatole Bère, Lille, France—Improvements in steam boilers.
715. Theophilus Wood Bunning, Newcastle-upon-Tyne—Improvement in steam engines.
716. Theophilus Wood Bunning, Newcastle-upon-Tyne—Improvements in steam engines.
750. Maximilien Evrard, Saint Etienne, France—Improved continuous drawing-compresser for moulding or bruising several substances or mixtures.
786. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Certain improvements in the construction of steam boilers. (A communication.)
853. John Kay, Bonhill—Improvements in preparing and printing textile fabrics and other surfaces.
886. Richard Bright, Bruton-street—Improvements in lamps and in lamp-wicks.
970. Pierre Dépierre, 101, Rue de Seine, Paris—Improvements in dyeing, part of which improvements is applicable to the manufacture of ink.
983. Thomas Lambert, Harrington-square—Improvements in piano-fortes.
989. William Basford, Penclawdd—Improvements in purifying coal gas, and for obtaining a residium therefrom, which may be used as a pigment or colour, or for other useful purposes.
1148. John Henry Johnson, 47, Lincoln's-inn fields—Improvements in signals for nautical purposes. (A communication.)
1312. Isaie Lippmann, 4, Rue Geoffroy Saint Hilaire, Paris—Improvements in the treatment of hides and skins for the manufacture of leather.
1377. John Sellars, Monsall-house, Manchester—Improvements in the manufacture of starch and in the use of substances employed therein.
1503. William Clay, Liverpool—Improved mode of manufacturing forged iron.
1561. Edwin Daniel Chattaway, Edinburgh—Improvements in buffing and coupling apparatus for railway carriages and rolling stock.
1597. William Edward Newton, 66, Chancery-lane—Improved mechanism for operating the shuttles of looms.
1599. William Pidding, Putney—Improvements in coverings for the feet of bipeds and quadrupeds.
1600. William Pidding, Putney—Improvements in the manufacture of building materials.
1601. Scipion Salaville, Paris—Improved apparatus for airing and preserving grain, seeds, apples, potatoes, hops, and other similar articles in granaries, warehouses, and ships.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

12. Thomas Wood Gray, Warkworth-terrace, Commercial-road, Limehouse—Improvements in steam-engines.
41. Joseph Barrans, Queen's-road, Peckham—Improvements in steam-engine boilers.
42. Oswald Dodd Hedley, Newcastle-upon-Tyne—Improvements in getting coal and other minerals.
108. Thomas Fearn, Birmingham—Improvements in ornamenting metallic surfaces, and in machinery and apparatus to be employed therein.
120. George Collier, Halifax—Improvements in the manufacture of carpets and other fabrics.
121. John Lee Stevens, Kennington—Improvements in furnaces.
172. John Jobson, Litchurch—Improvements in manufacturing moulds for casting metal.
245. William Dray, Swan-lane, London-bridge—Improvements in machinery for reaping and mowing.
247. Christopher Nickels, York-street, Lambeth, and Frederick Thornton, Leicester—Improvements in weaving.
326. Charles William Siemens, Adelphi-terrace—Improvements in engines to be worked by steam and other fluids.
354. Joseph Walker, Dover—Improvements in machinery for crushing and bruising malt, grain, and seeds.
543. John Norton, Cork—Improvements in blasting.
698. Oswald Dodd Hedley, Newcastle-upon-Tyne—Improvements in getting coals and other minerals.
808. George Wilson, York Glass Company—Improved manufacture of glass bottles and jars.
1013. George Collier, Halifax—Improvements in the manufacture of carpets and other fabrics.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3752 | September 6. | Brooch and Dress Fastening | Joseph Parkes | Birmingham. |
| 3753 | ,, | Stamp for Embossing Designs on Paper and other Substances | Hume and Melville | Edinburgh. |
| 3754 | September 10. | Brush | James Eagles and Son | Walsall. |
| 3755 | September 11. | Portable Economic Fireproof Building | Samuel Hemming | Clift-house Works, Bow. |
| 3756 | September 14. | French Signal and Cooking Lamp | Tucker and Son | 190, Strand. |
| 3757 | September 18. | Mouthpiece for Cornopeans and other Musical Instruments | Henry Bird | Stourbridge. |
| 3758 | ,, | Under Shirt | Donaldson, Hirsch, & Spark | 33, Spencer-street, Goswell-road. |
| 3759 | September 19. | Reversible Carriage Mantle | Henry Barry Peacock | 9, St. Ann's-square, Manchester. |

Journal of the Society of Arts.

*FRIDAY, SEPTEMBER* 28, 1855.

## SOCIETY'S VISIT TO PARIS.

The Council assembled at 14, Rue du Cirque, on the 3rd instant, when the Secretary reported that he had been in communication with his Excellency Lord Cowley, who, at the request of the Secretary when in Paris a few weeks since, had kindly undertaken to ask an audience of His Imperial Majesty the Emperor of the French, for the presentation of the address from the Society and its associated Institutions, but that at present no day had been fixed. The Secretary further reported that he had learnt that His Imperial Highness the Prince Napoleon, the President of the Imperial Commission for the Exposition Universelle, would leave Paris on Wednesday morning for a visit to the country, of some days' duration, and that under these circumstances His Highness could not fix a day for the reception of the address intended for him, but that His Imperial Highness had signified his desire that the address should be transmitted to him, and that the members of the Council should be presented to His Highness in the Palais de l'Industrie, during his visit there that afternoon. Accordingly the Chairman, accompanied by Lord Ebrington, V.P., M.P.; Mr. J. Scott Russell, V.P.; Mr. Joseph Glynn, Member of Council; Mr. W. B. Simpson, Mr. P. Palmer, members of the Paris Visit Committee, with the Secretary, proceeded to the Exhibition building, and had the honour of being presented to His Imperial Highness by M. Le Play, the Commissioner General.

The following address was placed in the hands of M. Le Play, for presentation to His Imperial Highness on his return to Paris:—

"May it please your Imperial Highness,

"We, the Council and Members of the incorporated Society instituted at London in 1754, for the Encouragement of Arts, Manufactures, and Commerce, together with the representatives of the Literary, Scientific, and Mechanics' Institutions throughout Great Britain and Ireland associated with us, beg leave to congratulate your Imperial Highness on the great success of the Universal Exhibition of all Nations.

"In accordance with the recommendation of His Royal Highness the Prince Albert, our illustrious President, we have visited the splendid capital of France to mark the progress of Arts, Manufactures, and Commerce. We have noted with great satisfaction their rapid advancement since the opening of our own Exhibition in 1851, whose universality, its dominant idea, was due to the comprehensive views of our Royal President. On every side we witness manifold proofs of the energetic will and organising power which have rendered the name of Napoleon so illustrious. The indefatigable zeal of your Imperial Highness has happily realised the grand conceptions of His Majesty the Emperor, and we are thus once more permitted to behold the great spectacle of the confederacy of nations, and the reunion of those men whose works and discoveries are the true glory of our age. It is only by gatherings such as these that we can hope to reunite in the firm bonds of lasting peace the great family of the nations of the globe. The moral good thus accomplished will be of more value than even the material results. The harmonious accord of the two great nations, France and England, which stand confessedly at the head of European civilisation, is the surest pledge of its conservation and advancement.

"Accept, Illustrious Prince, the homage of our profound respect,

"Given under our Common Seal this 8th day of September, 1855.

"JAMES BOOTH, *Chairman of the Council.*
"P. LE NEVE FOSTER, *Secretary.*"

On Tuesday morning, the 4th inst., at 10 o'clock, the Members of the Society and the representatives of the associated Institutions, with their friends, headed by the Chairman, proceeded to pay their first visit to the Exhibition. They were received at the grand entrance of the building by M. Le Play and M. Arles Dufour, the Secretary of the Imperial Commission, who, in the name of the Commissioners, bade them welcome, and expressed the gratification which the Commission felt at a visit from a Society which had taken so prominent a part in originating the Great Exhibition of 1851. The Members then dispersed to view the Exhibition.

On Wednesday morning, at nine o'clock, the Chairman, accompanied by Mr. Robert Stephenson, M.P., Mr. J. Scott Russell, F.R.S., and other members of the Society, and representatives, visited the Machinery Department of the Exhibition in the Annexe, over which they were conducted by Captain Fowke, of the Royal Engineers. At 12 o'clock, Mr. Macarthur, the Commissioner for New South Wales, conducted a party of the members over the Australian department; and afterwards Mr. Logan, the Commissioner for the Canadas, showed the Canadian products.

On Thursday the Chairman, accompanied by a large party of the members, visited the Palais des Beaux Arts, under the guidance of Messrs. Leighton and F. S. Carey. The members afterwards visited the Tomb of Napoleon, at the Invalides.

On Friday the members visited the Palace of the Luxembourg, and afterwards the Pantheon, from whence they proceeded to the Louvre. In the evening, a grand reception was given by the Imperial Commission to the members of the Society and the representatives of the associated Institutions and their friends. The reception was held in the Palais de l'Industrie, and the company were received, in the name of the Commission, by MM. Thibaudeau and Arles Dufour. About 500 persons were present. Previous to the reception a dinner was given by the Imperial Commission, at which the following members of the Society and representatives of the associated Institutions had the honour of being invited:—Earl Grey, Viscount Ebrington, M.P., John G. Appold, F.R.S., Edward Baines, E. Ball, M.P., H. G. Bohn, Rev. Dr. Booth, F.R.S., John Brady, M.P., General Buckley, M.P., F. S. Cary, John Cassell, Edwin Chadwick, C.B., R. L. Chance, W. Fothergill Cooke, John G. Crace, W. Ewart, M.P., Benjamin Fothergill, Capt. Fowke, R.E., Edward Glynn, Joseph Glynn, F.R.S., Peter Graham, William Hawes, Chandos W. Hoskyns, Herbert Ingram, W. Lane Joynt, J. C. Macdonald, Rev. Muirhead Mitchell, Philip Palmer, Alexander Redgrave, C. B. Robinson, Dr. Forbes Royle, F.R.S., John Scott Russell, F.R.S., W. Wilson Saunders, F.R.S., C. W. Siemens, W. B. Simpson, J. Jobson Smith, James Scott Smith, Thomas Sopwith, F.R.S., Richard J. Spiers, Robert Stephenson, M.P., F.R.S., William Turton, Thomas Twining, jun., W. Weallens, Thomas Woollcoombe, and P. Le Neve Foster, the Secretary.

After dinner M. Thibaudeau, who spoke in English, proposed the health of His Royal Highness Prince Albert, in the following terms:—

"Gentlemen,—His Imperial Highness Prince Napoleon has charged my colleague, M. Arles Dufour, and me, with the duty of receiving you, and entrusted me with the honour of proposing the health of H.R.H. Prince Albert, your President, and of the Society of Arts. We hope that you will make yourselves welcome, and that you will join in those sentiments which your gracious Queen was good enough to express during her visit, and which every Englishmen at the present time proves the truth of by coming amongst us. You who have been the first to

realise the idea of Exhibitions of all Nations must feel a peculiar satisfaction in viewing the marvels of intelligence and industry which surround us. Nevertheless, whatever may be the results of such Exhibitions as these, there is no bound to progress in our time. Science, art, and industry have their great difficulties; some must be turned, others must be taken by assault. In our progress we encounter Malakoffs and Great Redans, but we have also our glorious days of victory, as at Alma, Inkermann, and Traktir. Let us continue to march hand-in-hand in this career of progress, as our brave soldiers fight side by side for the conquest of Sebastopol."

Lord Ebrington, as a Vice-President of the Society, replied to the toast, thanking H. I. H. Prince Napoleon and the Imperial Commission for their hospitable reception, and concluded by proposing the health of His Majesty the Emperor, "who by his wisdom and genius had realised that which his predecessors had in vain attempted, the founding an alliance between the two countries on the firm basis of community of glory and community of interest."

Although it had been notified in the *Moniteur* that the stated receptions for the season had ceased, yet on the arrival of the Society in Paris, the Imperial Commission determined to signalise their visit by a public dinner to a limited number, and by a reception in the evening to the whole of the members and representatives.

On Saturday, at half-past nine, Mr. Sopwith, F.R.S., undertook to conduct a party over the mineral products exhibited in the Annexe; and afterwards Mr. Macarthur showed the Australian products to such members as had been unable to take advantage of his guidance on the previous occasion. At 12 o'clock, Mr. Peter Graham, one of the members of the Council, took a large party through the carpet, lace, furniture, and embroidery departments. Mr. Hobbs also explained to a party the various locks exhibited. The Secretary also took a party over the Canadian collection.

On Monday, at half-past nine, Dr. Royle showed the Indian products in the Annexe, and afterwards the Chairman, accompanied by a large body of the members and representatives, visited the Conservatoire des Arts et Metiers, and were conducted over the establishment by M. de Tresca, the *Sous-Directeur*. During this visit some experiments were made testing the power of certain pumps exhibited in the Palais de l'Industrie. General Morin's registering dynamometer was used to determine the force employed. A new arrangement for producing a steady and continuous light by electricity was also shown. At four o'clock, a party of the members visited the Model Lodging-house, exhibited in the grounds of the Palais de l'Industrie. The house was shown to the members by a gentleman deputed by Mr. G. Clark, the exhibitor.

On Tuesday, a large body of members and representatives, accompanied by the Chairman, visited the Chateau de Fontainebleau. The party, consisting of about 120 persons, afterwards dined together at the Hotel de la Ville de Lyons, where a dinner had been specially arranged by the Secretary, who went to Fontainbleau the previous evening.

On Monday and Tuesday, from two o'clock till four, Mr. Murray undertook to exhibit to the members the models of Irish fisheries, with live fish.

On Wednesday, the 12th, at 11 o'clock, the members visited the Hotel des Monnaies, and were conducted over the establishment, and shown the working departments, by Monsieur Hullot. In the afternoon a party visited the cemetery of Pere la Chaise, under the guidance of Mr. Winsor

Thursday, 13th.—The visit to the collection of Prince Salzicoff, under the guidance of Mr. H. Cole, and to the Agricultural department of the Exhibition, under the guidance of Mr. C. Wren Hoskyns, did not take place, owing to that day being appointed for the public rejoicings for the taking of Sebastopol.

On Friday, the 14th, a party of the members were conducted over the Prussian department of the Exhibition, by M. de Viebahn, the Prussian Commissioner.

Saturday the 15th.—This day was fixed for the inauguration of the "Exposition Economique," forming a special department of the Exposition Universelle, and the members of the Society and the representatives were invited to attend. The party assembled in the Salon de l'Empereur. In addition to many well-known members of the Société d'Economie Charitable of Paris, the Commissioners of nearly every nation exhibiting in the building, General Morin, M. de Rouville, and the members of the Imperial Commission, there were present the following members of the Society of Arts:—Earl Grey, Viscount Ebrington, H. Cole, C.B., J. Scott Russell, T. Twining, jun., T. Winkworth, E. Chadwick, C.B., C. Wren Hoskyns, R. P. Fauntleroy, Dr. Ellis, Henry Johnson, W. C. Dutton, J. H. Murchison, and others. At one o'clock, they proceeded with M. Arles Dufour to the special building erected in the grounds of the Palais de l'Industrie. M. Arles Dufour addressed the meeting as follows:—

"Our President, His Imperial Highness the Prince Napoleon, and my colleague, M. Le Play, greatly regret that it is not in their power to attend at the opening of this interesting department of the Exhibition, the formation of which is in a great measure due to their persevering exertions. But they would regret still more any delay in the opening, however small, which would otherwise have deprived us of the presence of the members of the Society of Arts of London. We must not forget that the idea of this special Exhibition was submitted by that honourable Society to her Majesty the Empress, who received and patronised it as she receives and patronises everything which relates directly or indirectly to the well-being of the labouring classes.

"To the active and zealous exertions of one of its members, Mr. Twining, and of Messrs. Michel, Cochin, and De Beausset, members of the "Société d'Economie Charitable" of Paris, is due the practical arrangement of this Exhibition, and I am happy to bear witness of the fact in the name of the President of the Imperial Commission, Prince Napoleon.

"Difficulties of various kinds, and especially want of space, have prevented the Imperial Commission from carrying out fully the principle of this special Exhibition. This explains the delay which has taken place, and the small space which it occupies.

"Let us hope that this Exhibition of cheap articles, such as it is, will contribute to lessen the expenses of small households, and let us also hope that it will be the commencement of more complete, and therefore more useful, Exhibitions of this kind."

The speech was received with marked feelings of sympathy from all present. The party then proceeded to inspect the articles exhibited, after which the Exhibition was thrown open to the public.

With this the Society's visit terminated. The number of members and representatives, with their friends, amounted to about six hundred.

During the Society's visit, the members of the Society's Committee for reporting on the improvements going on in Paris, and others, took the opportunity of personally inspecting the magnificent line of street now in the course of construction leading to the Hotel de Ville, and the vast improvements now being proceeded with in that neighbourhood; a large amount of information connected with this subject has been collected, and will be published shortly in the *Journal*.

In addition to this, several members and others have kindly undertaken to furnish for the *Journal*, notes of such departments of the Exhibition as they are most familiar with. Some appear in the present number.

The Secretary desires to express his great regret that the members should on one occasion have been disappointed at the nonfulfilment of the engagements made for them. The circumstance arose from the Secretary-Ge-

neral of the Prefecture being absent from Paris, and the assistant-secretary, with whom the appointment had been fixed, having left for his vacation without communicating to his colleague the arrangements he had made.

Owing to the arrival of the news of the taking of Sebastopol, and the consequent pressure of State business, no day had been fixed by the Emperor for the reception of the Society's address, which was, therefore, placed by the chairman on his departure from Paris in the hands of his Excellency Lord Cowley, to present on behalf of the Society.

On Thursday evening, the 20th instant, a communication was received by the Chairman from Lord Cowley, stating that the Emperor had granted an audience for the reception of the address on the 23rd instant. The Chairman and the Secretary started on Friday for Paris, and proceeded to arrange among the members in Paris a deputation to present the address. The deputation, consisting of the following members, viz.:—Dr. Booth, F R.S., Chairman of Council; Lord Ebrington, M P.; Mr. Henry Cole, C.B., V.P.; Mr. Edwin Chadwick, C.B.; Sir Charles Fox; Dr. Royle, F.R.S., Mr. Chance, of Birmingham; Mr. F. Chance; Mr. Lucy, of Birmingham; Mr. F. Bennoch; Mr. Hollins, President of the Potteries Chamber of Commerce, Mr. Simpson, Mr. Palmer, and the Secretary, proceeded to the Palace of St. Cloud, at two o'clock. Lord Cowley was in attendance, and introduced the members of the deputation, whereupon Dr. Booth presented to his Majesty the following address:—

"SIRE,

"May it Please your Imperial Majesty,

"We the Council and Members of the Society instituted at London in 1754, for the Encouragement of Arts, Manufactures, and Commerce, together with the Representatives of the Literary, Scientific, and Mechanics' Institutions throughout Great Britain and Ireland associated with us, beg leave to approach your Imperial Majesty with sentiments of the most profound respect.

"In accordance with the recommendations of his Royal Highness the Prince Albert, our illustrious President, who founded the Exhibition in 1851, in whose success our Society took a deep interest, we have visited this magnificent city to judge for ourselves of the effects of such displays of industry in accelerating the progress of Arts, Manufactures, and Commerce, as also carefully to inspect those splendid public works which adorn the capital of France, and reflect a lustre on your Majesty's name that will be as lasting as themselves.

"Since our arrival we have regarded with feelings of admiration and delight the manifold features of this Great Exhibition. We rejoice to be enabled to express our decided opinion that the contents of its several compartments afford the most convincing evidence of the marked and rapid progress which has taken place in Arts and Manufactures during the last four years.

"The sublime conception of inviting all nations to contend in friendly rivalry with each other for the promotion of the material welfare of mankind, is fully developed and once more realised in the French Universal Exhibition. This grand display of the vast and varied results of genius and industry assures us that the waste of war will be in some measure compensated, and that beneath the peaceful banners of an onward civilisation the nations of the West will achieve victories not less glorious than those which, under Providence, the justice of their cause and their own enduring bravery have won for their united arms. While the impulse thus given to the cultivation of the arts of peace has multiplied the relations and strengthened the bond of union between France and England, their political alliance, consecrated by the blood of the bravest and noblest of their sons, has ripened into the cordial sympathy of national friendship. That blood has not been shed in vain, for we hold it as our deepest conviction that the solidarity of France and England is the one sure guarantee for the conservation and advancement of the civilization of the world. And we further believe that they may best promote their mutual prosperity by a freer interchange of the products of industry, and consolidate their alliance by uniting their exertions to give a wider development to Arts, Manufactures, and Commerce, whose progress it is the special object of our Society to advance.

"As the faithful and unswerving upholder of that alliance, and the conservator of civilisation, your Majesty receives from us, and from our fellow-countrymen of every class and grade, the spontaneous homage of an unquestioning confidence. We pray your Imperial Majesty graciously to accept this our humble tribute of profound respect and unfeigned admiration.

Given under our Common Seal this eighth day of September, 1855.

JAMES BOOTH, *Chairman of the Council.*
P. LE NEVE FOSTER, *Secretary.*

The Emperor made a gracious reply, thanking the Society and members for the address, and regretting the unavoidable delay which had taken place in its reception, and the inconvenience which, he feared, had been occasioned to the members, and expressing his sense of the kindness which he had received from the English generally. His Majesty then entered into conversation with the members of the deputation, referring more particularly to matters connected with the improvements now going on in Paris, and to questions relating to sewerage and the drainage of towns. The audience lasted nearly half an hour.

The original deputation consisted of Earl Grey, Viscount Ebrington, M.P., General Buckley, M.P., J. Brady, M.P., E. Ball, M.P., W. Ewart, M.P., R. Stephenson, M.P., Sir Charles Fox, E. Chadwick, C.B., H. Cole, C.B., Dr. Booth, F.R.S., J. Glyn, F.R.S., P. Graham, J. C. Macdonald, J. Scott Russell, F.R.S., T. Twining, jun., T. Winkworth, T. Sopwith, F.R.S., the Rev. M. Mitchell, C. Wren Hoskyns, Dr. J. F. Royle, F.R.S., A. Redgrave, E. C. Tufnell, J. Jobson Smith, R. L. Chance, J. G. Appold, F.R.S., J. G. Crace, Dr. Farr, F. S. Cary, J. Scott Smith, W. Lucy, F. Bennoch, W. B. Simpson, M. D. Hollins, P. Palmer, C. F. Audley, F. Chance, with the following representatives nominated by the Institutions:—F. Barker, Bakewell Institute; W. Bide, Yeovil Mutual Improvement Society; Alderman Bramwell, Durham Mechanics' Institution; William Candland, Stoke-upon-Trent Athenæum; J. Cartwright, Loughborough Literary and Philosophical Society; Joshua Clarke, Saffron-Walden Literary and Scientific Institution; J. B. Cooke, Liverpool Chamber of Commerce; Thomas Cox, Cirencester Mechanics' Institution; Cuthbert Curtis, Wellingborough Mechanics' Institution; R. C. C. Dennett, Nottingham Mechanics' Institution; Robert Dawbarn, Wisbeach Mechanics' Institution; Thomas Dawson, Yorkshire Union of Mechanics' Institution; W. Ward Duffield, Chelmsford Mechanics' Institution; Henry Edwards, Lynn Conversazione and Society of Arts; W. G. Everett, M.D., Devizes Literary and Scientific Institution; W. Ewart, M.P., Annan Mechanics' Institution; William Fogerty, Limerick Institution; Benjamin Fothergill, Manchester Mechanics' Institution; D. Francis, Beaumont Institution, Mile-end; G. G. French, Poole Mechanics' Institution; Rev. John Clement Govett, Staines Literary, Scientific, and Mechanics' Institution; Jasper Gripper, Hertford Literary Society; G. Harris, Calne Literary Institution; Edward Heath, Liverpool Mechanics' Institution; Philip Hubbersty, Worksworth Mechanics' Institution; Oliver Ellis Jones, Welchpool Reading Society; William Knott, Oldham Lyceum; C. Langland, Epsom and Ewell Literary and Scientific Institution; Joseph Levi, Jews and General Literary and Scientific Institution; William Mabbell, Coventry Institution; Alexander McIvor, Leeds Mechanics' Institution and Literary Society; W. Marshall, Ely Mechanics' Institution;

Joseph Maugham, Gateshead Mechanics' Institution; Rev. Robert Maugham, Stanhope Literary Society; J. B. Morris, Lewes Mechanics' Institution; David Nicoll, M.D., Royal Institution of South Wales; Charles T. Phillips, Windsor and Eton Literary, Scientific, and Mechanics' Institution; James Poulter, Dover Museum and Philosophical Institution; R. S. Poulton, Maidenhead Literary and Scientific Institution; Moses Provan, Glasgow Athenæum; John Robson, Warrington Museum and Library; Joseph Ridley, Hexham Mechanics' Literary and Scientific Institution; William A. Rogers, Alton Mechanics' Institution; Richard Sharp, Lymington Literary Institution; W. Sparks, Crewkerne Literary and Scientific Institution; Teesdale Stephenson, Durham Washington Chemical Works; R. J. Spiers, Oxford Free Library; William Spooner, Sudbury Museum and Literary Institution; William Sutherland, Croydon Literary and Scientific Institution; Mark Thompson, Newport (Salop) Mechanics' Institution; John Warren, Royston Mechanics' Institution; George Webster, Kings Lynn Stanley Library; Henry Whitfield, Ashford Mechanics' Institution.

*** If any names of representatives have been omitted, the Secretary will feel obliged by their being sent to him for insertion in the next Journal.

## PARIS EXHIBITION, 1855.

### Mineral Products Exhibited.

On Saturday, Sept. 8, Mr. Sopwith, at the request of the Council of the Society of Arts, gave an explanation of the Mineral Products at the east-end of the Annexe, or long gallery.

This building extends for a distance of three-quarters of a mile along the north bank of the river Seine, and is divided into 145 partitions in length, and 4 in width. The numbers lengthways are marked on the pillars, and the letters A, B, C, D, indicate the first, second, third, and fourth divisions of breadth—A, being on the south side of the gallery, next the river. The term "gallery" is here applied to the entire building—including the ground floor as well as the side galleries, which extend on each side along the eastern half of the building.

The numbers commence at the east end of the Annexe, close to the entrance from the Place de la Concorde, and, together with the letters, form an excellent means of reference to any of the objects exhibited. The following numbers and letters indicate the general positions of mineral products, &c.

Nos. 1, 2, 3, 4—A, B, and C.—English Mineral Products.

9 to 13—D.—Minerals, &c., from Canada.

14 to 16—A, D.
44 to 69—A, B, C, D, } Mineral Products of France.

16 to 18—B, C, D.—Ditto Spain and Tuscany.

18 to 19—B.—Ditto Portugal.

19 to 20—B.—Ditto, Turkey, Egypt, &c.

20 to 21—B.—Ditto Greece.

18½ to 22—C.—Coal, Sardinia; Models, &c.

24 to 26—D.—Mineral Products from Sweden.

26—A, B.—Ditto Hamburg and Hanseatic Towns.

26 to 41—A, B, C, D.—Ditto Prussia and Austria.

41 to 44—A, B, C, Ditto, Belgium.

The following brief references, from notes made by Mr. Sopwith, may be found useful by those who wish to direct their attention to mining illustrations and mineral products. They commence from the extreme east end of the Annexe, and the prefixed numbers and letters show the vicinity of the several objects:—

1, A.—Lead and Silver from the mines of W. B. Beaumont, Esq., M.P., at Allenheads, in the North of England. Exhibited by Mr. Sopwith, together with specimens of rocks, ores, and geological models.

2, A.—An excellent collection from the Duchy of Cornwall Mines, accompanied by a descriptive manuscript book, and a series of specimens from South Wales, with a vertical section, on which several of the mineral and geological characters of the strata are well delineated.

4, A.—Minerals from Bristol; a good collection of building stones; marble in square blocks, &c. Partly formed in 1851 by Mr. Thomas Howard; exhibited in Crystal Palace 1851, and presented to Bristol Institution, with considerable additions recently made by Mr. Etheridge.

4, A. Specimens of coal and ironstone from Dowlais Iron Works; varieties of clay from Dorsetshire and Cornwall; specimens of peat in various stages of compression, and a great variety of coal specimens, 272 in number, from different parts of Great Britain. A good collection of specimens of coal, &c., from the Department of Science and Art in Ireland. Large specimens of coke from Marley Hill and Garesfield, with analysis by Dr. Richardson.

3, B.—Examples from Shelton Bar Works; a good section of strata and several instructive specimens; anthracite from Llanelly; copper ores in various stages of preparation; a great number of minerals from South Wales and Ireland; an excellent collection of minerals from Cornwall, many beautiful examples; a large specimen of copper ore from the Devonshire Mines; a collection of coals from Sunderland (extremely well arranged); a section of Jarrow Colliery, showing the dislocations of strata in a coal mine; magnesian limestone; collection of safety lamps; steel mills, &c.

1, 2, 3, 4, B and C.—Illustrations of iron; long railway bars, &c.; chairs and highly-ornamented products of iron. (At 34 B are also several examples of long iron rails.)

9 to 13, D.—Mineral Products from Canada; excellent examples of building stone and other useful materials, well arranged and displayed; a model of the Brock Monument is composed of the same building stone as the original; a great variety of marbles, agates, lithographic stones, ironstone, native gold, silver, copper, slate.

The Canadian collection is very complete and instructive.

15, A.—Several good specimens of modelling in this place are worthy of close observation, as are some maps showing the value of different scales; models of geometric forms and *rocks*, the latter useful for landscape painters, who often err in the geological character of rocks.

15, D.—Geological map of the department of Calais; the system of colours employed is clear and expressive.

14, D.—Interesting map of *minerals* in France, showing the extent and position of mining districts.

16, B.—Coals and other minerals in great variety from Spain; marbles, iron, copper, coke, good examples of lead, silver, antimony, charcoal, salt, &c.

16, C.—Tuscany. A collection of about 1,500 minerals and fossils, iron pyrites, iron ores, galena, marble and building stones, well shown.

18 to 19, B.—Minerals from Portugal, lead, copper, coal, &c.

19, 20, B.—Turkey, Tunis, Egypt. A few mineral products, and good fossil fish.

20, B.—Greece. Emery, magnesia, millstones, an excellent variety of marbles and lithographic stones.

18½.—Sardinia. Large block of coal.

21, 22, B, C.—Switzerland. Maps and models, terra cotta font. At 21 D, in upper gallery, a number of exellent mineral specimens from Norway.

25, D.—Sweden. Excellent specimens of lead, slate, peat, litharge, ironstone, copper; good specimens of iron ores, plans of furnaces, models of water wheels,

several mining models, crushing mills, rolling mills, products of iron, fine castings.

26 to 41, A, B, C, D.—This part of the gallery is extremely rich in mining illustrations.

26 to 27, C, D.—Coal and coke from Saxony; forty-one specimens of stone, in square blocks, extremely well arranged; minerals from Bavaria and Westphalia, well arranged.

Opposite 32, and ranging from 28 to 35, a great variety of minerals, especially iron ores.

32, B.—Large geological map of Rhenish Prussia, with several excellent mining maps and sections. An immense mass of coal. Abundant illustrations of black band and other ironstones.

39, B.—A fine specimen of galena from Holzappel; sections of mines, with drawing of St. Stephen's Church in Vienna, as a scale of comparative size.

41, A, B, C, D.—Coal, marble, copper in great abundance.

42 to 44, C.—Belgium. Minerals, lead, iron, &c. Dumont's maps of Belgium and Europe, at 44, C, are deserving of close study, as illustrations of geological mapping and colouring. Several of the sections of the Belgian coal-fields are extremely curious. Immense blocks of coal, and a great variety of mineral products from Veille Montagne works.

From 44 to the middle of the long gallery is occupied by mineral and other products of France, many of which are on a scale of great extent, and of a most valuable and instructive character.

53 to 59, A, B, C, D.—A good collection of minerals from Avignon, extremely well arranged; a great variety of marbles, extending from 57 to 59 C; slates, large iron plates, and rails.

55 to 65, A.—A great number and variety of mineral products; specimens of lead ores and lead; some good plans and sections of mines; gold from California; a large cake of silver from the lead mines of Pontgibaud, with processes of lead washing, &c., well illustrated. A great many examples of coal from different parts of France, some of great magnitude. At 65 C is a very large and curious model of the coal mines of the company D'Anzin, showing the men at work and the methods of extraction. Near it are several mining models, cages for descending and ascending shafts, &c.

67 to 69, C.—A most interesting series of examples of the products of Algeria, amongst which the minerals are especially worthy of notice, and apparently indicate considerable resources in that important feature of national wealth. The specimens of galena, marbles, &c., are very fine, and a cake of silver, value £2080, accompany the lead specimens from the mines of Le Calle. There is here also a very illustrative drawing on a large scale of the exterior of the mines.

The preceding notes are confined to the eastern half of the Annexe, or long gallery, in which the mineral products of the Exhibition are for the most part concentrated, so much so as to render it by far the most comprehensive school of general study which has ever been formed for the instruction of the miner and mineralogist. But in various other parts of the Exhibition are examples of machinery, models, maps, &c., which form a continuation of this department of study so extensive, and at the same time so clear and self-explanatory, that it is much to be wished that a large proportion of them could be permanently rearranged, as a mining and mineral collection, after the close of the Exhibition, and that upon a scale commensurate with the importance of the subject, for it must be kept in mind that mineral treasures are in every nation the very basis of manufacturing and commercial prosperity. In the gallery of communication leading from the Annexe to the Palace of Industry, is a fine collection of minerals and fossils from Turin; and in the south and east galleries of the Palace itself, the spectator can scarcely avoid noting the large and conspicuous geological and engineering maps, as, for example, the geological map of England and Wales, Griffiths' geological map of Ireland, Ordnance maps of Great Britain, and Knipe's useful compendium of the geology of Great Britain and Ireland. These, in connection with the mineral illustrations sent from other nations, which are placed in various parts of the Exhibition buildings, are so numerous as to be with difficulty grouped in any brief notice like the present. The Australian collections, at the east end of the Palace of Industry, are very complete, and show the remarkable varieties of gold found in different districts. Altogether the mineral kingdom is richly illustrated in the Paris Exhibition, and if the several collections which are now scattered over different parts of the Exhibition, and intermixed with other objects, were brought into one continuous, well-arranged series, they would undoubtedly constitute a more important and instructive mining school and museum than has ever yet been formed.

## PARIS EXHIBITION 1855.

### Products Exhibited by the Colony of New South Wales.

During the Society's visit, Mr. Macarthur, one of the Commissioners appointed to represent the Colony of New South Wales, at the request of the Council explained to the Members the products of this colony, and the following notes have been kindly furnished by that gentleman for the *Journal*:—

The products of the colony of New South Wales are separated, part of them being exposed in the gallery of the Annexe, adjoining the productions of other British colonies; the remainder, comprising the most valuable and probably the most interesting objects, being, for want of room in that quarter, displayed in the Palais de l'Industrie itself, at the top of the staircase, adjoining the East India Company's department, in the British portion of the gallery. Some pains and expense have been devoted towards the arrangement of the objects in this little detached quarter. The cases, which are of very elegant design and good execution, have been made at Paris, wholly of woods indigenous to the colony, which were brought to Europe as part of the collection of the woods mentioned below. There are, besides, some tables and other articles of decorative furniture which serve to show the fitness of the Australian woods for the purposes of ornament, many of them, it is stated, being now for the first time so employed.

#### Gold.

Amongst the contents of the cases may be specified a complete collection of specimens of gold, of considerable intrinsic value, representing the produce of a great number of different gold fields, accompanied by specimens of the respective auriferous earths, or "washing stuffs," and their superincumbent strata. These specimens exhibit a remarkable variety in the colour, form, and size of the grains, the produce of no two distinct fields being alike. More than fifty fields or "diggings" are said to be here represented. This fine collection has been made at the expense of the Colonial Government, and will be sold at the close of the Exhibition.

#### Minerals, &c.

The collection of minerals exhibited by the Rev. W. B. Clarke, of Sydney, next claims attention; it comprises more than 400 specimens, arranged systematically, beginning with the newest formations and terminating with the mountain limestones, granites, &c., of the older series, and forms a complete illustration of the geology of that distant portion of the globe. Many very interesting fossil remains are comprised in this fine collection, comprising impressions of heterocercal fish, bones of the diprotodon, &c., &c.

Secondary to this collection, giving a general idea of the whole formation of the eastern part of Australia, are several other sets of specimens more in detail, to illustrate particular portions of it; such, for instance, are the collections sent by the Rev. C. P. Wilton, of specimens of coal and the various coal measures, with fine impressions of ferns, &c., from the coal district of Newcastle (New South Wales), 60 miles north of Sydney, that sent by Mr. W. Keene, examiner of coal fields to the Government of New South Wales, comprising specimens from the Bullai and Wollongong coal field, 40 miles south of Sidney (the seams in both these localities cropping out on the line of coast cliffs), as well as the very complete collection of specimens of rocks in connection with the auriferous district on the Peel River Company's estate, made by Mr. Fr. Odernheimer. Besides these there are magnificent specimens of copper ore, from various lodes worked in the interior, with ingots of remarkably pure copper produced from them. An interesting set of specimens is contained in a separate case, the produce of a singular field of iron called the Fitz-Roy Iron Mine, the metal being exhibited in every state of manufacture. It is stated to yield 70 per cent. of iron, to exist in inexhaustible abundance, and to possess remarkable qualities, the ore having apparently been forced up by subterranean agency in huge masses, through beds of coal; specimens of the latter are exhibited with the iron. Fine marbles, granites, native sulphate of magnesia, and sulphate of alumina, with gems, argentiferous galena, and molybdenum, besides specimens of coal from various fields more than 400 miles apart, impart additional interest to this branch of the New South Wales contributions.

### Woods.

There are two fine collections of specimens of woods indigenous to the colony, made at the expense of the New South Wales Commission, which are chiefly exhibited in the Annexe. The first of these, made by Mr. Macarthur, comprises more than 240 specimens of distinct species from the districts near Sydney, with their systematic names as far as these could be ascertained, their aboriginal and local names, their average dimensions and the uses to which they are supposed to be applicable. It has already been stated that many fine ornamental woods unknown in Europe, have been selected from them, and successfully applied in the manufacture of furniture, &c., which is exhibited. A selected set of specimens from the hard durable carpentry woods of the collection is at the present time being subjected to a series of experiments to test their strength, flexibility, &c.; these experiments are conducted in the machinery department of the Annexe, under the intelligent superintendance of Captain Fowke, R.E., Secretary to the British section of the Exhibition. The result holds out the expectation that a number of excellent hard woods, of high colonial reputation for durability, may be added to the list of those on *Lloyd's List*, applicable to ships of class A 1; a subject of the greater moment, particularly to the shipping interest, since supplies of African oak are stated to have already become difficult to obtain. The sea board of New South Wales and of Western Australia, and portions of the Island of Van Diemen's Land, promise to afford immense quantities of these noble species of timber trees. The second collection, comprising 90 specimens, was collected by Mr. Charles Moore, Director of the Botanic Gardens, Sydney, from the northern districts of New South Wales, between lat. 26° and 28° S., and comprises many fine and interesting specimens of wood. It is stated that both collections might have been greatly increased had there been more time, or greater facilities in obtaining labour.

## Alimentary Substances.

### Wines.

Amongst the alimentary substances there are more than a dozen distinct samples of wines exhibited, the whole of which are understood to have been favourably classed by the jury of experts called in to assist the Jury of Class II., and some of them are stated to possess remarkable excellence. This branch of industry is of considerable interest to the mother country. As is most frequently the case on their first introduction with manufactures or agricultural products requiring specific knowledge of the subject and much experience, this article, although originated in the colony more than 30 years since, has hitherto struggled on without making any rapid extension; various local difficulties are stated to have occurred for a time, arising chiefly from want of experience in the proprietors, and a deficiency of the labour adapted to the pursuit. These having, to a considerable extent, been overcome, another obstacle, in the want of a market for wines of colonial growth, is stated to exist. The extensive importation of European wines into the colony, amounting to more than 750,000 gallons in 1853, valued at £198,000, interferes with it. Unless the vineyard proprietors of the colony could hold out the expectation of affording to the merchants an equivalent for this extensive importation, in wine to export, it seems clear that it is the interest of the latter to check, or at all events to afford no facilities for, the consumption of the Colonial wine at home, inasmuch as it would interfere with their import trade. This is stated to have been the case. The high character given at Paris to the products of these infant vineyards is therefore of the utmost importance to them; it will probably cause a demand for the wine in Europe, and a rapid increase in its production, reconciling the hitherto antagonistic interests of the merchant and the wine-grower.

As far as information has been secured, it appears that these wines can probably be supplied, duty paid, in London at 24s. to 30s. per dozen.

### Wheat and Maize.

The wheats exhibited are of great excellence, and some of the samples are amongst the heaviest, if not actually the heaviest, of the numerous specimens exhibited throughout the Exposition. The same high character applies to the specimens of maize, some of the cobs or ears of which are of unusually large size, and the corn of the very best quality. The produce is variously stated, according to the varieties, at from 50 to 80 bushels per acre.

### Beef, Biscuits, &c.

Some fine specimens of salt beef in the tierce are exhibited, and meat in tins, preserved fresh, the quality of which is much praised in the colony; but these, it is said, have not hitherto been examined at Paris. These supplies can be afforded in the colony at a lower rate than provisions of similar quality produced in Europe. It is of importance to shipowners to know that they can be obtained in the colony. The ship and other biscuits exhibited are also of excellent quality, and are stated to be extensively manufactured at Sydney by the aid of steam machinery.

### Wool.

The samples of wool exhibited seem to indicate that the exhibitors at least have endeavoured to maintain the reputation of the colony for this, its most important export. There are samples from several flocks in the collection; amongst them a bale, the produce of Mr. E. Cox, from which have been manufactured in France, shawls, satiné de laines, superfine cloths, some of great beauty, which are exhibited; and four samples from the original Merino flock created by the late Mr. John Macarthur, the founder of this branch of industry in the colony. These last are said to have been exceedingly admired by the French experts and manufacturers called in to assist the jury, as possessing the peculiar good qualities which characterise the Australian type, combined with the true Merino character in high perfection.

There are some beautiful specimens of cotton, almost wholly of the long-stapled or Sea Island variety; these are stated to have been produced at Moreton Bay, but from information received it appears that, following the sea-board

of New South Wales from lat. 36° northerly to within the tropics, and in the northern districts to a great distance inland, innumerable extensive tracts of country exist, possessing every requisite for the production of this valuable staple in high perfection. Hitherto, little or no attention to this subject has been paid by the colonists, their time having been devoted to other profitable pursuits; the scarcity of labour combined with want of information has operated to prevent any extensive cultivation of cotton. The former difficulty might be overcome by importing into the northern settlements labour from Bengal; unfortunately the regulations of the East India Company forbid this importation. These regulations having been suspended or relaxed in favour of the Mauritius and the West India Colonies, there seems to be no reason why they should be maintained with reference to those in Australia, where the climate would be not less suitable to the natives of India, and where their condition would, for many years to come, be much superior to that which they obtain elsewhere. The greatest vigilance is exercised by the colonial authorities to protect emigrant labourers of every description from being imposed upon, so that oppression of any kind, under the colonial regulations with respect to emigrants, is stated to be impracticable. A vast territory of virgin soil, waiting only the labour of man to bring it into a state of active production, exists on the one hand, possessing vast supplies of food which are annually wasted; and not very distant from it we see another portion of our empire teeming with people, frequently reduced to a state of distress for want of food, who would willingly emigrate to the former if they knew the improved condition which would there await them. Why should any regulations of the Government interpose to prevent this desirable intercourse from being effected through the instrumentality of the community willing to bear the cost?

It may be added, from competent colonial authorities, that rivers exist along the eastern coast within the latitudes favourable to the growth of cotton, which possess navigable waters, already explored to the extent, collectively, of from 500 to 1,000 miles, nearly the whole of which is bounded by lands favourable to the production of cotton.

Numerous other objects meet the view in the New South Wales collection, of considerable interest, as affording hopes of future advantageous production. In the Fine Arts, however, there is little to notice, except a beautiful medal, struck in London, from dies by Mr. Leonard C. Wyon, after designs by two colonial artists, and three statuettes, two of them in gold, representing the "digger" in characteristic costume at his toilsome trade, and the other, in silver and gold, of an aboriginal savage in pursuit of his game, all executed by a colonial artist, with great truth and considerable merit.

## ON A NEW PROCESS OF OBTAINING AND PURIFYING GLYCERINE.

BY GEO. FERGUSSON WILSON, ESQ., F.R.S.

*Part of this Paper was read at the Glasgow Meeting of the British Association for the Advancement of Science, Sept. 1855.*

The paper I was asked to give was one on our new processes of obtaining and of purifying glycerine. I trust, however, you will excuse, as an introduction, a short sketch of the past history of glycerine and its uses, though it will take us over some ground well known to most members present.

Glycerine was discovered in 1789, by Scheele, as a product in the process of lead plaister making, and was called by him the sweet principle of oils. About twenty-five years afterwards it was studied by the father of fatty chemistry, Chevreul, and shown by him to be the base of fats and fat oils. M. Chevreul lately received a specimen of glycerine obtained by our new process, with expressions of extreme pleasure. Nearly half a century has passed since the earliest of those beautiful researches into the constitution of fatty bodies in the course of which he discovered the function of glycerine, yet our specimen found him still lecturing to his class.

A source of impure glycerine has long existed in the preparation of lead plaister, in which the combination of the litharge with the acids of the olive oil sets the glycerine free; another source in soap-making, the soda or potash setting free the glycerine; and a third source in the stearic candle manufacture, where the lime saponification separates the glycerine. Most of the purifiers of glycerine appear to have preferred this last source.

Notwithstanding the known existence of those great sources of impure glycerine, it was long before glycerine was in any way utilised: hundreds of tons have been and are yearly thrown away.

The first suggestion of a use which we can trace dates in the beginning of 1844, when Mr. Thomas De la Rue, being engaged on some experiments requiring the use of syrupy substances, procured some glycerine from Mr. Warington, of Apothecaries' Hall, some of which he applied to a burn and an irritation of the skin. The experience thus obtained of its properties of soothing and keeping moist, led to its introduction, through Mr. Startin, into the Hospital for Skin Diseases, where it soon came into extensive use.

In 1846 Mr. Warington took out a patent for the use of glycerine as an agent in preserving animal and vegetable substances, and tried many experiments on preserving meat. He informs me that part of a neck of mutton preserved in glycerine for several months, when cooked by Soyer, was partaken of by a gentleman with great satisfaction.

Mr. Warington, I believe, first applied glycerine in mounting objects for the microscope, for which it has proved so successful.

In the *Lancet* of June 1849, Mr. Thomas Wakley published the results of a year's experience in a long and very interesting paper on the Use of Glycerine in Diseases of the Ear, giving a number of cases in which it had proved a cure for deafness. In the number of the 23rd of the same month, his results were confirmed by letters from Mr. Erasmus Wilson and Dr. Gardner, the latter of whom drew attention to the fact that the glycerine should be free not only from any trace of lead, but also as much as possible from water. His theory was, however, better than his practice, for the glycerine he speaks of using, s. g. 1·280, being above the density of anhydrous glycerine, must have been impure.

Isolated applications of glycerine had thus been suggested, but M. Cap appears to have been the first to see its extraordinary value in a great variety of medicinal preparations. His very valuable and interesting papers were published in the *Annales de Pharmacie et de Chimie*, and translated into the *Chemist*. I shall give two short extracts from them.

M. Cap in his first paper (*Journal de Pharmacie et de Chimie*, February 1844, *Chemist*, April, 1854,) begins by attacking the process of purifying glycerine given in the French chemical books, and shows its defects. He then gives his own process, remarks upon the great value of glycerine in skin diseases, and after suggesting a number of valuable uses, proceeds as follows:—

"Glycerine dissolves the vegetable acids, the deliquescent salts, the sulphates of potassa, soda, and copper, the nitrates of potassa and silver, the alkaline chlorides, potassa, soda, baryta, strontia, bromine, iodine, and even oxide of lead. It dissolves or suspends the vegetable alkaloids in the same manner as the aqueous liquids, and at the same time the resulting products may be used for the same purposes as though mixed with oil. Thus the salts of morphia dissolve in it completely, even cold, in all proportions. Sulphate of quinine, in the proportion of $\frac{1}{10}$, dissolves in it when hot, but when cold separates into clots, which when triturated with the supernatant liquid give it the consistence of a cerate very useful for frictions

and embrocations. It is the same with the salts of brucine, strychnine, veratrine, and most preparations of the same order, which enables us to consider that we have now if not medicinal oils with a vegetable alkaloid base, at least a series of new preparations which will fulfil a perfectly analogous use in therapeutics."

M. Cap, in his second paper (*Chemist*, Oct. 1854), states that he employed glycerine of 28 Beaumé, or containing 88 per cent. of anhydrous glycerine, and speaks of it as a solvent of sulphuret of potassium, and sulphuret of lime, of iodine, iodide of sulphur, iodide of potassium, iodide of mercury, of some chlorides, and of quinine, and sulphate of quinine.

In the *Chemist* of February, 1855, Dr. Crawcour, of New Orleans, states that for twelve months past he had been in the habit of using glycerine very extensively in those cases requiring cod liver oil, in which the nauseous taste of the latter medicine rendered its exhibition impossible, and that now, in his practice, it had entirely superseded cod liver oil.

In a paper read at the meeting of the Royal Institution of the 30th of March, 1855, by the Rev. John Barlow, F.R.S., attention was again drawn to the great preservative power of glycerine upon meat. On this occasion Mr. Barlow showed specimens of flesh which had been immersed, some partially and some wholly in glycerine, for more than a month. I can answer for the flesh having appeared to be perfectly fresh.

M. Cap worked upon the waste liquors of soap and stearic candle works, which liquors he had first to concentrate. His process was shortly this:—he used sulphuric acid to separate the lime, and continued boiling and agitation to drive off the volatile fat acids, removing any excess of sulphuric acid by means of carbonate of lime, allowing the liquor to cool at different densities, so as to deposit sulphate of lime, and, after final concentration, treating and filtering with washed animal charcoal.

M. Cap's process, though an undoubted improvement, was not perfect, as glycerine so purified is always liable to contain more or less of salts of lime. And some glycerine, purified in our laboratory, according to M. Cap's directions, contained, in addition, volatile fat acids; and though the process was known in this country, specimens of the so-called "pure" glycerine, obtained from the best sources in London so recently as last January, contained in every case more or less impurity.

The best specimen came from Edinburgh, but even this was not absolutely free from impurity. Some medical men appear to have been afraid to prescribe glycerine for internal use, sometimes with reason, as appears from the *Chemist* of May 1855, when Mr. Hamilton, of Liverpool, referring to the papers of MM. Cap and Garot, and of Dr. Crawcour, stated, that no doubt the glycerine purified and used by them might be safely used internally, but that having doubts about the purity of the glycerine commonly sold as "pure glycerine," he had procured samples from several of the most respectable chemists in Liverpool, and on examination, had detected lead in considerable quantity, and that the specimen in which he detected the largest quantity of lead was labelled "pure glycerine," was sold at double the price of the common glycerine, and was warranted free from lead.

I will now proceed to describe the new process for obtaining and purifying glycerine, and may remark that the road by which we arrived at pure glycerine was a rather circuitous one. Our first step was to do away with the lime process of saponification, and with it our only source of impure glycerine. By our first improvement in separating the fat acids from neutral fats, the glycerine was decomposed by the direct action of concentrated sulphuric acid at a high temperature, and all that remained of it was a charred precipitate. A new process for decomposing neutral fats by water under great pressure coming under our notice, led us to look again more closely into our old distilling processes, and the doing this showed, what we had often been on the brink of discovering, that glycerine might be distilled.

In our new process the only chemical agents employed for decomposing the neutral fat, and separating its glycerine, are steam and heat; and the only agents used in purifying the glycerine thus obtained are heat and steam, —thus all trouble from earthy salts or lead is escaped.

Distillation, however, purifies the impure glycerine of the old sources.

On the table is a series of products of palm oil, which will serve to illustrate the process. Steam, at a temperature of from 550° to 600° Fah., is introduced into a distillery apparatus containing a quantity of palm oil. The fatty acids take up their equivalents of water, and the glycerine takes up its equivalent; they then distil over together. In the receiver the condensed glycerine, from its higher specific gravity, sinks below the fat acids. Sufficient steam must be supplied, and the temperature regulated, otherwise the elements of the glycerine do not take up their equivalent of water, and acroleine is evolved —a body of a very different character, an acrid eye-inflaming vapour, appreciated only by those who have had the misfortune of an experimental acquaintance with it.

In an ordinary apparatus the glycerine distilled from the neutral fat is not in a sufficiently concentrated state for most purposes; it should, therefore, be concentrated, and, if discoloured, be redistilled. It is then obtained, in the state of the specimen on the table, at the temperature of 60° Fah.; it is of s.g. 1·240, and contains 94 per cent. of anhydrous glycerine. It can be concentrated to s.g. 1·260, or to contain 98 per cent.

I have now to mention some uses for glycerine which I believe to be new, or to which I have seen distilled glycerine applied.

A possible use which appears worthy of experiment is to inject it into the bladder, for the purpose of dissolving calculous deposits; from its blandness it should not cause irritation, while, as it is a solvent of urea and phosphate of lime, it might dissolve them when in the bladder. Some of the high authorities have received glycerine for the purpose of the experiment.

The use of glycerine in photography having being suggested, some distilled glycerine has been sent to several of the best photographers and makers of photographic preparations. It was very well received, and considered to promise well, and is still the subject of many experiments, but as yet it does not appear that any great results have been arrived at. It is, however, expected to supersede the honey of Shadbolt's process.

The properties of soothing and keeping moist the skin have caused it to be used upon chapped hands and sunburnt faces. It has been proposed as a substitute for syrup in preserving fruits. Mixed with alcohol or peroxylic spirit, it has been proposed by Mr. Warren De la Rue as an economical fuel for spirit lamps.

For some time past, in Edinburgh as in London, it has been used in skin diseases; it is now being tried in some cases of diseases of the mucous membrane of the stomach.

We have been informed that in the preparation of several medicines glycerine may be substituted for syrup or sugar, with the effect not only of preserving the medicine in an active state and free from change, but also of very greatly improving its taste. Griffiths' iron mixture has been mentioned to us as an instance of this.

Glycerine appears to give the means of preservation of some objects of natural history without change in their colour. This is shown by the specimens of fish upon the table. Our first experiment was upon a brilliantly-coloured two-pound trout, caught in one of the Perthshire lochs. Immediately on taking it from the water I poured a quantity of glycerine over it, and wrapped it in a cloth. At night the fish was cleaned and immersed in glycerine. Next day it was again wrapped in a saturated cloth. On examining it a day or two afterwards in Edinburgh the colour on the scales was unchanged. When it arrived in

London, part was steeped in water and then cooked. Though perfectly fresh and firm, it had lost almost all its flavour. The uncooked portion was immersed in glycerine, and sent to Professor Owen, who suggested that the brilliantly-tinted fishes of the Coral Islands and tropical coasts might be brought home in kegs of glycerine.

On the table are specimens of trout, roach, and perch, which have been, the trout more than two months, the perch and roach more than one month, in their bottles. It will be seen that the colours continue bright.

I may now state in conclusion, that though a variety of uses, actual and possible, for pure glycerine have been mentioned, yet when we consider its power as a solvent, and at the same time its blandness, and freedom from all irritant, exciting, acid, and fermenting properties, we must feel that not a tithe of its uses have yet been developed: that in glycerine there is a wide field open, requiring many scientific and practical labourers, and which, once fully worked, will yield a tenfold crop of uses. Pure glycerine will then take its proper place among the most valued of modern products; and, produced, as it will be, in great quantities, it will be recognised in the arts as well as in medicine as a new real blessing to mankind.

## Home Correspondence.

### DECIMAL COINAGE.

SIR,—In the separate copies of the List of Books and Pamphlets on the Decimal question, instead of the usual short titles, there occurs the following statement:—

"Rathbone, Theo. W.: Letter of the 19th August, 1853, in the *Athenæum*, containing the First Sketch of a Plan for introducing, with no compulsory change but that of the tenpence for the twelvepence, as one of our moneys of account, and a silver coin corresponding in amount of pure silver with the franc to represent this tenpence (the 24th of the pound sterling in value), an absolutely Perfect Practical System of Decimal Accounts in this Country, and an International Silver Coinage with France and all European countries using the franc,—easily extended to the florin or double franc, and the dollar or five franc, decimal system of Europe and America. B."

I do not know on what authority this statement was inserted—it was not in the proofs transmitted to me, and unfortunately it is incorrect in almost every particular, viz., the date, the contents of the letter, and the class to which it ought to be referred, and as I fear it may mislead some persons interested in the progress of the question, I send you the following observations:

"T. W. R.'s" letter is not dated; it was published in the *Athenæum* of the 3rd of September, 1853. It may be thus condensed. After complaining of the committee's scheme and praising the French system, which he regards as a universal monetary system, wishing it to be not only introduced here but to the United States, he then proposes. "In this country, for instance, in place of the half-dozen new mil coins, wholly without correspondence with anything now in existence, proposed by the committee, and the banishment of all the old figures but the pound sterling from our accounts, we should have little to do but to substitute an issue of francs for our shilling, to stamp our sovereign with the number 25,* our crown with 6, and our half-crown as 3 franc pieces, and we might still keep our accounts in pounds, francs, and pence (or double sous), instead of our present pound, *shillings*, and pence."

In the P.S. after reading my letter in the *Times* of Tuesday last, he proceeds—'I would just observe that the great conclusion at which this writer (that letter) arrives, viz., 'that no decimal system of coinage will be just and practicable which does not retain the penny as one of its essential elements,' is entirely in harmony with the scheme which I have proposed. Both in our coinage *and as a denomination in our accounts*, the penny or two-sou piece, the tenth of the franc or livre, (*the unit is far the most widely extended and perfect decimal system in existence*), would retain the position claimed for it, on grounds it appears to me altogether irresistible."

It is clear that T. W. R. in this letter recommends, like a correspondent of the *Times* in 1816, and more lately Mr. James Yates, at the Institute of Civil Engineers, the introduction of the present French coinage in all its details, only with a sovereign of 25 for a Napoleon of 20 francs. That when he speaks of the penny, he intends as he generally also designates it, the *two-sous* piece of France, and not our present penny, or he could not have overlooked that though the sovereign contains (about) 250 two-sou pieces, it only contains 240 English pence. Under such circumstances it should have been marked C, like Mr. Yates's essay, and classed with "other plans."

I suspect that the paragraph added to the reference to the letter should have been appended to the next work, in which Mr. Rathbone, having changed his views, there recommended the tenpenny plan as now usually understood, only urging the retention of the pound as a coin of account, which is incompatible with its true decimal character.

I am, yours, &c.,
JOHN EDWARD GRAY.

20th September, 1855.

* This number cannot be a mere error of the press, as it is repeated several times over in different forms in the letter.

### INTERNATIONAL STATISTICAL CONGRESS AT PARIS.

*To the President and Council of the Liverpool Chamber of Commerce.*

GENTLEMEN,—In conformity with your letter of instructions, I had the honour of attending as delegate from your Chamber (as well as from the Edinburgh Chamber of Commerce, and Society for Promoting an International Code of Commercial Law) the International Statistical Congress held at Paris on the 10th inst., and beg now to lay before you the report of the procedings.

The International Statistical Congress held its first meeting in Brussels, in 1853, the object in view being to introduce unity and uniformity in the statistical documents of different countries. The Congress being chiefly composed of members directing the statistical departments of public administrations, it was contemplated to arrive at an agreement whereby the items of information to be collected, the times when the statistics or census of population should be taken, and the form in which the statistical documents should be drawn out, shall correspond, and be as much as possible alike in all countries, for the purpose of easy reference and comparison.

The Paris Congress was attended by official deputies and other statists from the United Kingdom, Austria, Baden, Bavaria, Belgium, Costa Rica, Denmark, France, Frankfort, Greece, Hamburgh, Hanover, Hesse, Mecklenburgh, Norway, the Netherlands, Parma, Peru, Portugal, Prussia, Saxony, Sardinia, Spain, Sweden, Switzerland, Tuscany, the Two Sicilies, the United States, and Wurtemburg. The Minister of Agriculture, Commerce, and Public Works of France presided over all the sittings of the Congress, which met at the Corps Legislatif for six days, and the members of the Congress were honoured by a reception by the Emperor, at the Palace of the Tuileries.

The first Congress, held at Brussels, dealt with the questions of Population, Territory, and National Survey, Emigration, Agricultural Statistics, Industrial Statistics, Commercial Statistics, Navigation, Economical Budgets, Statistics of Pauperism, Educational and Criminal Statistics. The present Congress endeavoured to establish a system of statistics relating to Means of Communication, Agricultural Statistics (not completed at the first meeting

at Brussels), Penitential Establishments, or prison discipline, Judicial Statistics, Provident Institutions, Statistics of Accidents, of Insanity, of Epidemics, and of Great Cities, and other important questions connected with medical science.

Without extending on the first subject, respecting the means of communication, which comprises roads, bridges, railways, natural and artificial navigation, harbours, light-houses, telegraphs, &c., I shall pass to Agricultural statistics, the collection of which has been repeatedly urged in this country. This question attracted considerable attention, and both at the meeting of the Section (the Congress being divided into sections, for the better consideration of the various subjects), and at those of the Congress, the discussion was very animated. The first point was—By whose instrumentality shall such statistics by collected? Shall the agents be salaried or not? In other words, as applied to this country, shall the operation be entrusted to the Poor Law Board, or other public bodies or societies, or to paid inspectors? The Congress decided in favour of the latter, except in cases where non-salaried commissions may be safely and conveniently formed. As to the method for obtaining such statistics, it was decided that, first of all, the Governments should obtain a good topographical survey; where that exists, it should serve as the basis of, and control upon, the agricultural statistics; where no survey has been made, care should be taken to obtain local guarantees for the utmost correctness. The statistics of the acreage laid out in different crops should be taken in May or June: those of the crops soon after the harvest, the statistics of cattle in December. Besides the annual collection of the statistics of the acreage and crops, decennial statistics were suggested for a fuller and more detailed account of the state and progress of agriculture. I have laid before the Congress the Report of the Committee of the House of Lords on Agricultural Statistics, and also the Reports of Agricultural Statistics in Scotland, Ireland, &c., &c.

On the subject of judicial statistics, both as regards civil and commercial justice, some important recommendations were made. The law of imprisonment for debt has created much interest in the Continent, and it was decided to inquire into its working by indicating in the statistics the ages and sexes of the persons imprisoned, the nature of the debt, the profession of the debtor and creditor, the duration of the detention, and the causes of the liberation. It was also suggested to form a better classification of the number of judgments given by each group of tribunals, their organisation, and their competence, the amount of notarial acts, according to their different nature, the number of contracts under seal, and of judicial sales, the number of partnerships according to their legal character, the consumption of stamped papers according to the tariff, and the amount of bills of exchange and other negociable titles.

Bankruptcy statistics, of which there is a complete want in the United Kingdom, formed part of the inquiry. With respect to these, besides the description of the trade, it is important to know the comparative solvency of individual or private traders, commandite partnerships, general partnerships or public companies, &c., &c. No such distinction was hitherto made on the personality of the bankrupt, and I suggested its introduction. Another addition was made in bankruptcy statistics, viz., the immediate or proximate causes of bankruptcy, whether brought about by misfortune, by ignorance, by speculative adventures, or by operations beyond the range of the ordinary trading, or by waste or gambling.

The subject of assimilating the commercial laws of different countries was seriously discussed, and it was decided that it would be of much utility in the interest of statistics, of international commerce as well as for the benefit of individuals, to establish, as much as possible, uniformity in the law and usages which govern commerce, and especially in the facts and acts which are of the same nature in all countries, such as bills of exchange, partnerships, bankruptcies, &c. The report on the subject, after having described the advantages of the study of comparative jurisprudence eloquently stated,—"A day will come when all legislations shall be submitted to, or shall be compared in their theories, by the jurisconsults, and controlled in their results by the statists. Then a new light will be afforded to all nations, which will enable them to appreciate the merits or imperfections of their legislators. Then we shall obtain uniformity in the commercial laws of nations, the necessity of which will be felt every day more by the multiplicity of relations between people and people, the rapidity of the exchanges, and the importance of international transactions. This uniformity of legislation has been early prepared by the Roman law; now we feel the want of it, and it will be a great glory to have prepared it for the future. The civilized world has tended for eighteen centuries towards the same moral law—that written by God himself in the Gospel. Let us pursue this great and fruitful universality, which will by degrees efface all differences, create uniformity in all laws, and leave but one balance in the hands of justice."

Considerable importance was attached to the forming of statistical departments in all countries to superintend and to systematize the statistics of all the branches of the public service, a subject already strongly recommended by the Brussels Congress. In this country such a department is especially needed, that originally founded by Mr. Porter of the Board of Trade, and now ably directed by Mr. Fonblanque, being very limited in its functions. When we consider the irregularity which exists in the publication of statistical documents, the imperfect form in which they often appear, merely as appendices to otherwise highly important reports, and the want of system in all such publications, which renders them often the ready tools of political parties, it will be admitted that a great national good will be derived from the creation of a complete statistical department. The report on the subject described the state of statistic administration as follows: "Many statistics are at present collected without a statistical department, because each branch of administration wants to know the result of its labours, that it may serve as the basis for the future. These statistics, which contain much precious information, remain mostly in the archives, and are altogether lost to the use of science. We often see the statistical department circumscribed in its labours to the facts of the administration of the university to which it is attached. And often those connected with the same ministry consider this department simply as a scientific institution with which they have nothing to do. It is quite evident that this state of things is neither profitable for the science, the domain of which is so restricted, nor for the administration which is deprived of the assistance of science, and which, by so acting, will always experience a difficulty in collecting all its forces and knowing all its means, because it must seek them out from many offices, in tables drawn up according to plans altogether different and having no relation among themselves. In the opinion of the section there is only one means to remedy the evil and to avoid the inconveniences resulting from the present method of collecting statistics, and that is the centralization of its labours by the formation of Central Statistical Commissions, formed of members from the principal branches of public administration and other persons, who by their studies and by their special knowledge, may assist the practice and resolve the difficulties which belong entirely to science." The entire question is worthy of the most serious consideration of the Chambers of Commerce of the United Kingdom, the interests of commerce being greatly connected with correct statistics of trade, navigation, value of imports and exports, &c. With respect to the other subjects of inquiry, it may be sufficient to state that the Congress have laid the basis for the statistics of Provident Institutions, including Savings

Banks, Friendly Societies, Tontine Institutions, and Insurance Companies; Statistics of Accidents, such as Accidents in Workshops and Manufactories, Accidents on Roads, Accidents in Mines, and Accidents on Railways; Statistics of Mental Alienation and Statistics of Epidemics; and, lastly, Statistics of Great Cities, including Topographic Situation, Area, Houses, Hygiene, Public Security, Population, Consumption of Produce, Industry, and Commerce, Means of Communication and Transport, Municipal Organisation and Municipal Budgets, Public Charities, Provident Institutions, Statistics of Criminal and Civil Justice, Public Instruction, Religion, and Public Amusements.

A desire was expressed that the programme of the next Congress should embrace the subjects of Finances, Public Instruction, and the statistics of Articles of Food.

The want of assimilating the Moneys, Weights, and Measures of different countries was again felt and expressed by a vote of the Congress. As the question of introducing the decimal system into all monetary institutions is almost ripe for legislation, it is all-important that, in effecting the change, we should obtain a measure as complete as possible, avoiding the usual practice of piece-meal legislation. And inasmuch as a universal tendency exists to remove the differences which separate nations from each other, it is also essential that we should not have to remain still in a state of isolation, but that with equal convenience, and even at some temporary national sacrifice, we should put our institutions of Moneys, Weights, and Measures on a par with those of foreign countries.

It has been proposed to invite the International Statistical Congress to hold its third meeting in London, in 1857. Should such a proposal be realised, the Chambers of Commerce might confer an essential benefit by indicating what special branches of commercial statistics, are found wanting in this and other countries.

The happy cordiality which prevailed among all the Members of Congress, most of whom being individuals of the highest eminence in science, and in official position, and the hospitality and extreme kindness which were manifested by the Minister of Commerce, as President, and by all the Members of the French Statistical Commission, have contributed materially to the success of this great Statistical Assembly, and deserve the grateful acknowledgment of all the delegates and of the governments and learned societies therein represented.

I have the honour to be, gentlemen,
Your obedient servant,
LEONE LEVI.

12, The College, Doctors Commons,
London, 22nd September, 1855.

## PUBLIC LIBRARIES ACT.

SIR,—The publication, in your last number, of the Public Libraries Act of last session, suggested to me that you, or some of your obliging correspondents, might be able to inform your readers of the number of towns and parishes in England in which Free Libraries have been established—of any places which have refused to adopt the Act—and of any circumstances connected with the working of the local rate system.

I hope to have the honour of bringing the matter before the Town Council and citizens of Limerick, and as the Act is as yet untried in Ireland, the information I seek for may, if obtained, assist in attaining the object I have in view—the establishment of a Free Library in Limerick.

I am, sir, your very faithful servant,
WM. LANE JOYNT.

Kilkee, County Clare, September 24, 1855.

## NORTHERN UNION EXHIBITION.

SIR,—I shall esteem it a great favour if you will insert this note in the columns of your excellent *Journal*, which will give a degree of publicity to the intentions of the Northern Union of Literary and Mechanics' Institutions that otherwise could not be obtained.

At the next annual meeting, which is to be held at Newcastle on the 31st of October, under the presidency of the Right Hon. Earl Grey, an Exhibition of Works of Art and Education will be held in aid of the funds. Through the liberality of the Society of Arts of London, their collection of photographs, together with local productions, will be exhibited.

It is proposed to make the exhibition as much educational as possible; and, to carry out this object, tables will be provided for the display of books, maps, globes, philosophical instruments, models, and all articles appertaining to teaching. Those persons who purpose favouring the exhibition with any of the above objects, are requested to inform me, on or before the 16th of next month, of their intentions, and the prices have to be attached to each article. No such exhibition ever having been held in the north, it will, I have no doubt, be productive of great advantage, by affording teachers an opportunity of examining the most approved plans, which the progressive advances of the age have adopted in teaching.

I am, sir, your obedient servant,
J. L. THORNTON, Hon. Sec.

Gibson-street, Newcastle-on-Tyne,
September 25th, 1855.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette September 21st*, 1855.]

*Dated 5th June*, 1855.

1287. A. Morton and E. Hunt, Glasgow—Motive power engines.

*Dated 20th July*, 1855.

1639. W. A. Gilbee, 4, South-street, Finsbury—New material in the manufacture of paper. (A communication.)
1645. F. Moll, Annaberg, Prussia—New materials in the manufacture of paper.

*Dated 23rd July*, 1855.

1663. C. Goodyear, 25, Avenue-road, St. John's-wood—Wheels for carriages, &c., where india rubber is used.
1665. C. Goodyear, 25, Avenue road, St. John's-wood—Bands for holding papers, &c., where india rubber is used.

*Dated 11th August*, 1855.

1823. T. Hewitt, Lorn-street, Chester-road, Manchester—Machinery for pulverizing and levigating.

*Dated 16th August*, 1855.

1865. W. Hudson, Burnley—Stop rods or protectors in power looms.

*Dated 18th August*, 1855.

1875. Robert Crawford, Beith—Ornamental weaving.

*Dated 25th August*, 1855.

1930. A. H. Hardy and J. H. Fordoff, North Bierley—Pill and ointment for scorbutic disorders.

*Dated 30th August*, 1855.

1956. J. Gedge, 4, Wellington-street South, Strand—Galvanizing substances. (A communication.)

*Dated 1st September*, 1855.

1974. A. M. Job, 22, Halliford-street, Lower-road, Islington, and E. Tomlinson, Barn's Cray, Crayford—India rubber leather cloth, applicable to covering roofs, &c.

*Dated 5th September*, 1855.

2008. W. Craymer, Bristol—Propelling vessels.
2010. A. Palmiéri and J. B. Ferrari, 39, Rue de l'Echiquier, Paris—A new system of construction of ships or vessels. (A communication.)
2012. G. Peacock, Gracechurch-street—Ship building.
2014. I. Nettleship, Derby—Spindle for spinning silk, &c.

*Dated 6th September*, 1855.

2016. T. Schwartz, New York, U.S.—Heating or cooling aeriform and liquid bodies.
2020. W. A. Gilbee, 4, South-street, Finsbury—Purification and clarification of oils. (A communication.)

*Dated 7th September*, 1855.

2022. S. Hand, Glinton Iron Works, Glinton—Combined cake-crushing, oat-bruising, and bean-splitting mill.
2024. R. A. Brooman, 166, Fleet-street—Casting mortars, cannon, &c. (A communication.)
2026. J. Stewart, Preston—Steam boilers for the more effectual consumption of smoke.
2028. L. Dameron, Paris—Construction of carriages.

*Dated 8th September*, 1855.

2030. H. Hart, 5, Waterloo-crescent, Dover—Lubricating and burning oils. (A communication.)
2034. H. Boucherie, Bordeaux—Impregnating woods with chemical materials, &c.
2036. A. H. A. Durant, Tong-castle, Salop—Raising and lowering weights, and saving persons, &c., from fire.
2038. A. H. A. Durant, Tong-castle, Salop—Apparatus for ascertaining the number of, and distance travelled by, passengers in public carriages.

2040. A. H. A. Durant, Tong-castle, Salop—Sweeping chimnies.
2042. H. Webster, Dalby-terrace, City-road—Construction of chronometers, clocks, watches, &c.
2044. J. Panet, Echenoz-la-meline, France—Hydraulic system for propelling on railways, or obtaining motive power and distributing water.

*Dated 10th September*, 1855.

2046. C. Hewett, 8, King's-road, Pentonville—Baking ovens.
2048. J. Rhodes and J. Johnson, Manchester—Steam engines.

*Dated 11th September*, 1855.

2052. J. Gimson, Welford-road, Leicester—Feed apparatus for steam boilers.
2054. G. S. Hinchliff, Piccadilly—Paper hangings. (A communication.)
2056. F. H. Lebaigue, Little Titchfield-street—Chocolate.

*Dated 12th September*, 1855.

2060. J. Higgin, Manchester—Treating madder or preparations of madder.
2064. J. G. Roger, Trinity-street, Cardiff—Ships' signal lanterns.

*Dated 13th September*, 1855.

2068. R. B. Cousens, 50, Halliford-street, Islington—Machinery for making casks.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2062. J. Partridge and J. Kirkham, West Bromwich—Malt crushers.—12th September, 1855.
2091. J. Gray, M.D., Nos. 4 and 5, Princes-street, Dublin—Water closet arrangement.—17th September, 1855.
2100. A. E. L. Bellford, 32, Essex-street, Strand—Fountain lamps. (A communication.)—17th September, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed September 22nd*, 1855.

645. Frederick Ransome, Ipswich—Improvement in the manufacture of artificial stone.
650. Robert Joseph Jesty, Great Northern Railway, King's-cross—Improvements in apparatus for indicating between parts of a train of carriages on a railway.

*Sealed September 25th*, 1855.

663. John McKinnell, Glasgow—Improvements in ventilation.
667. Henry Charles Hill, Parker-street, Kingsland—Improvements in the manufacture of waterproof flocked cloth and other fabrics.
674. John Cooke Bourne, Holmes-terrace, Kentish-town—Improvements in photographic apparatus.
675. John Gedge, 4, Wellington street South, Strand—Improvements in the mode or modes of transferring designs on to woven, textile, or other fabrics, or on paper, and in the machinery used for such purposes.
682. John Shae Perring, Radcliffe—Improvements in the permanent way of railways.
684. François Etienne Hudde and Jean Baptiste Emmanuel Fouquet, 39, Rue de l'Echiquier, Paris—Improvements in the construction of pyrometers.
685. William Hutchison, Tonbridge Wells—Improvements in manufacturing artificial stone and in giving colour to the same.
694. John Gedge, 4, Wellington-street South, Strand—Improvements in the means of stopping or retarding railway trains. (A communication.)
699. Alexander McDougall, Manchester—Improved method of consuming smoke in steam engine or other furnaces or fireplaces.
708. William Swain, Birmingham—Improvements in furnaces for japanners' stoves, ovens, boilers, and kilns, and which improvements are also applicable to other fireplaces, by which combustion is rendered more complete and the fuel thereby greatly economised.
710. George H. Babcock and Asher M. Babcock, Westerly, U.S.—Improvements in presses for printing in colours, called polychromatic printing presses.
719. John Bailey Surgey, Lidlington-place, St. Pancras—Improvements in instruments for threading needles.
720. William Corbitt, Elm Tree Bank, Rotherham—Improvements in warming and ventilating apartments, parts of which improvements are applicable to the prevention of smoky chimneys.
721. Robert Hardman, Bolton-le-Moors—Improvements in looms for weaving.
725. Thomas Russell Crampton, Adelphi—Improvements in locomotive and other steam boiler furnaces.
740. Thomas Prideaux, Birmingham—Improved plough for draining and other similar purposes.
751. Samuel Greenwood, Sunderland—Improvements in machinery for making rivets, bolts, nuts, and other similar articles.
755. Louis Ambroise Michel Mouchel, Paris—Improved method of joining pipes, tubes, and ducts.
759. James Chesterman, Sheffield—Improvements in the manufacture of table and other like knives.
770. Alexander Rollason, Birmingham—Improvements in photography.
791. Lord Charles Beauclerk, Riding, Northumberland—Improvements in machinery for tilling and subsoil ploughing.
795. Léopold Oudry and Alphonse Oudry, Paris—Improvements in preserving wood, metal, and other substances.
805. James Lee Norton, Holland-street, Blackfriars—Improvements in separating wool and other animal fibres from vegetable matters, and in drying wool and other animal fibres.
812. William Terry, Francis-street, Aston, Birmingham—Improvements appertaining to breech-loading fire-arms.
814. Jules Laleman, Lille, France—Improved machinery for combing flax and other similar fibrous materials.
1007. Samuel Roberts, Hull—Improvements in steam engines.
1144. Alexander Henry Mentha, Manchester—Improvements in the manufacture of wadding, and in the machinery or apparatus connected therewith.
1301. Moses Heap, Blackburn—Improvements in machinery or apparatus for "grinding" dye woods or roots, and for other similar pulverizing purposes.
1335. Isaie Lippmann, 4, Rue Geoffroy Saint Hilaire, Paris—Improvements in dyeing or colouring the hides and skins o animals.
1385. Thomas Blanchard, 2, Rue Drouot, Paris—Improved method of bending timber.
1452. Moses Poole, Avenue-road, Regent's-park—Improvements in sculpturing surfaces of marble and stone.
1570. Samuel Cunliffe Lister, Bradford—Improvements in weaving looped or pile fabrics.
1573. Richard Hornsby, Spittlegate Iron Works, Grantham—Improvements in thrashing machines.
1596. William Edward Newton, 66, Chancery-lane—Improvements in vices.
1603. Henry Samuel Boase, Claverhouse, Bleachfield—Improvements in the process of drying organic substances.
1618. William Ball, Ilkeston, and John Wilkins, Nottingham—Improvements in the manufacture of warp fabrics.
1684. Benjamin Bailey, Leicester—Improvements in manufacturing knitted fabrics.
1722. James Kerr, Bedford-terrace, Trinity-square, Southwark—Improvements in revolver fire-arms.
1728. Charles Piper, Cambridge—Improvement of gun stocks of every description used both for sporting and military purposes.
1732. John Hanson, Dough, Belfast—Improvements in machinery or apparatus for digging potatoes.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

20. Charles Frederick Bielefeld, Strand—Improvements in constructing portable houses and buildings.
49. Edmund Morewood and George Rogers, Enfield—Improvements in coating metals.
95. William Oxley, Manchester—Improvements in apparatus for heating and drying.
100. William Potts, Birmingham—Improvements in sepulchral monuments.
251. Auguste Edouard Loradoux Bellford, 16, Castle-street, Holborn—Improvements in sewing machines.
296. Alfred Trueman, Swansea—Improvements in obtaining copper and other metals from ores or matters containing them.
324. Thomas Restell, Strand—Improvements in chronometers, watches, and clocks, part of which improvements is applicable to roasting-jacks.
407. Charles Henry Waring, Neath Abbey, Glamorganshire—Improvements in the cutting and working or quarrying of coal, stone, shale, clay, and other similar substances, and in machinery for that purpose.
77. Stephen Soulby, Ulverston—Improvements in machinery for letterpress printing.
96. Henry Bridson, Bolton-le-Moors—Improvements in machinery to facilitate the rinsing, washing, and cleansing of fabrics, which machinery is also applicable to certain operations in bleaching and dyeing.
142. Henry Bernoulli Barlow, Manchester—Improvements in the manufacture of cylinders for carding cotton and other fibrous substances.
184. Joseph Needham, 26, Piccadilly—Improvements in breech-loading fire-arms, and in apparatus connected therewith.
200. William Coles Fuller, Bucklersbury, and George Morris Knevitt, New York—Improvements in applying india-rubber or other similarly elastic substance as springs for carriages.
545. Charles Benjamin Normand, Havre—Improvements in machinery for sawing wood.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3760 | September 20. | Improved Mill Frame. .......................... | E. R. and F. Turner ......... | St. Peter's, Ipswich. |
| 3761 | ,, 25. | Linnecker's Smoke Consuming Furnace. | Ravel Linnecker .............. | Norton Woodseats. |

Journal of the Society of Arts.

*FRIDAY, OCTOBER* 5, 1855.

## MEETING OF COUNCIL.

Wednesday, 26th September, 1855.

The following Institution has been taken into Union since the last announcement:—

399. Fenton (Staffordshire Potteries), Literary and Scientific Institution.

## PREMIUM LIST.

Members who visited Paris and others are requested to be good enough to communicate to the Secretary any suggestions which may have occurred to them as desirable for the Society's forthcoming Premium List.

## SOCIETY'S VISIT TO PARIS.

The following name was omitted from the list of Representatives nominated by the Institutions given in last week's *Journal*:—

Hugh Dunn, Darlington Mechanics' Institute.

## PARIS EXHIBITION.

### Palais des Beaux Arts.

On Thursday, the 6th of September, Messrs. F. S. Cary and J. Leighton, at the request of the Council, showed a party of the Members the Palais des Beaux Arts. The following notes have been kindly furnished for the *Journal* by the former gentleman:—

The present Paris Exhibition, which is considered to be superior in many respects to our Great Exhibition of 1851, is most remarkable for the collection of modern pictures from all nations.

We have been accustomed to see the works of the old masters brought together from different countries, and were thus enabled to judge of the merits and style of all the early schools. It was suggested to the Royal Commissioners of the Exhibition of 1851, that they might admit modern paintings to the Crystal Palace; but they shrunk from the greatness of the task. It has, therefore, been left for the Emperor Napoleon (whose word alone commanding anything to be done is sufficient to ensure its being accomplished) to form the finest collection of modern pictures that the world has ever seen.

In a short visit it would be impossible to take a minute view of such a vast gallery, containing, as it does, more than 5,000 works of art. We must, therefore, be contented with a glance at those specimens which are the most striking examples of the talent of each country.

The French artists occupy half the Exhibition, and have as great a number of works as all the other nations put together. Owing to this circumstance, there are more pictures of an inferior class to be found in the French department than almost in any other. At the same time the great space allotted to them has afforded an opportunity for their painters of large historical pictures to appear to the greatest advantage; and although they cannot be compared with the old Italian masters, there can be no question as to their being superior to all modern schools in this class of art.

Ingres and Horace Vernet have each a large room to themselves; the works of the former, learnedly clever, hard, and repulsive, unvaried in style and execution, are greatly admired by French artists, and I believe by the people in France; but as I am unable to appreciate their merits, I shall pass them all by, with the exception of the cartoons for stained glass windows, which are most delicately drawn, and are the best adapted designs for the purpose that I have ever met with. They are flat and distinct in treatment, and grand in composition.

The works of the latter, Horace Vernet, are more easily understood. They are addressed to the multitude, and the multitude know what they mean. The "Smala" is a *real* charge of cavalry surprising a camp of *real* Arabs, who are determined to fight to the last in defence of their women and their treasure. The horses, foreshortened, dash completely out of the picture; the landscape and sky are clear, open, and real, not made up of smoke and mist, but represented with that broad daylight effect with which Roberts would paint an eastern view, only without his sweetness of tone, Vernet's intention in this picture being rather to astonish than to please. In the same room is to be seen his "Boar Hunt," the "Return from the Lion Hunt," the "Mazeppa," "Rebecca at the Well," and many paintings of a variety of subjects, which show his power of executing pleasing cabinet pictures.

The upper part of the two great rooms are principally occupied by large historical pictures from the Luxembourg, and other galleries in the neighbourhood of Paris. Here are Delacroix's works; gorgeous in colour, mild in composition, and doubtful in drawing. The Dante and Virgil in the boat is a more careful picture, deserving the reputation it has earned; the colour rich and pleasing to the eye, yet suited to the awful subject, and the drawing not objectionable. Biard's dramatic sea pieces, Cogniet's "Massacre of the Innocents," and "Death of Tintaret's "Daughter;" Gerome's "Augustine Age;" the "Pillory," by Glaize; "Vive l'Empereur," and "Victims of the Reign of Terror," by Muller, and many more in that huge style for which our neighbours are so famous.

It is very remarkable, the number of subjects of horror and bloodshed which thrust themselves upon one's notice in the French department of the Exhibition, more especially as they are a pleasure-seeking people, loving happiness, and easily pleased, cruelty being the opposite of their nature. What reason is there then for the French artists dwelling so much on the painful side of human nature? The French people cannot require these disgusting historical facts to be perpetuated for their enjoyment, or they would not collect in such crowds around our happy English pictures. Mulready, Horsley, Millais, Goodall, Webster, Frith, Leslie, &c., evidently delight them. A priest, with an unusually attentive congregation around him, is generally to be seen explaining points of interest in these pictures; he never fails to notice how, in Mulready's picture of the "Wedding Gown," the linen-draper puts on his most polished manner to the beautiful bride, assuring her that the material she is about to buy is of the very best manufacture, while the countenance of his wife in the background reflects the stupidity of her customer. At first sight of Frith's picture, everybody laughs, with Lady Mary Montague, until the figure of the afflicted poet is seen, when a feeling of compassion is excited. Leslie's dry humour, Webster's fun, Stone's love, and Millais pathos, interest the learned, as well as the unlearned, far more than all the French horrors. In the English pictures whatever would shock the feelings is either subdued or omitted. Maclise, in the "Ordeal by Touch," has placed the murdered man in the background. Pickersgill's "Harold" is full of deep sentiment, without being gore-stained. In Knight's "Shipwreck" nobody is drowned. Cope soothes the "Death of Lear" with sweet music, and Eastlake's "Spartan Youth" is victorious without bloodshed. The Italian painters never represented disgusting incidents until the time of the Caracci, when art began to decline in Italy. That this endeavour to excite unpleasant feelings is not necessary for the French people, is shown by the success of Delaroche, Scheffer, and some other artists, who do not exhibit, but whose works are well known and highly appreciated in France. Dela-

roche's painting, exhibited last year at the French exhibition in Pall Mall, of the assassination of the Duke de Guise, is an instance of the interest he can impart to a dreadful subject without shocking the feelings.

If we turn our attention to the cabinet pictures in the French school, we shall find many beautiful paintings of landscape, flowers, cattle, portrait, and common-life subjects, which are in general painted in a more bold and vigorous manner than we are accustomed to see in England. Amongst these may be mentioned Decamp's Eastern courtyards, with strong moonlight effects and deep shadows; Troyon's cattle, particularly the "Yoke of Oxen going to Work,"—the quiet motion of the beasts and the still morning light is wonderfully fine; Beaumont's "Gleam of Sunshine;" Benouville's picture of "St. Francis Blessing the City of Assise," well known by a beautiful lithograph; St. Jean's "Fresh Roses;" Ziem's sea views; Rosa Bonheur's charming "Hayfield," a conscientious imitation of nature, notwithstanding the peculiar moonlight effect of deep shadow; Scheffer's manly portraits; and Winterhalter's courtly dames.

Amongst the very small pictures are some most exquisitely-finished little paintings by Bellangé, Chavet, Plassan, and Meissonier, artists highly and deservedly esteemed in France, but not yet well known to the British public. Nothing gross or offensive is to be seen in their works, which are mostly of a playful or humorous character, exhibiting a true relish for whatever is agreeable in nature, both as to colour and form, and in some instances equalling the old Dutch masters for delicacy of pencil.

The Belgians come out with great strength, and like the French, take a wide range in their class of subjects; indeed, they appear to be formed rather by the modern French school than by the early Flemish painters. Their great historical works are painted in that free off-hand sort of manner as if art to them had no difficulties. Verlat's "Assault of Jerusalem" is an instance of more care and thought. "The Village School," by De Braekeleer, Alfred Stevens' domestic subjects, Madou's fetes, and Piéron's landscapes, are works of great merit. Louis Robbe's "Landscape and Cattle" will bear comparison with the best pictures in the Exhibition, though not so bold as Troyon, nor so delicate and tender in tone as Cooper, yet uniting qualities belonging to each. Willems has three very fine cabinet pictures; "Coquetry," and the "Interior of a Silk-mercer's Shop," are excellent in drawing, character, and colour. His works, and those of Verboeckhoven, the famous animal painter, approach nearer to perfection than anything else in the Belgian school.

The Germans have some well-drawn and finely-composed pictures, though mostly dull and heavy in colour. Their Scripture-pieces are treated with more purity and taste than the large French works of the same subjects. "Christ predicting the Fall of Jerusalem," by Begas; Hildebrandt's "Winter;" Kaulbach's compositions, and Cornelius's cartoons, are all worthy specimens of German art.

## COMMISSIONERS OF PATENTS.

### Abstract of the Report for 1854. Dated 23rd July, 1855.

The Commissioners of Patents appointed under the Patent Law Amendment Act, 1852 (15 & 16 Vict., c. 83), in compliance with the terms of the third section of that Act, make the following Report of all their proceedings under and in pursuance of the same, for the year 1854, in continuance of their First Report of proceedings for 1852-3, dated the 31st July, 1854.

The number of applications for provisional protection recorded within the year 1854 was 2,764; the number of patents passed therein was 1876; the number of specifications filed in pursuance thereof was 1828; and the number of applications lapsed or forfeited, the applicants having neglected to proceed for their patents within the six months of provisional protection, was 888.

The number of applications recorded within the first six months of the current year (1855) was 1,493, showing a probable increase as compared to the number of the year 1854.

All the provisional, complete, and final specifications filed in the office upon the patents sealed under the Act, from the 1st October, 1852, to the 30th June, 1855, 4,897 in number, have been printed and published with lithographic outline copies of the drawings accompanying the same. The prints are sold to the public at the Patent Office, and each specification is printed and published within three weeks of its deposit in the office.

The provisional specifications filed in the office within the same period and lapsed and forfeited, 2,290 in number, have also been printed and published.

Printed certified copies of all the specifications filed in the office up to the 30th June, 1855, as also certified copies of patents and of the record book of assignments of patents and licences, with copies of such assignments and licenses, have been sent, in continuation, to the office of the Director of Chancery in Edinburgh, and the Enrolment Office of the Court of Chancery in Dublin, pursuant to the Act of 1852, and the Act of the 16 and 17 Vict., c. 115.

The following is a list of the publications made by the Commissioners since the commencement of the Act (1st October, 1852). The whole are printed in imperial 8vo., and the specifications alone form 170 vols. of letter-press, and the like number of vols. of lithographic drawings.

#### Indexes of Patents.

1. Titles of Patents of Invention (chronologically arranged). From March 2, 1617 (14 Jas. I.) to October 1, 1852 (16 Vict.) 2 vols. (1554 pages).

2. Alphabetical Index of Patentees of Inventions, for the same period. 1 vol. (647 pages.)

3. The Subject-Matter Index of Patents, for the same period. 2 vols. (970 pages.)

4. The Reference Index of Patents; pointing out the Office in which each enrolled Specification of a Patent may be found; the Books in which Specifications, Law Proceedings, and other subjects connected with Inventions have been noticed or reported; also such of the Specifications of Patents granted since the 14th of James I. as have been published by the Commissioners. 1 vol. (681 pages).

5. An Appendix to the Reference Index of Patents of Invention, containing abstracts from such of the early Patents and Signet Bills as describe the nature of the Invention, and on which Specifications were not enrolled.

6. The Chronological Indexes of Applications for Patents and Patents Granted from the 1st October, 1852, to the 31st December, 1853. 1 vol. (258 pages.)

7. The Alphabetical Indexes for the same period. 1 vol. (182 pages.)

8. The Subject-Matter Indexes for the same period (in course of preparation, and to be published before the end of the current year).

9. The Alphabetical Index for the year 1854. (120 pages.)

#### Specifications.

1. The series of 4,746 Final Specifications, 151 Complete Specifications, and 2,290 Provisional Specifications lapsed or forfeited, the applicants having neglected to proceed for their Patents, together with the Disclaimers and Memoranda of Alterations filed under the Act from the 1st October, 1852, to the 30th June, 1855.

2. Fire-arms, Projectiles, &c. The entire series of Specifications and Drawings on this subject, from the earliest period to the present time.

3. Reaping Machines. The entire series of Specifications and Drawings on this subject, with an Appendix.

4. Structures and Apparatus employed in the Combustion of Fuel and in connection therewith. The entire series of Specifications and Drawings on this subject.

5. Propulsion of Vessels, &c. The entire series of Specifications and Drawings on this subject from the earliest period to the present time.

6. A Miscellaneous Collection of Specifications of Patents enrolled under the old law; printed from time to time to be used in evidence in courts of law.

JOURNAL.

The Commissioners of Patents Journal, from its commencement, January, 1854, to the present day, the numbers for 1854 being bound in one volume, with an Index.

This Journal is published on the evenings of Tuesday and Friday in each week, and contains the following information:—

1. Grants of Provisional Protection for Six Months. 2. Inventions protected for Six Months on Deposit of a Complete Specification. 3. Notices to Proceed for Patent. 4. Patents Sealed. 5. Patents Extended. 6. List of Foreign Patents. 7. Official Advertisements and various Notices.

The balance sheet (1854) shows an expenditure of £42,208 6s. 9d. on account of printing and lithographic drawing, as compared to £10,831 10s. 2d. expended in the year 1853; the explanation of the apparent excess in 1854 is, that the work of printing the Specifications of 1852-3 was not commenced until September, 1853, and that the arrear was overcome in the course of the year 1854. The sum of £53,039 16s. 11d. having been expended in printing, from the 1st October, 1852, to the 30th December, 1854, 2 years and one-fourth of a year, is equal to an annual expenditure of £23,573 5s. 4d.

The expenditure for the current year (1855) is estimated at £30,000, of which sum it is calculated not more than £12,000 will be expended in printing Specifications, Indexes, &c. of the year, leaving £18,000, or thereabouts, to be expended in the work of printing the Specifications enrolled previously to the Act of 1852.

The old Specifications number 12,977; of these, 1,526 have already been printed, and as it is proposed to print at the rate of 2,000 in each succeeding year, the work will be completed in six years or thereabouts, and the annual expenditure of £18,000 on this account will then cease.

The contract prices for lithographic printing having been lowered, and the number of copies now printed of each Specification being 250, instead of 500 as formerly, the expenditure in respect of printing has been considerably reduced.

The work now in progress in the printing of the old Specifications, is the whole subject of steam-engines, those applicable to the propulsion of vessels having been already printed; when this subject shall have been completed, it is intended to commence the subject of the machinery for the manufacture of textile fabrics.

The Commissioners have transmitted the prints of Specifications, Indexes of Patents, and all other papers printed by them to the chief magistrates and corporations of the principal towns within the United Kingdom, to be placed in such public free libraries as may now exist, or may hereafter be formed for the purpose, upon the following conditions:—

A librarian to be appointed to take charge of the works, who shall be held answerable for their safety and condition.

The works to be deposited in a public free library of the town, and to be open to the inspection of the public at all reasonable hours.

No charge to be made, or fee of any kind to be taken, on any pretence whatsoever, for the inspection, reading, or taking notes from any of the works.

No work to be lent to any person, or removed from the library, except for binding, or necessary repairs.

The Commissioners recommend that the letter-press part of the Specifications be bound in volumes apart from the drawings, and the drawings be mounted on cloth, and also bound in volumes.

The prints have been received by the several towns, subject to the above-mentioned conditions, and in many of the large towns the gift has laid the foundation of free libraries, no such libraries having previously existed; the prints in continuation will be forwarded every succeeding Monday.

The Commissioners have established a public free library of research within the Patent Office in Southampton-buildings. Convenient rooms are provided for the purpose, and the library is open to the public from ten to four every day.

RULES AND REGULATIONS.—CLERKS AND OFFICERS.

No additional rules or regulations were made, or clerks or officers appointed under the Act within the year 1854.

Appended is the following

BALANCE SHEET OF INCOME AND EXPENDITURE FOR THE YEAR 1854.

| RECEIPTS. | £ | s. | d. |
|---|---|---|---|
| In stamp duties in lieu of fees | 53,030 | 4 | 2 |
| By sale of prints of specifications, indexes, &c. | 834 | 14 | 4 |
| Surplus income on balance of accounts to the end of the year 1853 | 25,311 | 15 | 9 |
| | £79,176 | 14 | 3 |
| Surplus income | £15,672 | 5 | 9 |

| PAYMENTS. | £ | s. | d. |
|---|---|---|---|
| Fees to the law officers of England, their clerks, and the clerks of the law officers of Scotland and Ireland | 8,649 | 6 | 0 |
| Salaries of officers and clerks in the Commissioners' Office | 3,686 | 5 | 4 |
| Compensations | 4,537 | 0 | 0 |
| Current and incidental expenses in the Commissioners' Office | 3,342 | 15 | 11 |
| Estimated cost of stationery supplied by Her Majesty's Stationery Office | 590 | 14 | 6 |
| Rent of offices and library | 490 | 0 | 0 |
| Messrs. Eyre and Spottiswoode, for printing specifications of patents, indexes, &c. | 14,924 | 3 | 1 |
| Lithographer's bills for drawings acpanying specifications | 14,822 | 6 | 0 |
| Estimated cost of paper supplied to printer and lithographer by her Majesty's Stationery Office | 12,461 | 17 | 8 |
| | £63,504 | 8 | 6 |

## PUBLIC LIBRARIES ACT OF 1850.

The following notes on the operation of this Act are published, giving the information asked in the letter of Mr. W. Lane Joynt in the last number of the *Journal*, and it is hoped they may be found useful to individuals desiring to bring into operation the Act of last session.

I. The Act has been put into operation in the following cities and towns:—

| | Votes. |
|---|---|
| 1. Bolton | 662 for; 55 against. |
| 2. Cambridge | ... ... |
| 3. Kidderminster | ... ... |
| 4. Liverpool | Under Special Act, no poll required. |
| 5. Manchester | 3,962 for; 40 against. |
| 6. Norwich | ... ... |
| 7. Oxford | 596 for; 72 against. |
| 8. *Salford | Under Museums Act, no poll required. |
| 9. Sheffield | 838 for; 232 against (2nd poll). |
| 10. *Warrington | Under Museums Act. |
| 11. Winchester | 361 for; 13 against. |

The polls by which the Act was adopted in each town respectively, are shown by the figures appended. Liverpool has its special "Library and Museum Act," passed in 1852. The libraries of *Salford and *Warrington are attached to *museums* established under the "Museums Act" of 1845, which Act was repealed by the Act of 1850, and those institutions are now maintained under the powers and provisions of the Act last-named.

At Birmingham and at Exeter, polls have been taken under the Act, and its adoption *negatived*, in the former case by 534 votes against 363; in the latter by 853 votes against 118.

By the town-councils of Aberdeen, Bristol, Newcastle-on-Tyne, and Preston, as well as by the Common Council of London, resolutions approving of the principle of the Act have been adopted, and committees appointed to report as to the steps to be taken to bring it into operation. Similar steps are, it is stated, in contemplation in several other towns, but are delayed in hope of the passing of the amended Bill. (At King's Lynn and St. Helen's free libraries have also been established, which are *partially* supported out of rates under local powers).

II. The free libraries at Bolton, Liverpool, Manchester, Oxford, Salford, Warrington, and Winchester, are in active operation, and contain in the aggregate nearly 90,000 volumes. Those of Cambridge and Sheffield are on the eve of opening,—the former with 2,000 volumes to start with; the latter with 3,100. At Norwich a new building is now in course of erection, which is to receive its free library.

III. The produce of the rate by which these various institutions are supported is at present (under the existing limit of one halfpenny in the pound, except in the case of Liverpool, where the limit is one penny) as follows:—

| | £ |
|---|---|
| 1. Bolton | 285 |
| 2. Cambridge | ... |
| 3. Kidderminster | ... |
| 4. Liverpool | 4,600 |
| 5. Manchester | 1,980 |
| 6. Norwich | ... |
| 7. Oxford | 150 |
| 8. Salford | 700 |
| 9. Sheffield | 650 |
| 10. Warrington | 90 |
| 11. Winchester | ... |

IV. The practical working of the libraries thus established, and the degree of success with which their object has been thus far attained, will perhaps be sufficiently illustrated by the subjoined tabular view of the operations of the four libraries of Salford, Manchester, Liverpool, and Bolton (all of them embracing distinct departments for reference and for circulation), the substance of which may thus be briefly stated:—

| Free Public Libraries of | Amount of Money raised by subscription. | Amount of Money raised by rate or granted by Town Council. | Total amount of money raised. | Number of Volumes of Books in Library, | | Total number of Volumes in Library. | Number of Volumes issued. | | Total number of Volumes issued up to date of last report. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | By Gift. | By Purchase. | | To readers in the Library. | To Borrowers from Lending Collections. | |
| | £ s. d. | £ s. d. | £ s. d. | | | | | | |
| 1. Salford, 1850 | 6,470 10 0 | 5,090 2 5 | 11,560 12 5 | 5459 | 7121 | 12,580 | 160,218, during 5 years. | 13,815, open during portion of 1 year | 174,033, during 5 years. |
| 2. Manchester, 1852... | 12,823 10 0 | 3,852 11 2 | 16,676 1 2 | 8155 | 19,789 | 27,944 | 168,887, during 2½ years. | 204,661, during 2½ years. | 373,548, during 2½ years. |
| 3. Liverpool, 1852 ...... | 7,389 2 10 | 17,030 13 11 | 24,419 16 9 | About 5,000 vols.* | About 20,195 vols.* | 25,195 | ............ | ............ | 246,461, during 2 years. |
| 4. Bolton, 1853 | 3,195 4 2 | 855 0 0 | 4,050 4 2 | 1651 | 11,541 | 13,192 | 27,288, during 1 year. | 61,184, during 1 year. | 88,472 |
| Total in four towns of Lancashire since 1850. | 29,878 7 0 | 26,828 7 6 | 56,706 14 6 | 20,265 | 58,646 | 78,911 | ............ | ............ | 882,514 |

* The statement in the Liverpool Reports and other documents received are not quite precise on this point, but these numbers are nearly accurate.

In these four towns, and within an average period of three years, a sum of £26,828 has been levied by rate or granted by town-councils, under the Acts named, and a further sum of £29,878 raised by voluntary subscriptions; nearly 80,000 volumes of books have been inalienably devoted to public use; every such volume has, on the average, been actually used 11 times; and provision, both certain and permanent, has been made for the replacement, from time to time, of all books that may be worn out in public service.

V. One of the best results which has attended the establishment in Lancashire of town libraries supported by rate is the union of *all* classes, not only in the efforts which have been necessary to their foundation, but by subsequent mutual participation in their advantages. They are emphatically libraries for the city or town which supports them, and not for any one section of its population. Under the amended Act, now in progress through Parliament, this will become increasingly apparent, by the enlarged means which will be afforded for the acquisition of books adapted to the requirements of all classes, and such as, in most towns, have been attainable only by private purchase.

VI. Shows how important to the efficient working of the Libraries Act is the clause now introduced into the Act of last session, enabling the monies raised by rate to be applied to the purchase of books (a power already possessed by Liverpool under its special Library Act, and by Manchester, in virtue of a clause inserted in a recent Improvement Act). Under circumstances which, in some respects, were very favourable, only about 20,000 volumes of nearly 80,000 have been obtained by gift. It appears highly probable that, in the course of time, the good working of the Libraries Act may become an additional inducement to liberal-minded and reflecting men to *bequeath* their libraries to communities in whose welfare they are interested; but true lovers of books will rarely in their lifetime part with those that are worth keeping.

## LIGHTING.

Mr. John Longbottom, of Leeds, has recently patented some improvements in combining atmospheric air with hydro-carbons for the purpose of producing light and heat. The invention consists in causing the atmospheric air, which is to be combined with hydro-carbons for the purpose of light and heat, to be passed in contact with pumice stone, or other porous substance, saturated with caustic potash, and then to be passed in contact with pumice stone, or other porous substance, saturated with sulphuric acid, in order to free the air from water. The

dry and pure air is then passed in contact with the hydro-carbon to be used, which, combining with the air, produces a compound suitable to be used in place of gas. The air is propelled through the process by bellows or blowing apparatus, and caused to pass into, and in contact with, the hydro-carbon employed in a divided or thin stream by means of cups and floats; the combined matters then pass into a gasometer, from which they are supplied for use in like manner as gas. By passing atmospheric air through a bath of pumice stone, or any other suitable porous substance saturated with caustic potash, for the purpose of absorbing the carbonic acid gas contained in the air, and then through a bath of pumice stone, or any other suitable porous substance, saturated with sulphuric acid, for the purpose of absorbing any watery particles or aqueous vapours, and thus thoroughly desiccating or drying the air, and fitting it for the absorption of the vapours of hydro-carbons, it is said to be rendered highly luminiferous, and well suited for all the purposes of which illuminating gas is susceptible.

## THE SALFORD PUBLIC LIBRARY AND MUSEUM.

At a recent meeting of the Salford Town Council, the following report was presented by the Public Park Committee, in reference to the library and museum established in Peel-park:—

"The committee beg to call the attention of the Council to the following particulars, showing the progress of the library and museum for the last four months. The additions to both departments of the library, by purchase and donation, are 556 volumes, exclusive of the specifications of patents which have been presented by the commissioners to the library, and amount to 720 in number. The average daily issue of books from the reference library has been 240, and in the total issues it will be seen that there has been a steady increase, as well as an improvement in the character of the works given out. The monthly issues have been as follow, for the four weeks ending on the days named:—June 30, 6,405; July 28, 5,168; August 25, 5,680; September 30, 7,319; total, 24,572. In the corresponding periods of previous years the numbers were, in 1854, 22,704; in 1853, 5,303; in 1852, 11,177; in 1851, 9,178; in 1850, 7,671. The classes of literature into which the volumes issued as above are divided are: Theology, 676; jurisprudence, 124; history, 3,829; science, 4,042; novels, 7,261; and general literature, 8,637. The committee can assure the council that the borrowers of books take every possible care of them, and that none have been lost since the last report. In consequence of an application by the privates of the 25th regiment, stationed at the Salford Barracks, to be permitted to have books from the lending library, your committee have made the necessary alterations in the rule, to enable them to comply with their request, and the rule is now in full operation. (All the military stationed at Manchester in future will, therefore, have full access to this excellent institution.) The total issues, from the commencement of the library, in the lending department, have been: Books, 49,295; cards, 1,525; vouchers, 2,589. The ages of the applicants have been as follow: 995 under 20, 614 under 30, 287 under 40, 126 under 50, and 76 above 50. The female applicants have numbered 491; youths 371; workmen 1,117; clerks, &c., 536; others, 74; residents in Salford, 2,340; in Manchester, 249. In the 17 weeks ending September 29, there were issued 461 books on theology, 2,249 on history, 1,056 on science, 11,419 on general literature; making a total of 15,185. The total issues from both departments of the library, during the four months, is 39,757, giving an average of 397 daily. The attendance in the reading-room has averaged 366 daily. The museum continues to be very attractive, not only to the inhabitants of the borough, but to those of the adjoining towns; and it is very gratifying to the committee to find the estimation in which it is held by the public generally. The committee have to notice the presentation to the museum, by Joseph Brotherton, Esq., M.P., on behalf of the subscribers, of a valuable portrait of William Lockett, Esq., the first mayor of the borough, which cannot fail to be highly interesting to the inhabitants generally, on account of the satisfactory manner in which he discharged the duties of his office as mayor, and the good opinion entertained of him by his fellow-townsmen. The total number of visitors to the museum for the last four months is estimated at 206,900 visitors, being a daily average of 2,430."

# Colonial Correspondence.

## THE COMMERCIAL RESOURCES OF PORT NATAL.

**Feniscowles, near D'Urban, Port Natal, South Africa.**

Sir,—Several numbers of your most useful *Journal* have been forwarded to me, and I have perused with especial interest the number for February 9th, 1855, relating to Messrs. Dickins and Chadwick's invention for reeling from the cocoon, and the former gentleman's paper upon the Commercial Consideration of the Silkworm. Several varieties of the mulberry have been introduced into this colony. I give the preference to the white, as it is not only of most rapid growth, but the size of the leaves renders the feeding the worm a much easier operation and quicker than when fed on the smaller sorts. From its rapid growth the leaf is soft and tender, and the worm thrives well upon it. Last year I was so fortunate as to be able to obtain a few eggs,* from which I raised about 400 worms. These I brought to maturity, and I anticipate having this season from 30,000 to 40,000. The whole of these it is my intention to increase from, so as to form a supply not only for myself, but for distribution. I have induced a number of my friends and poorer neighbours to put in mulberry cuttings, with a promise to supply eggs, and either buy or find a market for their cocoons. Thus, sir, you will perceive the great utility and benefit to the community that arises from the publishing the transactions of your Society. Hitherto Natal has suffered from its inhabitants not knowing what to turn their attention to, ignorance of its climate, seasons, and capabilities. These, I am happy to say, are now becoming better understood, but it has been a bitter experience, most having lost their all for the lesson. I may say for myself, my original intention in settling here was to produce cotton for the home market. Three years' trial resulted in a loss of about £600. The plant grows too luxuriantly, the pod bursts irregularly, and the picking extends over too long a period; moreover the Kafirs detest the work. I have since tried the China grass; it grows luxuriantly, but here again I was disappointed in not having the requisite machinery, and not being able to procure labour to do it by hand. I send you a small sample, but it is rendered weak by, I think, being too long in the water, and other objections, as described in the paper "On the Preparation of Fibrous Substances," Vol. II., No. 101, October 27th, 1854. It is, however, sufficient to show that the article can be grown here. The plantain and bananas thrive luxuriantly. We have a wild description of plantain, bearing a flower, but I have seen no fruit. The Kafirs obtain a very strong thread from it, which they use for sewing their baskets and mats. A wild palm leaf produces material for the former, which also works up into an excellent material for hats, &c. The woods are stored with many products that

* I must mention that five years since I endeavoured to introduce them, and brought out several bottles containing eggs, but all unfortunately hatched on the voyage.

may at sometime become valuable. One tree bears a nut in great abundance, very astringent, and used here in tanning, and for making ink. Another produces a remarkably fine oil, very clear, and particularly free from impurities. The sarsaparilla is a perfect weed, as is also the castor-oil tree. The mimosa tree is in large quantities: its bark is valuable tan; the gum I will say nothing about, as I sent several tons home, and, like the gentleman with his first bale of cotton, was advised to send no more. The same result happened with a shipment of vegetable ivory nuts. The clays of this country are very peculiar, and well worthy of attention. In the Illovo district I have seen pipe-clay as pure as any housemaid uses for the hearthstone, also yellow, red, and blue clays; a black used by the natives for their grots is very tenacious, almost the consistency of pitch. I am making a collection of such things as come under my notice, and will send them by the first private opportunity to save expense, hoping that although they are of no great intrinsic value they may in the hands of your Society lead to good, and be ultimately beneficial to this colony, as well as to our mother country. Pine-apples do remarkably well; I sold upwards of 4,000 last year, shipping them to Algoa Bay and the Cape. I was much distressed at having to throw away so much valuable material as the old stocks contained in the way of fibre. Would any of your numerous readers suggest a mode whereby I might be enabled to save this waste, and be able to produce a marketable commodity at a remunerative price. Constant and continued labour is difficult to obtain, and for some things more than others. In No. 106, Vol. III., Dec. 1, 1854, Mr. P. L. Simmonds mentions a machine, the invention of the Honourable Frances Burke, for preparing the fibre of the plantain, at the cost of about £3. I should be most glad to become not merely the purchaser of one for myself, but I may safely say I could part with many to the mutual advantage of the patentee and our own poor farmers. I trust I shall not be considered as taking an undue liberty if I request that through your aid our wants may become known, and that I may be put *en rapport*, as the mesmerists would say, with the proper parties.

Again, reverting to silk, I observe Mr. Dickins to say, that even heavy freights, £30 per ton, he says, would not prevent a profit upon the importation of cocoons. I should wish to be informed what price I may hold out to the producer per lb. for cocoons dried and ready to pack for shipment. I have sent *all* the empty cocoons of last year unpicked, from which some opinion may be formed and given as to their value in the home market. This colony may probably be too young at present to introduce heavy and expensive machinery for silk. At the same time, considering the great weight the insect bears to the silk, freight on which would have to be paid (rather dear manure, or food for ducks and geese), I would suggest, as most advisable, to bring the machinery to this country, with suitably trained hands to work it, and so save the loss of freight for mere waste. If this suggestion meets the eye and approval of parties interested in the matter, I will, upon a satisfactory reference being given, place a small estate I have, distant say about six miles from the Port, at the disposal of such party or parties, and plant about eight or ten acres with the mulberry, ready for a commencement. I write this more as a motive to set the trade on foot, and as early as possible produce an article of export for the good of the colony. I merely name my place, Briarcliffe, from its having been under cultivation now for some five years. It was on this farm where the Messrs. Ecroyd grew cotton, and sent in their reports from, to the Manchester Chamber of Commerce. When they left the colony I became the purchaser. There is no scarcity of land, so that any parties wishing to try it can easily purchase suitable land, at not very outrageous prices, say from 10s. to £10 per acre, according to the locality and distance from town. Land is becoming daily more valuable, now that sugar operations are becoming so extensive. I have enclosed a sample of some of my own sugar, grown and manufactured at Springfield, where I have some 150 acres in course of cultivation. Several mills and machinery are now being erected, and others ordered and coming out. By next year at this time there will be about 800 acres in cane in the colony. I alone this year shall have from 50 to 60 tons. This will find a better market on the spot than shipping home, especially at the high rates of freight, £5 10s. It is a thousand pities some good botanist is not sent out; the whole country teems with valuable products—herbs, balms, and every variety of most lovely flowers—that would be highly prized at Kew or Chiswick. I must, before bringing my letter to a conclusion, apologise for so far intruding upon your valuable time, and I trust my plea of doing some little good to others as well as myself will be accepted.

I am, sir,
Your obedient servant,
J. L. FEILDEN.

P.S.—I hope to send off a small box to your care, per *Intrepid*, to sail shortly. [This box has not yet arrived. —Sec.]

## Home Correspondence.

### WROUGHT-IRON GUNS.

Sir,—It is remarkable that in the present day so much skilful workmanship and practical knowledge should have been bestowed by Mr. Dundas upon the original rude mode of constructing cannon. A mere assemblage of staves and hoops, unless the former be welded together, a process now proved by a costly experiment to be impracticable on a large scale, can only produce a barrel or tube of which the tenacity or strength is alone due to the hoops, and not to the staves, however skilfully planed up and put together.

Tubes intended for horizontal or point-blank fire were not, however, the first form of projectile engine constructed for the use of gunpowder. The mortar, or *Bombarda* of the old writers was the first form introduced, now acknowledged to be the best, an adoption which naturally followed the transition from the *Catapultæ* and *Balistæ* of ancient artillery to those machines intended for the use of the newly-discovered powder. The *Bombarda* was merely a hollow receptacle of cast brass, constructed to throw stones of great weight into the enemy's camp or fortress, precisely as the *Catapultæ* had hitherto done. The *Arcobusio*, literally *Tubular Bow*, was the original type of cannon, and when they came to be required of large calibre, were made of welded staves and hoops, of which there are numerous examples extant.

In regard to modern cast-iron guns it would appear that English cast-iron produced by means of coke is unfit for the purpose, at least in comparison with Russian iron produced from charcoal furnaces. Coke-iron has certainly the great advantage of making beautiful castings with exceedingly sharp angles, a beauty of which charcoal iron is incapable, but the latter is vastly superior in toughness, and therefore far more suitable than coke-iron as a material for cast-iron guns. Tin-plate workers are perfectly aware of the great difference between plates made from charcoal or coke-iron.

It is utterly impossible for us, from the want of fuel in England, to produce charcoal iron in any quantity, but by a combination of wrought steel and ordinary cast-iron or brass, we may produce artillery very superior to the cast-iron guns of this or any other country.

In your *Journal* No. 108, p. 78, will be found the description of a simple and practicable mode of constructing cast-iron or brass guns with a soft steel bore, but it unfortunately happens that in this country no process that may be published without being previously secured by exclusive rights to which publication is an effectual bar, can be taken up by our English manufacturers, who

could not in such case secure to themselves exclusive profits upon a process open to all.

I am, sir, yours, &c.,
CIVIL ENGINEER.

September 26th, 1855.

## DECIMAL COINAGE.

SIR,—May I request the favour of your inserting, as an addendum to my Westminster lecture, the following tabular comparison between the number of figures required under the present system of accountancy, and those of a decimal florin, based respectively on the *mil* and the *penny*, to represent every sum of money as entered in the books of bankers, merchants, &c., ascending in pence—the lowest term employed in such accounts. It will be seen from an inspection of this table that the plan recommended by the late Committee on Decimal Coinage presents a very undignified appearance as a "labour-*saving*" scheme, in this view of the subject, beside the penny plans, or even that now in use:—

| All Sums of Money rising evenly in Pence. | £ | s. | d. | Require in *present system* the following total numbers of Figures to express them. | In the proposed system of £1 divided into 1000 *Mils.* | In any of the proposed systems based upon the *Penny.* | Advantage of *present system* over *Mils.* | Advantage of a *Penny basis* over *Mils.* | Advantage of a *Penny basis* over present system. |
|---|---|---|---|---|---|---|---|---|---|
| From 1d. to | | | 3 | 2 | 2 | 2 | 0 | 0 | 0 |
| ,, ... | | | 10 | 9 | 16 | 9 | 7 | 7 | 0 |
| ,, ... | | 2 | 0 | 39 | 44 | 37 | 5 | 7 | 2 |
| ,, ... | | 8 | 4 | 203 | 272 | 189 | 69 | 83 | 14 |
| ,, ... | 1 | 0 | 0 | 627 | 692 | 609 | 65 | 83 | 18 |
| ,, ... | 4 | 3 | 4 | 3393 | 3732 | 2889 | 339 | 843 | 504 |
| ,, ... | 10 | 0 | 0 | 8547 | 9332 | 8489 | 785 | 843 | 58 |
| ,, ... | 41 | 13 | 4 | 43973 | 47332 | 38889 | 3359 | 8443 | 5084 |
| ,, ... | 100 | 0 | 0 | 109347 | 117332 | 108889 | 7985 | 8443 | 458 |
| ,, ... | 416 | 13 | 4 | 539973 | 573332 | 488889 | 33359 | 84443 | 51084 |
| ,, ... | 1000 | 0 | 0 | 1333347 | 1413332 | 1328889 | 79985 | 84443 | 4458 |
| ,, ... | 4166 | 13 | 4 | 6399973 | 6733332 | 5888889 | 333359 | 844443 | 511084 |
| ,, ... | 10000 | 0 | 0 | 15733347 | 16533332 | 15688889 | 799985 | 844443 | 44458 |
| ,, ... | 41666 | 13 | 4 | 73999973 | 77333332 | 68888889 | 3333359 | 8444443 | 5111084 |
| ,, ... | 100000 | 0 | 0 | 181333347 | 189333332 | 180888889 | 7999985 | 8444443 | 444458 |
| ,, ... | 416666 | 13 | 4 | 839999973 | 873333332 | 788888889 | 33333359 | 84444443 | 51111084 |
| ,, ... | 1000000 | 0 | 0 | 2053333347 | 2133333332 | 2048888889 | 79999985 | 84444443 | 4444458 |

Thus it will be seen that the number of figures saved upon the sum of all figures below £100,000, by the use of decimal pence would be less than $\frac{1}{4}$ per cent.; while the additional figures in the pound-and-mil system would amount to about $4\frac{1}{2}$ per cent. On smaller sums, such as may be supposed to be entered in the books of tradesmen generally, the sum of all figures below £100, would give a saving of a little more than $\frac{2}{5}$ per cent. for the penny, and an increase of nearly $7\frac{1}{3}$ per cent. for the mil system. On still smaller sums, representing the dealings of retail traders, the sum of all figures below £10 would give for the decimal pence a saving rather more than $\frac{2}{3}$ per cent., and for the pound-and-mil plan an increase of nearly $9\frac{1}{4}$ per cent.

Yours obediently,
FREDERIC JAMES MINASI.

Parkfield House, Islington, September, 1855.

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SIR,—A copy of your paper of September 21 has just been forwarded to me, in which I find an answer from a "London Merchant" to my remarks of May 5, published by the Decimal Association, on his communication to the City article of the *Times* of May 3. On receiving it, I sat down to make some consideration of the question whether I should rejoin. The first passage I came to was the following:—"He challenges the advocates of the tenpenny to produce their calculations in contrast with those of the £ and mil. We accept it; and shall take his own figures in illustration. What is the freight on 1,632 cwt. of cotton at $\frac{5}{16}$d. per pound." This made me suppose, of course, that I had proposed this question as a challenge, and I was about to cast my eye on the calculations following, when it was arrested by "Mr. Brown will inform the learned Professor that calculations like this are of constant occurrence in Liverpool." It seemed so strange that I should be referred to Mr. Brown to justify my own question to myself, that I hunted out a copy of my remarks, and found, to my amusement, that my critic has indeed taken *my own figures*, but has packed them into a question of his own choosing. My figures 1,632 occur in £1 6fl. 3ct. 2m. Glancing further, I saw enough of this kind of proceeding to convince me that to answer this reply to my remarks I should find it necessary, after so long a lapse of time, to reprint a large portion of my remarks, and even of the article in the *Times*, on which they were made. My conclusion was, that neither my patience nor your space would last out an answer.

I am, sir, yours, &c.,
A. DE MORGAN.

University College, October 1, 1855.

## THE PENNY IN A DECIMAL SYSTEM.

With reference to a decimal currency, there is one fact which does not appear to have received sufficient attention from the advocates of the various schemes already before the public. I allude to the circumstance that in France and Holland, so often referred to as examples worthy of our imitation, the change of system did not interfere with what might be termed the *market units*. Thus the *sou* in the former country, and the *stiver* in the latter, still remain the measures of value in small transactions, and are likely long to continue so. For instance, a Frenchman calculates the price of a joint of meat by *sous* rather than by centimes, and speaks of 9lbs. at 13 *sous*, in preference to 65 *centimes* a lb. In reality, the adoption of a decimal notation by the French and Dutch was a much easier business than is generally imagined. No alteration had to be made in the value of a single coin, and the sous and stiver were merely deprived of their separate columns in account-books by being entered as *five-hundredths* instead of *one-twentieth* of the franc and florin respectively.

Now with us the chief obstacle in the way of a decimal system is that our "market unit," the penny, does not happen to be in decimal relationship with the other coins of account, consequently, the desired change cannot be accomplished so easily as in the countries mentioned. To sacrifice the penny is indeed out of the question, since to insist on the whole nation going to market and purchasing at the rate of, say, 29 *mils* instead of *sevenpence* a lb., would be a step in legislation such as the great Napoleon himself would hardly have attempted.

Whatever alteration we make, *the penny must remain intact.* In the *Journal* of September 21st, I have shown that by legalising the fifth of a shilling as the elementary unit of account, the gold and silver currency would be completely decimalised. There seems to be but one other feasible plan, namely, the issue of a new coin, in value 20 pence, its hundredth, the fifth of a penny, being the elementary unit. *This would give the penny a corresponding position, in a decimal system, with that of the French sous and the Dutch stiver.* The shilling would accordingly appear in accounts as 60 units, and the pound as 1,200 units. The principal objection to this plan is that the omission of the pound from the decimal scale would probably lead to its abandonment as our commercial unit. This scheme may, however, be found deserving of consideration as possessing advantages in addition to those afforded by the "tenpenny system."

I am, sir, yours, &c.,
SAMUEL A. GOOD.

H. M. Dockyard, Pembroke Dock,
1st October, 1855.

## THE SOCIETY'S VISIT TO PARIS.

### Archæological Museums and Monuments.

Sir,—The visit of the Society of Arts to Paris cannot but be productive of good—for not only has it been the cause of some visiting the fair city for the first time, but also the cause of others examining familiar monuments with greater care. It will open many eyes to things hidden. The magnificent quays and clear Seine show how neglectful we are of our nobler Thames, choking both stream and strand, the one with the refuse of our vast metropolis, the other with crazy tenements and irregular wharves that have grown without regard to order or public convenience at the demand of individual requirements—carrying our conservative feeling to an inconvenient extent, every one doing as he pleases with his own, regardless of the pleasures of his neighbour.

The French, unlike us, know how to destroy and preserve. They, with material resources far inferior to our own, are fast making Paris the most beautiful city in the world; not only building and beautifying, but adapting and restoring with great judgment, though in some cases simple preservation would, perhaps, have been preferable to restoration. The adaptation displayed in some of their buildings is very remarkable. The dome Church of the Invalides into the tomb of Napoleon; the isolated tower of Saint Jaques de la Boucherie into a sanctuary to the memory of Blaise Pascal; and the Chapel of Saint Martin des Champs, at the Conservatoire des Arts et Métiers, into a receptacle for machinery in motion, is, to say the least of it, passing strange.

That we *may* have a promenade along the silver river prior to our turning Henry VIII's chapel into an engine-house I do not doubt; but how many Colonel Trenches will lay plans for a Thames quay before Parliament, and future John Martins sketch Babylonian wharves and terraces over sewers of gigantic proportions ere we get a limpid stream at London-bridge, time only knows—for both Martin and Trench's schemes are ancient now—worthy of being deposited in some mediæval museum like that of Cluny, if we had such an institution? Have we not treasures of the middle-ages in abundance, and buildings, in themselves monuments, worthy to contain such jewels. What has the second society of *savants* in London done to promote such a museum? Would it not have been a worthy endeavour for the Society of Antiquaries from their lodgings in the Royal Palace of Somerset House to watch and ward that great historical monument, the Tower of London, and prevent at least some of the cruel alterations effected there; using every endeavour to convert it into a national museum—a worthy rival of the Hotel de Cluny and the Palais des Thermes? Had the Tower existed amongst the military French, I doubt if they would have endangered any part by storing powder therein, as I understand we do, and have done for years. The Society of Arts deserves great credit for their efforts to found a mediæval museum—not alone by urging Government to purchase the Bernal Collection, but by collecting within their own walls one of the most remarkable exhibitions of the art workmanship of the middle ages as a precursor of the Exhibition of 1851. The liberal donation of Mr. Ruskin to the Society of Antiquaries for the purpose of preventing injudicious "restorations," will do good; but what the public most desire of the curators of the past is that it should be opened up and made patent to the present, as in France.

I am, sir, yours, &c.,
F.S.A., and Member of the Society of Arts.

## SRENGTH OF MATERIALS.

Wallington, Newcastle-on-Tyne, 23rd Sept., 1855.

Sir,—As we know that a ship's mast constructed of *several* pieces of wood is stronger than when made of *one* piece only, so it might be supposed that an axle made of several pieces of metal might be stronger than one as usually made, of a single piece; and it is possible that, if made of several pieces, especially if they were of *different* metals, the same molecular change, whether resulting from the effects of vibration, or from any other cause, would probably not take place simultaneously in all the pieces of metal, and thus, perhaps, some of the accidents occasioned by the change might be guarded against. Can you inform me whether, in experiments on the strength of materials, any have been made on the comparative strength of a bar or axle of iron and bundles of wires of different sizes, but containing the same weight of metal as the solid bar? They probably have; but, if not, I would suggest the importance of such experiments.

I remain, Sir, yours faithfully,
W. C. TREVELYAN, Bart.

# Proceedings of Institutions.

Corfe Castle.—The Mutual Improvement Society of this place is progressing favourably, and has now completed its fourth anniversary. The accounts for the past year show a small balance in the hands of the treasurer. The library has been increased, and the number of books now amounts to 400 volumes. The Society is placed in connection with the Society of Arts, London, from which much valuable information is derived. The reading-room is supplied with the leading periodicals of the day and the London and provincial newspapers. During the past season several instructive lectures have been delivered. The grateful thanks of the members are due to the nobility, clergy, and gentry of the neighbourhood, through whose kind and continued assistance they are enabled to enjoy those benefits at a low rate of contribution. The Society is patronised by the Right Hon. the Earl of Eldon, the Right Hon. George Bankes, the Ladies Scott, the Revs. Edward Bankes, Eldon S. Bankes, Nathaniel Bond, O. L. Mansel; O. W. Farrer, Esq., A. Bell, J. H. Calcraft, T. Bond, J. Crouch, W. Voss, G. Mayo, R. Taylor, J. Voss, W. J. Pike, J. W. Pike, J. Oldham, Esquires, Colonel Mansell, &c.

Islington.—An exceedingly interesting meeting was held in the theatre of the Literary and Scientific Society

on Thursday evening, the 27th ult., for the purpose of presenting a testimonial to Mr. Joseph Simpson, on the occasion of his retirement from the office of librarian. The attendance was numerous. The chair was occupied by Charles Woodward, Esq., F.R.S., (President of the Institution), who, while he congratulated Mr. Simpson upon the improvement of his position and prospects by his removal, expressed his deep regret at the loss the Society would sustain thereby. He then, in a highly-complimentary manner, bore testimony, from his own personal observation, to the zeal and ability displayed by Mr. Simpson in the discharge of his duties during the eight years he had been connected with the Society; and after assuring him that he left with his own best wishes, and with those of all the members, for the success of his future plans, presented him, in the name of the officers of the Society and the subscribers, with a very handsome timepiece, and a purse of £30, the proceeds of a subscription entered into with a view of expressing their very high sense of the efficient, yet unassuming manner in which the diversified and onerous duties of his office had been invariably performed. Mr. Simpson expressed the great gratification afforded him by the proceedings; stated the circumstances which led to his resignation: and warmly thanked the officers and members of the Society, not only for their parting gifts, but also for the many previous acts of kindness which he had received from them. He assured them that the recollection of that evening, and the associations connected with his residence in Islington, would be cherished till life's latest day with feelings of lively gratitude; and after wishing them, individually, and as a Society, every prosperity, with much feeling, he bade them—farewell. The timepiece (the value of which is £14) is of bronze and gold, and was manufactured by Mr. Hislop. It bears the following inscription:—"Presented with a Purse of £30, by the President, Vice-Presidents, Committee, and 182 Members of the Islington Literary and Scientific Society, to Mr. Joseph Simpson, on his retirement from the office of Librarian, as a testimonial of their high approval of his zealous, faithful, and valuable services during a period of eight years.—27th September, 1855."

Much Wenlock.—On Wednesday, the 12th ult., the Olympic Class in connection with the Agricultural Reading Society met upon the Race-ground for athletic exercises. On the following Friday, a magnificent collection of botanical specimens, got together by the indefatigable zeal of the members, illustrative of the Flora of the neighbourhood, was exhibited in the large room of the Institution, over the New Corn Market. The glorious weather afforded the desired opportunity of exhibiting the rustic sports and trials of strength and skill which the Agricultural Reading Society has promoted by offering prizes to the successful competitors. The Society itself has proved a very successful experiment,—so successful, that it has been determined to enlarge, next spring, the building now devoted to the convenience of its members, by the addition of a corn-market office, and a room above for a museum of objects of local interest. The cost of erection will be £300, out of which £135 has been already received in the shape of subscriptions. The Society develops itself in classes, thus, the "Music class," the "Local Antiquities class," the "Natural History of the Neighbourhood class," and the "Olympic class," the last mentioned being the one whose feats the fine weather of Wednesday tempted a large number of the residents of the neighbourhood to the race ground to witness. The money given away is raised by subscription, and the average amount of subscription has been, each year, £20, but this year that amount has been exceeded by some pounds. The grand-stand was occupied by a number of ladies and gentlemen, and was decorated with laurels, flowers, banners, and flags, interspersed with appropriate mottoes. The attendance of spectators from the town and the country round, although small in the morning, far exceeded in the afternoon that of the previous years. The "games" commenced about ten o'clock, and men and boys seemed to enter with spirit and enjoyment into the old English sports which were revived on the occasion. The jumping was spirited, and the race by the boys under 14 excited great amusement, all the formula of a regular horse-race being gone through on the occasion. The successful little competitor won by "two lengths," at least. The game at prison-bars also excited much merriment, both among the players themselves and the lookers on. There were eight entries for the wheelborrow race, which afforded much amusement, owing to the tortuous circuit by which many of the blindfolded candidates approached the goal. The winner was John Skett, who completed his performance by a summersault into the hedge at the end of the field. At one o'clock the proceedings were suspended for two hours, but at three o'clock the men returned to the sports with increased energy and increased good humour. There was a foot-ball match, £2 winning side. The field in which the match was played was a very large one, and the fun was very fine; the match being well-contested, and not won till after near half-an-hour's sport. This game was followed by a foot hurdle race, splendidly run round the entire course, and almost as exciting as a horse-race itself. Badger, the Wolverhampton pedestrian, won, clearing the hurdles and coming in in gallant style. Shingler, a Wenlock man, winning the second prize of ten shillings. The games concluded, between six and seven in the evening, with a jingling match in a large rope ring, in which 20 blind-folded competitors for the prize made many ineffectual attempts to catch the jingler, who by ringing a small bell, attracted them successively to various parts of the ring, and slipped aside adroitly as they approached him, to the great merriment of the circle of spectators. After a country-dance on the field, the members of the class, accompanied by a great number of the visitors, returned in procession, accompanied by the band, to the Corn Market, where the president of the class, W. P. Brookes, Esq., previous to the distribution of the prizes, addressed the company. He said:—"The yearly increase, both in the funds of your Society and in the number of visitors who attend your annual meetings, afford the most satisfactory evidence of the estimation in which your games are held; and the spirited manner in which you have on this and former occasions contended for the prizes, humble as they were, renders it unnecessary for me to address you for the purpose of exciting your zeal and perseverance in favour of an Institution which has already been a source of so much benefit and pleasure to the working classes of this neighbourhood. You would not, however, I am sure, feel satisfied were we to part without expressing our grateful sense of the kindness of Mr. Crowther in placing his meadows at our disposal, and also to Mr. Ainsworth for the offer of his field on the other side of the town. In the present day, when nearly every spot of ground in the vicinity of a town is enclosed, and, doubtless, advantageously so, for the purposes of agriculture, the poor would lose much recreation were the occupiers of land not to act with that consideration and kindness which Mr. Crowther has evinced on the present occasion. To another class of benefactors, too, you would wish publicly to offer your thanks—I mean to the honorary subscribers to your games. It would be invidious to mention names, as they include nearly all the nobility and gentry of this immediate neigbourhood. Nothing can be more pleasing than to find the affluent in circumstances coming forward, by their subscriptions, to aid in the improvement and innocent amusements of those in a humbler sphere of life, and whose unassisted efforts would not be sufficient to procure for them these advantages and pleasures. * * * * Which of us would send a boy to a public school were he confined all day to the desk, and debarred that exercise which is so essential for the healthy development of the body. The inhabitants of Wenlock must, I feel sure, have been highly gratified the other day in witnessing the skill,

activity, and cheerfulness displayed by those fine youths from Dr. Kennedy's school at Shrewsbury, who came to contend with the Wenlock Cricket Club, a separate branch of athletics, one which requires much practice, and which has been carried out so successfully and with so much honour to the town and neighbourhood of Wenlock by Mr. James, the hon. secretary, to whom great credit is due for his exertions in its behalf. I cannot conclude without expressing a hope that you will ever retain undiminished your love for our manly old English sports, that make us cheerful, active, and healthy, and promote that harmony and good feeling among the different classes which so distinguish the inhabitants of this town and neighbourhood. In after years you will look back with pleasure on these social gatherings, and regard them as sunny spots in the memory of the past. I have great pleasure in informing you that Mr. Slaney, of Walford Manor, has kindly sent a donation to this year's fund, and that you have the honour of adding to your list of honorary subscribers the name of Lord John Manners, who has consented to become an annual subscriber. I beg, therefore, to propose 'Three times three' for Lord J. Manners, who, as well as Mr. Slaney, is a warm advocate of those societies which have for their object either the moral and intellectual improvement, or the innocent recreation of the working classes. I have also to propose, what I am sure you will heartily respond to, viz., 'Three times three' for Sir Watkin, to whose kindness and liberality, in giving us the site on which the Corn Market and reading room are built, we owe so much of the happiness we enjoy." The president concluded amid much applause, and then proceeded to distribute the prizes, addressing to each of the successful candidates some appropriate remarks of approbation and encouragement. Dancing then commenced, and was continued till twelve o'clock with the greatest order and propriety, and thus brought to a conclusion a day which will long be remembered by the inhabitants of Wenlock. The decisions of the umpire were as follows:—Quoits (thrown 21 yards), first prize, 5s., W. Theobald; second, 2s. 6d., W. Ward. Leaping in height, 5s., G. Theobald, who jumped 4 feet 2 inches. Leaping in distance, 5s., W. Badger, Wolverhampton. Foot race for boys under 14 years of age, first, a book value 3s. 6d., Evan Morrison; second, value 1s. 6d., George Thomas. Foot hurdle race, first, £1, W. Jones; second, 5s., Joseph Hickman. Foot race for boys under 10 years of age, first prize to have an olive crown and a book, value 3s. 6d., E. Roberts; second, book, value 1s. 6d., J. Massey. Wheelbarrow race (five to start), first, 10s., G. Skitt; second, 2s. 6d., J. Rowley. Foot hurdle race, all round the course, first, £2, B. Badger; second, 10s., — Shingler. the prison base match was £1 a side, and the foot-ball match £2 a side. There were several other games played for minor sums. It is the intention of the committee to give far higher prizes next and succeeding years, as they find the subscriptions materially extending. The provision of a healthful and innocent means of recreation for the working classes is an object worthy of support, and the pleasant and amusing character of the day's proceedings would no doubt increase the popular favour of the "Olympic class." It may reasonably be expected that an augmentation of patronage and an increased attendance of visitors will take place at the future exhibition of the games. The neighbourhood have reason to congratulate, and the working men to thank, Mr. Brookes, for his successful efforts in promoting this, in common with other useful objects of the Wenlock Agricultural Reading Society.—On the following Friday, the exhibition of beautifully preserved specimens of the wild plants and flowers growing round Wenlock took place. It is to be regretted that only 300 out of 600 specimens collected this year by the Wenlock Agricultural Reading Society could be shown for want of space. This inconvenience is in a fair way to be obviated next spring, by the subscription entered into for the purpose of building the corn-market office, with a room over it for the museum of objects of local interest, and which is every day receiving accessions, which will shortly render it extremely attractive. The sum required is only £300, of which £135 has been subscribed; C. O. C. Pemberton, Esq., of Millichope-hall, and W. H. Sparrow, Esq., of Wolverhampton, have each contributed £5 during the last few days, and their example will be followed by others, for there are few towns of the same size and population where the inhabitants have, by their unanimity and perseverance, accomplished so much for the improvement of themselves and those who will come after them. Such exertions deserve to be encouraged, and, doubtless, the undertaking will receive the cordial support of all the well-wishers to this spirited and improving town. W. P. Brookes, Esq., surgeon, has consented to act as secretary to the committee, and also to receive the subscriptions.

Northampton.—A soirée was held by the Northamptonshire Religious and Useful Knowledge Society on Monday evening, the 20th of September. Possessing convenient premises, with easy communication to the spacious parochial school rooms, and availing themselves largely of the gratuitous and able services of many kind friends, the committee were enabled to provide an entertainment abundantly varied. Much money and time, too, had been spent in preparation. When it is considered that, not only the handsome lecture hall was occupied, but that four other rooms—two of them as large as the lecture hall—were put in requisition, the magnitude of the affair, and the labour and anxiety involved, will be at once apparent. Much was attempted, but all was accomplished, and visitors had ample reason to be satisfied with almost everything but the fearful crushing which the crowds that thronged the place frequently rendered inevitable. Commencing at the entrance to the building, banners were seen waving, and a new and elegant lamp suspended over the portal. The lecture hall was adorned with evergreens and choice flowers, kindly supplied by Sir Charles Wake, E. Bouverie, Esq., R. T. Clarke, Esq., G. Osborn, Esq.; Messrs. Perkins, Jeyes, Smith (Roade), G. West (Dallington), Holliday and Archer (Northampton), &c. In one part was R. T. Clarke, Esq., with his valuable collection of plants, engaged in giving illustrations of economic botany. In another direction the Rev. C. F. Luttrell West and Mr. Dorman were surrounded with electric telegraph apparatus, gratuitously supplied by the Electric Telegraph Company, with clerks to work it; Mr. Dorman's illustrative diagrams, and Mr. West's explanations, kept a knot of interested listeners round the table. Mr. H. M. Greville, who was to have been present, and "at home" in his interesting experiments in pneumatic chemistry, was prevented by severe illness from attending. Proceeding onwards, the boys' school was decorated with flowers and evergreens, the walls covered with a series of architectural illustrations (by Mr. E. F. Law, of this town), executed in sepia, on a large scale, illustrative of the works of antiquity in Egypt, Greece, and Rome, and the entire mediæval period in this country. A large orchestra was erected at one end of the room, and at the other a stage for electrical apparatus, presided over by Mr. E. F. Law, with ability and untiring energy. Around the room were ranged numerous cases of insects, illustrative of British entomology, belonging to the Rev. Hamlet Clark, by whom they had been collected and preserved with infinite care. These were to have been explained by that gentlemen, but, unfortunately, he had not sufficiently recovered from illness to justify his undertaking the task. As it was, however, they proved a source of considerable attraction. Crossing over into the girls' school-room, the portfolio of Mr. E. F. Law again contributed most liberally in the decoration of the place, the walls being hung all around with original water-colour sketches, ecclesiastical, domestic, and landscape, not a few of them displaying considerable taste and ability in execution. Here again a profusion of choice plants met and pleased the eye. In this room, too, were located the Revs. W. Law, of

Marston, and J. Thornton, of Kimbolton, both gentlemen favourably known to the scientific world. Mr. Law was experimenting most interestingly with his magnetic apparatus, and Mr. Thornton was affording much amusement by his illustrations of microscopy. In the first infant school was displayed a large and beautiful collection of photographs, supplied by the Society of Arts, of London, the Rev. F. A. S. Marshall, of Peterborough, and, through that gentleman, by Messrs. Herring and Rymington, of London. The photographs were much admired. There was also a large painting of Queen Victoria, about 10ft. by 6ft., by Mr. E. F. Law, lent for the occasion by Mr. Osborn. The second infant school was devoted to refreshments. Over and above this, there was an efficient band provided from the Choral Society, which performed in the boys' school-room, and there was vocal music in that and in all the other rooms in succession. The leadership of the band was confided to Mr. Packer; the whole being under the able direction of Mr. Charles M'Korkell, who, in the course of the evening, treated the company to a solo on the pianoforte. Miss Ransford was the principal vocalist. She was in excellent voice, and sang admirably. MissRansford sang a second time Bishop's lovely song, "Bid me discourse," and the orchestra spiritedly repeated Bishop's animating "Tramp" chorus. Mr. Wickes sang several songs with good effect. Mr. Aylward, an accomplished player on the violoncello, played two solos on that instrument. The entertainments commenced at seven o'clock, and terminated at half-past ten, not fewer than from fourteen to fifteen hundred persons, including the principal inhabitants of the town, being present. The success attending this first essay was so great, that the committee determined on having a second entertainment at a uniform low charge of sixpence per head, the lecturers, who deserve all praise, kindly volunteering a repetition of their services.

## Miscellanea.

Birmingham Gun Trade.—The discussions which took place during the last and the present year, with respect to the quality and quantity of fire-arms which Birmingham could produce, has operated advantageously upon both the makers and the operatives. It is now proposed to establish a gun-makers' guild. The object of thisassociation is stated to be the obtaining of specimens of important gun manufactures, statistical accounts from other countries, information as to other new markets which might be opened, &c. It is proposed also that lectures should be delivered on the nature of gunpowder, illustrative of improvements in all branches of the trade, &c.; Birmingham, it is contended, will then be better able to enter into competition with other countries. The proposition has been well received, and is likely to be adopted.

## To Correspondents.

A letter on the subject of "Decimal Coinage" has been received from Mr. Theo. W. Rathbone, and will appear next week.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette September 28th*, 1855.]

*Dated 28th May*, 1855.

1218. J. Leese, jun., Manchester—Obtaining colouring matter.

*Dated 21st July*, 1855.

1648. W. Striby, Weinheim, Baden—Musical notation.

*Dated 1st September*, 1855.

1971. M. Butcher and T. H. Newey, Birmingham—Bobbins used in winding, twisting, weaving, &c.
1973. T. Dodds, 53, Wigmore street, Cavendish-square—Heating furnaces with coal or other gases.
1975. F. C. Calvert, Manchester—Heating, puddling, and refinery iron slags.
1977. T. S. Prideaux, Willow-house, Hampstead—Marine steam boiler furnaces and flues.
1979. A. V. Newton, 66, Chancery-lane—Gas for illumination. (A communication.)

*Dated 3rd September*, 1855.

1981. W. McLiesh, Belfast—Boiler furnaces, and prevention of smoke.
1982. A. Heaven, Manchester—Embroidering fabrics.
1983. G. T. Holden and R. Nicholas, Brook-street, St. Paul's, Birmingham—Roasting-jack.
1985. J. T. Chance and H. Adcock, Birmingham—Casting articles of slags produced by the smelting of iron and other ores.
1987. E. Sy, Paris—Motive power.
1989. H. E. Flynn, Retreat, Ranelagh, Dublin—Prevention of railway accidents.
1991. J. Humby, 47, Little Britain—Machine for cutting vegetables.
1993. A. H. Golding, Maidstone—Apparatus for blocking and lasting leather.

*Dated 4th September*, 1855.

1995. C. Clark and J. Clark, Street, Glastonbury—Boots and shoes.
1997. J. G. Taylor, Glasgow—Coating or plating metallic surfaces.
1999. T. T. Coniam, Chagford, Devon—Tiles for roofing.
2001. C. G. Mueller, South Carolina, U.S.—Locks for doors.
2003. W. A. Gilbee, 4, South-street, Finsbury—Manufacture of glass. (A communication.)
2005. W. Southwell, Philadelphia, U.S.—Machinery for grinding or polishing saws and other articles.

*Dated 5th September*, 1855.

2007. G. H. Ingall, Bartholomew-lane—Self-acting signal-posts and apparatus.
2009. G. Collier, Halifax—Carpets.
2011. J. H. Glassford, Glasgow—Printing textile fabrics.
2013. J. G. Martien, Newark, New Jersey, U.S.—Roasting, calcining, oxydizing, and subliming metallic and mineral substances.

*Dated 6th September*, 1855.

2015. S. A. Goddard, Birmingham—Preventing the fouling of fire-arms, and cleaning the same.
2017. C. P. Aston, Cross-street, London—Breech-loading arms.

*Dated 7th September*, 1855.

2021. G. Lowry, Manchester—Machinery for heckling flax, &c.
2023. F. Garand, Paris—Machinery for cutting veneers.
2025. N. Templeton and D. Miller, Glasgow—Manufacture of figured fabrics.
2027. J. McIntyre, Jarrow-upon-Tyne, Durham—Caulking decks, ceilings, and floors.
2029. L. P. Reynaud, Paris—Endless stair crane.

*Dated 8th September*, 1855.

2031. E. H. Rascol, Catherine-street, Strand—Fastening for wearing apparel as a substitute for buttons. (A communication.)
2033. J. H. Tuck, Pall-mall—Dredging and excavating machinery. (A communication.)
2035. T. H. and W. Hemsley, Melbourne, Derbyshire—Fabrics in warp and twist lace machines.
2037. J. Bird, Seymour-street West—Manufacture of biscuits.
2039. P. A. Balestrini, Bresica, Lombardy—Insulating wires for electric telegraphs.
2041. A. Robertson, Nether Holehouse, Neilston, Renfrew—Treatment, cleansing, and finishing of textile fabrics.
2043. E. Grenet, jun., Paris—Electro-magnetic apparatus for motive-power.
2045. T. Allan, Adelphi-terrace—Correcting deviation of the compass needle.

*Dated 10th September*, 1855.

2050. A. E. L. Bellford, 32, Essex-street, Strand—Governor for steam engines. (A communication.)

*Dated 13th September*, 1855.

2066. J. Macintosh, Great Ormond-street—Metallic and other pens.

*Dated 14th September*, 1855.

2072. J. Hartmann, Mulhouse, France—Colours for printing stuffs and textile fabrics.
2074. W. Church, Birmingham—Mounting ordnance and other fire-arms.
2076. V. Scully and B. J. Heywood, Dublin—Bottles, inkstands, &c., and in caps for closing the same.
2078. F. Stocken, 5, Halkin-street, Belgrave-square—Carriage springs.

*Dated 15th September*, 1855.

2080. W. Oxley, Manchester—Machinery for washing.
2082. J. G. Martien, Newark, New Jersey, U.S.—Manufacture of iron and steel.
2084. V. Scully and B. J. Heywood, Dublin—Manufacture of articles subject to corrosion.
2086. W. Sangster, Cheapside—Stays and corsets.
2088. D. Zenner, Newcastle-upon-Tyne—Washing and separating pulverised ores and matters. (A communication.)
2090. A. Ford, St. James's, Middlesex—Solutions of caoutchouc, gutta percha, &c.

*Dated 17th September*, 1855.

2092. J. Lewtas, Manchester—Apparatus for holding and letting go cords, chains, or bands.

2094. T. Forsyth, Manchester—Treatment of scrap iron.
2096. W. H. Smith, Birmingham—Bolts, latches, and locks.
2098. J. T. Caird, Greenock—Steam engines.
2102. R. A. Brooman, 166, Fleet-street—Raw silk. (A communication.)

*Dated 18th September*, 1855.

2106. R. A. Brooman, 166, Fleet-street—Knitting machinery. (A communication.)
2108. F. H. Smith, Ludgate-hill—Break for carriages with poles.
2110. W. Warren, Regent-place, Birmingham—Vices.

*Dated 19th September*, 1855.

2112. L. Cornides, 4, Trafalgar-square, Charing-cross—Impressions of prints or drawings, and in transferring, printing, and colouring, or ornamenting the same on glass or other surfaces.
2114. S. Coulson, Sheffield—Ornamented metal tea-pots, &c.
2116. R. A. Brooman, 166, Fleet-street—Preserving animal and vegetable substances. (A communication.)

## WEEKLY LIST OF PATENTS SEALED.

*Sealed September 28th*, 1855.

695. François Joseph Anger, 16, Stamford-street, Blackfriars-road—Improvements in the preservation of vegetable substances.
704. William James, Crosby-hall Chambers—Improvements in the manufacture of screw bolts.
727. Thomas Hedgcock, R.N., 7, Cavendish-grove, Wandsworth-road—Improved quadrant for taking solar altitudes for latitude without aid of marine horizon, and for ascertaining the true longitude.
731. John Taylor, Spring-grove, Hounslow—Improvement in the manufacture of covers for books.
748. Henry Richardson Fanshawe and John Americus Fanshawe, North Woolwich—Improvements in the manufacture of waterproof fabrics of the vulcanised, sulphurised, or cured class.
806. Soren Hjorth, Copenhagen—An improved magneto-electric battery.
808. Soren Hjorth, Copenhagen—An improved electro-magnetic machine.
811. Isaiah Vernon, West Bromwich—Improvement or improvements in the slide valves of steam engines.
830. Gustave Irenée Scultort, Mauberge, France—Improvement in screw wrenches.
849. Henry Woodhouse, Stafford—Improvements in the construction of crossings for the permanent way of railways.
1116. William Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture, treatment, and application of oily, resinous, and gummy substances and soaps.
1212. Edward George Swinton, Warsash-house, near Titchfield—Improvements in applying motive power for grinding corn and for other similar purposes.
1255. John Charles Pellenz, Aix la Chapelle, Prussia—Improvements in the manufacture of iron wheels.
1370. John Harvey Sadler—Lady Pitt-lane, Hunslet, Leeds—Improvements in looms for weaving.
1507. James Connor, Coventry—Improvements in apparatus for communicating between the engine drivers and the guards of railway trains.
1662. Henry William Ripley, Bradford—Improvements in dressing and finishing woven fabrics composed wholly or partly of wool. (Partly a communication.)
1752. Richard Albert Tilghman, Philadelphia, U.S.—Improvements in the manufacture of candles.
1798. Charles Frederick Thomas, Massachusetts, U.S.—Improvements in boilers for steam carriages.

*Sealed October 2nd*, 1855.

729. Frederick Phillips, Hall Farm, Downham, near Brandon, Suffolk—Improvements in machinery or apparatus for distributing manure, sowing or depositing seeds, and effecting the working and cultivation of land.
737. François Theodore Botta, Paris—Improvements in the method of and apparatus for beer brewing.
742. Hiram Powers, Florence—Forming perforations or throats to the cutting edges of files or rasps for allowing the particles cut away to pass through, and to prevent the instrument from clogging or choking.
743. William Henry Tooth, 2, Pilgrim-street, Kennington-lane—Improvements in the construction of floating vessels, and in the machinery and steam signals connected therewith, and in the application thereof to other purposes.
744. William Eathorne Gill, Totnes, and Henry Brinsley Sheridan, Parsons-green—Treating fish for oil, and utilising the products of such process.
745. Louis Cornides, 4, Trafalgar-square, Charing-cross—Improvements in saturating and coating or covering leather, paper, and textile fabrics, so as to render the same on the coated or covered surfaces thereof impervious to water.
753. John Crowley, Sheffield—Improvements in the manufacture of malleable cast iron.

## PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

56. John Finlay, Glasgow—Improvements in grates and fireplaces, or apparatus for the generation of heat.
70. Robert Lakin, Ardwick, and William Henry Rhodes, Gorton—Improvements in machines for spinning and doubling cotton and other fibrous substances.
81. Frederick Osbourn, Albion-street, King's-cross—A machine or apparatus for facilitating the manufacture of various kinds of garments or wearing apparel.
84. Edwin Pettitt, Kingsland—Improvements in the manufacture of ammoniacal salts and manures.
115. Charles John Carr, Belper—Improvements in machinery for making bricks and other similar articles.
136. William George Nixey, Moor-street—Improvements in tills and other receptacles for money.
187. Alexander Miller, Glasgow—Improvements in the treatment or finish of textile fabrics and materials.
214. Thomas Kennedy, Kilmarnock—Improvements in obtaining and applying motive-power, which improvements or parts thereof are applicable to timekeepers and clockwork, and for measuring and registering the flow of water and other fluids and aeriform bodies.
216. Archibald Brown, Glasgow—Improvements in the construction of sheaves for blocks.
246. George Hallen Cottam, Charles-street, Hampstead-road—Improvements in chairs, sofas, and bedsteads.
278. William Adolph, 9, Bury-court, St. Mary Axe—Improvements in apparatus for warming and ventilating rooms.
285. Edwin Pettitt, Kingsland, and James Forsyth, Caldbeck—Improvements in spinning and drawing cotton and other fibrous substances, and in machinery for that purpose.
290. William Horsfield, Swillington Mills, near Leeds—Improvements in splitting, crushing, and grinding corn, seeds, grain, minerals, or other substances.
371. Walter McFarlane, Glasgow—Improvements in water-closets.
565. William Henry Fox Talbot, Lacock Abbey, Wilts—Improvements in the art of engraving.
710. James Noble, Leeds—Improvements in combing wool and other fibres.
908. Francis William Ellington, Drummond-street, Euston-square—Improvements in the making of screws for collapsible and other vessels.
9. George Green, Mile-end-road—Improvements in the manufacture of casks.
11. Thomas Wood Gray, Warkworth-terrace, Commercial-road, Limehouse—Improvements in cocks and valves.
40. Frederick Richard Holl, Waymouth-terrace, City-road—Improvements in watches and chronometers.
51. Thomas Craddock, Ranelagh Works, Thames-bank—Improvements in the steam-engine and the steam-boiler.
64. Henry Richardson Fanshawe, Arthur-street, Old Kent-road—Improvements in shawls, scarfs, neckerchiefs, handkerchiefs, mantles, sails or sail cloth, table cloths and table-covers, napkins, and umbrella and parasol tops and covers, and in an improved loom for weaving, applicable especially to the said improvements in respect to some of the said articles.
71. John Ambrose Coffey, Providence-row, Finsbury—Improvements in apparatus for performing various chemical and pharmaceutical operations, hereby denominated Coffey's Improved Patent Esculapian Apparatus, parts whereof are applicable to steam-boilers, steam and liquid gauges, stills, and syphons.
74. Christopher Kingsford, 18, Buckingham-street, Adelphi—Machinery for solidifying peat, coal, and other substances of a like nature.
86. David Dunne Kyle, 120, Albany street, Regent's-park—Improved method of excavating and removing earth.
110. John Wright and Edwin Sturge, Cornwall-road, Lambeth—Improved machinery for the manufacture of envelopes.
137. Arthur Jackson, Exchange-court, Liverpool—Improvements in gas-burners.
140. Thomas Robson, Woolwich-road—Improvements in apparatus for igniting signal and other lights.
141. Astley Paston Price, Margate—Improvements in the manufacture of citric and tartaric acids, and of certain salts of potash, soda, ammonia, lime, and baryta.
165. Moses Poole, Serle-street—Improvements in constructing bridges, viaducts, and such like structures.
272. Joseph Hill, Birmingham—A machine for stamping metals and forging iron and steel.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3762 | September 27. | Focus Regulator | Woog Javal | 13, Broad-street-buildings. |
| 3763 | October 1. | The Crimean Stove | James Burnett Haden | Warminster. |

Journal of the Society of Arts.

FRIDAY, OCTOBER 12, 1855.

## PREMIUM LIST.

Members who visited Paris and others are requested to be good enough to communicate to the Secretary any suggestions which may have occurred to them as desirable for the Society's forthcoming Premium List.

## ANIMAL PRODUCTS.—THE SILK SERIES.

By P. L. Simmonds.

Much very valuable information respecting the silk-worm and its products having already been furnished to the members of our Society during the past year; it may be interesting to bring under notice a few facts connected with attempts to obtain a species of silk from other insects than the silkworm proper. One of the earliest of these, at least of modern times, was in 1710, by M. Boon. This gentleman, after much time spent in examining the varieties of spiders, fixed upon two under the name of long and short legged, from which he obtained a fibre which he says is equally fine, strong, and beautiful, with that obtained from the silkworm. We must not, however, suppose that the latter silk is at all like the former in the mode of production. The spider's spinning apparatus is placed at the hinder end of the body, and consists of a number of papillæ, so minute as hardly to be distinguished by the naked eye, the tip of each furnishing from innumerable orifices so many fibres that Reaumur supposes each gives 1,000; in this way each line of the spider's web will be a twist of 5,000 smaller threads. This web, however, must not be confounded with the silk produced by the same insect, and which M. Boon tried to introduce into commerce; the latter forms the bag in which the eggs are hatched, and is of a much stronger texture, and of a grey colour.

The machine by which wire is drawn, will, it has been observed, furnish us with some idea of the manner in which the spider forms the threads of its little net, the orifices of the five papillæ or teats through which the thread is drawn contracting or dilating at pleasure. The threads which we see, and which appear so fine, are, notwithstanding, composed of five joined together, and these are repeatedly doubled as the work proceeds.

But although, as a matter of experiment, this fibre has been made into gloves and stockings, yet the quantity required, and the difficulty of keeping the spiders, owing to their wandering habits and pugnacious qualities, precludes any idea of this manufacture succeeding. Indeed Reaumur, who collected by order of his government some thousands of spiders, found, on dividing them into troops of fifty each, that after a few days only one or two remained in each division, and that it required upwards of 50,000 of the largest variety to produce one single pound of silk.

The web of the great American wood spider, which is found in the West India islands, is strong enough to retain even the large-sized humming bird, but I am not aware of its having been manufactured to any extent.

Dr. Walsh (*Travels in Brazil*) speaks of finding immense spiders' webs, like veils of thin gauze, suspended across the trees in the interior, as large as a sheet, or 10 or 12 feet in diameter, formed by *Aranea maculata*. Some of these spiders, when their legs were expanded, formed a circle of six or seven inches in circumference. They were particularly distinguished by bright spots. The cords composing the web were of a glossy yellow, like the fibres of silkworms, and equally strong. Dr. Walsh wound off several on a card, and they extended to the length of three or four yards. A gentleman of Languedoc, some time ago attempted to establish a manufacture of spider silk, and so far succeeded that he made gloves and stockings from the fibres of the web; the great objection, however, to his success was the implacable hostility of these insects to each other. This objection to the process did not exist in the Brazilian species, for there the insect is not solitary, but gregarious, and colonies of more than 100 occupy the same web, and live in amicable communion together.

Austrian papers state that a merchant of Vienna has lately presented to the Industrial Union of that capital, the details of a series of experiments made by him to manufacture spiders' thread into woven tissues. The thread is wound on a reel, and two dozen spiders produce, in six minutes, a beautiful and delicate thread, two thousand feet in length. The stuffs manufactured are spoken of as being far superior to those of silk in beauty and delicacy of fabric.

At a recent meeting of the British Association for the Advancement of Science, a paper was read "On a Tissue woven by Caterpillars," by Mr. J. Dennistoun:—"In the early part of this century there lived at Munich a retired officer, Lieut. Hebenstrait, who amused himself by experiments on the means of giving consistency to the gossamer produced by caterpillars, which is occasionally seen blown about in flakes over the fields in Germany, and he was at one time sanguine of rendering it available as a material for ladies' dress. It is said that his plan was to prepare a paste of lettuce or other leaves beat up with butter, and, after spreading it thinly over a smooth surface on an inclined plane, he placed at the lower end a number of chenilles or caterpillars of the proper species. These animals gradually ascended the incline, devouring the paste, and depositing as they proceeded a sort of tissue, until the whole surface was uniformly covered with it. He is reported to have produced open-work designs by drawing the pattern with a hair pencil dipped in olive oil before the animals began to work. These I never saw, but I have seen one veil on which were some letters exactly resembling a watermark on paper, the secret of which I do not know. The inventor pursued his experiments with great secrecy, in the hope of turning his invention to valuable account; but finding this impracticable, it appears that he produced but very few specimens, which are now preserved in various museums on the continent. I have seen two besides my own, which I procured at Munich, in 1837, after having advertised for it several months. The objections to using this tissue seem to be chiefly its exceedingly flimsy quality, and its very adhesive properties, which render its management and preservation extremely difficult, attaching itself closely even to the smoothest surfaces, from which it can be separated only by the breath. My veil is about 42in. by 24in. One of 26½in. by 17in. is said to have weighed only 1½ grain. Another containing 9 square feet is mentioned as weighing 4⅓ grains, while the same surface of silk gauze weighed 137 grains, and of fine lace 262½ grains. It would seem that the art was in some degree known at an earlier period, and occasionally practised in convents, where coloured drawings on small bits of it are said to have been made. I have seen in all four of these on the continent, and two or three on which impressions from copper plate had been taken—always of sacred subjects. One of the drawings is in my possession, about 7in. by 5in., executed apparently in the last century, and I have seen one dated about 1770."

This beautiful tissue was unfolded to the Section. It was rather more transparent than the finest lace veil, but it floated about with every slight current in the Section room, after a manner quite its own.

Another animal, whose labours have been coerced by man to the same end, is the *Pinna marina*. This mollusc, like most of its order, has the power of spinning a viscid

silk, but not in the same manner nor for the same end as the caterpillars. The latter seeking for protection during a certain stage of life only, have organs which, during the rest of their existence, are preparing for this end, but the Pinna has a constant use for this production, which, although like silk, a secretion of certain organs within its own body, acts as an anchor, a leg, or a hand, as may be required. The operation of the worm may truly be called spinning, but that of the fish is rather like the work of a wire-drawer, the substance being first cast in a mould formed by a sort of slit in the tongue, and then drawn out as may be required; its mechanism is very curious, but would be foreign to our purpose. This mollusc is found in the West India seas, but in the Mediterranean the wing shell is often seen three feet long.

The long silky material was well known to the ancients by the name of byssus, and was tolerably extended in its use. Even as late as 1754 it was woven into stockings, which had the appearance of brown silk, but were said to be too warm for ordinary wear. The filaments are extremely fine and strong, and the colour, which is a reddish brown, never fades.

This mollusc, the steckmuschel of the Germans, is very common in some parts of the Mediterranean, and at Smyrna, Tarentum, and Palermo, in Italy, they were wont to make gloves and other articles from them, more however from curiosity than for use.

These samples serve but as an illustration of the curious resources of Nature, which appears equally able to produce a given substance whether from animal or vegetable material.

The attempts at Malta to rear the Bombyx cynthia on the castor-oil plant having failed, I may call attention to the fact that since the muscardine has made so great ravages among the mulberry silkworm, there has been an attempt to introduce into France other silkworms. It is now proposed to acclimate three American species of bombyx; the *cecropia*, whose larves feed on leaves of the willow, and may be fed also on the plum; the *luna*, an elegant species, of a green colour, which lives on the liquidambar, and which will also eat the leaves of different species of walnut; and the *polyphemus*, a large *Attacus*, of a brownish grey colour, which feeds on the apple, oak, beech, &c. These three species are abundant in the woods of Louisiana, Georgia, and South Carolina. Their silk is of inferior quality, but it costs so little to obtain it, that the acclimation of the species is regarded as desirable on the score of economy.

At a recent local show held at Madras, very fine samples of this product, the most costly of all materials for textile purposes, were shown from Mysore, the produce of *Bombyx Mori* (silk worm). It is probable that the culture may be successfully prosecuted in the valleys of the Neilgherries. Indeed, for some years past experiments have been energetically carried on by the late Mr. Cassamajor, and at present by Major Minchin. Specimens of silk from Italian worms reared at Katy have also been sent. On the Bombay side, the culture of silk under M. Mutti, an Italian, did not succeed, and has been abandoned for want of success.

Silk reared by the children at the Chittoor School was also exhibited. The culture of silk has been much promoted and is being skilfully carried out by Mons. Perrotet, Pondicherry.

Tussah Silk.—Cocoons, from which this description of silk is obtained, were exhibited from several localities. They are formed by caterpillars of several species of moth, belonging to the genus Saturnia. That which is most commonly met with in Southern India appears to be *S. Paphia*, according to the Jury Report. The caterpillar feeds on the leaves of the country almond tree (*Terminalia catappa*), whence it is often called the almond moth. It is also found on the leaves of the ber tree, (*Zizyphus jujuba*,) the casuarina, &c. The cocoons are ingeniously attached to the twiggy branches of the ber, by a long stalk terminating in a ring, encircling the branch. In the thicker foliage of the casuarina, the silk is woven among the leaves without the above provision. It does not appear that silk in any quantity has been obtained from this source in the Madras Presidency. Considerable quantities of the small silk cloth worn by Brahmins at their meals are imported into the Northern Circars, from Cuttack. The only use to which the cocoons appear to be turned is that of a ligature for native match locks. They are cut spirally into long narrow bands, with which the barrels are tied to the stocks. Dr. Roxburgh, in the 7th vol. of the Linnæan Transactions, has described the preparation of the tussah silk of Bengal, which is derived from two different species of Saturnia. One called *bughy* by the natives of Beerbhoon, appears to be the same as the Madras species, (*S. Paphia*,) and is stated to feed on the ber tree and on the Asana (*Pentaptera glabra*). The other, termed *jarroo* by the natives of the same province, is the *S. Cynthia*, and is domesticated. The caterpillars are fed on the leaves of the castor oil plant (*Ricinus*) whence it is called the arrundy, or arundi silk worm, but it also eats the leaves of the Ber and Asana. Colonel Sykes has a paper in the 3rd vol. Trans. Roy. As. Soc. Lond., on the cocoons of *S. Paphia*, found by him in the Deckan under the designation of the kaliswar silk worm, which he states is met with on the ber tree, pentaptera glabra, teak tree, and common mulberry. The Chinese tussah is said to be obtained from *Saturnia atlas*, which is also to be met with in Southern India.

Another species of Saturnia (*S. Selene*) the posterior wings of which are prolonged into a tail-like process, is common in Southern India. The caterpillar may be observed feeding in considerable numbers on the Odina Wodier or Bsharm tree in February and March. Its chrysalis is enveloped in a silky covering, so like that of *S. Paphia*, it would probably be found to yield astrong and useful thread.

It may be worth while to direct attention to the silk spun by several smaller specimens of Bombyx and moths, found on different species of Cassia, Acacia, and Phyllanthus. A gregarious caterpillar (a species of Lasio campris) may be observed clustering in great numbers on the stem of the guava, the Jamoon (*Syzygium jambolanum*,) and probably other trees; the silky covering of these also seems deserving of examination.

Lieut.-Colonel F. Cotton sent some of the cocoons gathered by him when exploring the Godavery.

Some singular religious notions stand in the way of the extended production of silk by some of the natives of the East. Thus Mr. Wright, of Paradenia, near Kandy, Ceylon, has been making exertions to extend the culture of the silkworm, and forwarded 500 or 600 cocoons to be distributed among the natives. The headmen were called to assist, but they doubted whether the priests of Boodha would sanction the cultivation of the silkworm. The high priests were convened and came to the meeting, flaunting in their large yellow silk shirts, their sacerdotal dress, but nothing could induce them to recommend an occupation which involved the destruction of life.

"Why," said the agent, "you come here wrapped in the spoils of the worms which are killed by the strictest Boodhists in China and Siam." But they would not sanction a practice which involved the destruction of the worm, although they themselves gave the greatest encouragement to it by the use of silk.

## PUBLIC LIBRARIES ACT (SCOTLAND).

### CAP. LXIV.

An Act to amend an Act of the last Session for extending the Public Libraries Act, 1850, to Ireland and Scotland. [31st July, 1854.]

Whereas it is expedient to amend the Act of the sixteenth and seventeenth years of her present Majesty, chapter one hundred and one, so far as the same relates

to Scotland, and to give greater facilities for the establishment there of public libraries and museums: Be it therefore enacted by the Queen's most excellent Majesty, by and with the advice and consent of the Lords spiritual and temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

I. In the construction of this Act the following words and expressions shall have the meanings hereby assigned, if not inconsistent with the context or subject matter; that is to say, the expression "parliamentary burgh" shall mean a burgh or town to which magistrates and councils were provided by the Act of the third and fourth years of King William the Fourth, chapter seventy-seven; the expression "occupier of premises" shall mean a male occupier of a dwelling-house or other heritable subjects of the yearly value of ten pounds or upwards, not being a lodger or a party in the occupation as tenant of a furnished house let for a less period than one year, but in such case shall mean the party by whom such house is so let.

II. So much of the said Act of the sixteenth and seventeenth years of her present Majesty, chapter one hundred and one, as relates to Scotland, is hereby repealed, but such repeal shall not invalidate or affect anything already done in pursuance of such Act; and all public libraries and museums established in Scotland under that Act shall be considered as having been established under this Act.

III. In citing this Act for any purpose whatever, it shall be sufficient to use the expression "the Public Libraries Act (Scotland), 1854."

IV. Upon the requisition in writing of the magistrates and council of any royal burgh, parliamentary burgh, burgh of regality or burgh of barony in Scotland, whose population according to the then last census shall exceed ten thousand persons, the chief or senior magistrate of such burgh, or, in the case of a burgh not being a royal or parliamentary burgh, the sheriff of the county in which such burgh is situated, shall, within ten days after the receipt of such requisition, convene a meeting of the occupiers of premises in such burgh, or in such part thereof within which it may in such requisition be proposed to adopt this Act, for the purpose of considering whether this Act shall be adopted for such burgh or such part thereof, such meeting to be held in the town hall or other convenient place on a day not less than twenty-one days or more than thirty days after the receipt of such requisition, and notice of the time and place of such meeting to be given by affixing the same upon the doors of the several parish churches within such burgh fourteen days preceding the day of meeting.

V. For the purpose of deciding as to the adoption of this Act, all occupiers of premises in such burgh or in such part thereof as aforesaid, as the case may be, shall be entitled to vote, and companies or copartnerships occupying houses or other heritable subjects above the yearly value of ten pounds, so as to afford more than one qualification of ten pounds, may grant authority in writing to any one of the partners of such company or copartnership to vote, but such company or copartnership shall not so authorise or have right to vote by more than one partner in respect of each qualification of ten pounds afforded by such premises: and any dispute as to the qualification or identity of any occupier of premises shall be decided by such senior magistrate or sheriff, as the case may be, whose decision shall be final.

VI. If at such meeting it shall be determined by a majority of two-thirds of the votes of the occupiers of premises present that the provisions of this Act shall be adopted in such burgh or in such part thereof respectively, then the same shall from thenceforth come into operation therein, unless a poll shall be demanded in writing at such meeting by any five persons present and qualified to vote, and in that case the meeting shall be adjourned to a future day for the purpose of declaring the result of the poll.

VII. When such poll shall be demanded, such magistrate or sheriff as aforesaid shall appoint the necessary number of clerks, and cause proper poll books to be prepared, and such poll shall be proceeded in within such period as he shall determine, not exceeding two days from the day of the holding of such meeting; and the poll shall be kept open for one day at the places fixed by him, commencing at nine of the clock in the forenoon and ending at four of the clock in the afternoon; and as soon after the close of the poll as may be the poll clerks shall transmit to such magistrate or sheriff the state of the respective polls, who shall sum up the same, and openly declare the result of the total poll at the adjourned meeting.

VIII. If it shall appear by the result of such poll that two-thirds of the votes given have been given in favour of the adoption of this Act, then the same shall from thenceforth come into operation in such burgh or such part thereof as aforesaid; and in all cases of the adoption of this Act the same shall be put into execution by the magistrates and council of the burgh.

IX. For defraying the expenses incurred in calling the meeting and in taking such poll, whether this Act shall be adopted or not, and the expenses of carrying this Act into execution, the magistrates and council of such burgh shall yearly assess all occupiers of premises within the burgh, or within such part thereof where it may have been decided to adopt this Act, in the sums necessary for defraying such expenses, but in no case to an amount exceeding one penny in the pound of the yearly rent of such premises; and such assessments shall be made, levied, and recovered by the magistrates and councils of such burgh or town in such and the like manner, from the same descriptions of persons and property, and with and under the like powers, provisions, and exceptions, as the general assessments leviable under the Act of the thirteenth and fourteenth years of her present Majesty, chapter thirty-three, for police and other purposes, are authorised to be made, levied, and recovered, and as if such magistrates and council were commissioners elected under that Act, and the said assessments were part of the general assessments authorised to be thereby made.

X. The magistrates and council shall provide and keep books in which shall be entered true and regular accounts of their receipts, payments, and liabilities with reference to the execution of this Act, to be called "The Public Libraries Account," and such books shall at all reasonable times be open to the inspection of every person liable to be assessed by virtue of this Act, without fee or reward, who respectively may take copies of or make extracts from such books, without paying for the same; and in case such magistrates or council, or any of them respectively, or any of their respective officers or servants having the custody of such books, shall not permit the same accounts to be inspected, or copies of or extracts from the same to be made or taken, every person so offending shall for every such offence forfeit any sum not exceeding five pounds.

XI. The boundaries of parliamentary burghs, royal burghs, burghs of regality and of barony, shall for the purposes of this Act be the same as the boundaries declared for such burghs by and for the purposes of the said Act of the thirteenth and fourteenth years of her present Majesty, chapter thirty-three.

XII. The magistrates and council of any burgh may from time to time appropriate for the purposes of this Act any land or buildings vested in them, and also purchase, feu, or rent any land, and may, upon any land so appropriated, rented, feued, or purchased respectively, erect any buildings suitable for public libraries or museums, or both, and may alter and extend any buildings for such purposes, and repair and improve the same respectively, and fit up, furnish, and supply the same respectively with all requisite furniture, fittings, and conveniences.

XIII. All the clauses and provisions of the "Lands Clauses Consolidation Act (Scotland), 1845," with respect to the purchase of lands by agreement, and with respect to the purchase money or compensation coming to parties having limited interests, or prevented from treating, or not making a title, and also with respect to conveyances of lands, so far as the same clauses and provisions respec-

tively are applicable to the cases contemplated by the last section, shall be incorporated in this Act; and the expression "The Special Act," used in the said clauses and provisions, shall be construed to mean this Act; and the expression "The Promoters of the Undertaking," used in the same clauses and provisions shall be construed to mean the magistrates and council of the burgh in question.

XIV. The magistrates and council of any burgh may sell any lands vested in them for the purposes of this Act, or exchange the same for any lands better adapted for the purposes; and the monies to arise from such sale, or to be received for equality of exchange, or a sufficient part thereof, shall be applied in or towards the purchase of other lands better adapted for such purposes.

XV. The general management, regulation, and control of such libraries and museums shall be vested in and exercised by the magistrates and council of the burgh, or such committee as they respectively may from time to time appoint (the members whereof need not be magistrates or councillors), who may from time to time purchase and provide the necessary fuel, lighting, and other similar matters, books, maps, and specimens of art and science, for the use of the library or museum, and cause the same to be bound or repaired when necessary, and appoint salaried officers and servants, and dismiss the same, and make rules and regulations for the safety and use of the libraries and museums, and for the admission of visitors; and the lands so to be appropriated, purchased, or rented as aforesaid, and all other real and personal property whatever presented to or purchased for any library or museum established under this Act, shall be vested in such magistrates and councils.

XVI. The admission to all libraries and museums established under this Act shall be open to the public free of all charge.

## PUBLIC LIBRARIES ACT (IRELAND).

### CAP. XL.

An Act for further promoting the Establishment of Free Public Libraries and Museums in Ireland. [26th June, 1855.]

Whereas it is expedient to amend the Act of the sixteenth and seventeenth years of her present Majesty, chapter one hundred and one, and to give greater facilities for the establishment in Ireland of free public libraries and museums, or schools of science and art: Be it therefore enacted by the Queen's most excellent Majesty, by and with the advice and consent of the Lords spiritual and temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:

I. The said Act of the sixteenth and seventeenth years of her present Majesty, chapter one hundred and one, and section ninety-nine of the Towns Improvement Act (Ireland), 1854, are hereby repealed; but such repeal shall not invalidate or affect anything already done in pursuance of either of such Acts; and all public libraries and museums established in Ireland under either of those Acts shall be considered as having been established under this Act.

II. In citing this Act for any purpose whatever, it shall be sufficient to use the expression "The Public Libraries Act (Ireland), 1855."

III. In the construction and for the purposes of this Act (if not inconsistent with the context or subject-matter) the following terms shall have the respective meanings hereinafter assigned to them; that is to say, "town" shall mean and include any city, borough, town, or place in which commissioners, trustees, or other persons have been or shall be elected or appointed under the Act of the ninth year of King George the Fourth, chapter eighty-two, or the "Towns Improvement Act (Ireland), 1854," or any local or other Act or Acts for paving, flagging, lighting, watching, cleansing, or otherwise improving any city, borough, town, or place, for the execution of any such Act or Acts, or superintending the execution thereof, and in which there shall not be a town council or other such body elected uuder the Act of the third and fourth years of her present Majesty, chapter one hundred and eight, or any other charter granted in pursuance of such Act, or any Act passed for the amendment thereof; "town commissioners" shall mean the commissioners, trustees, or other persons, for the time being, elected or appointed under any such first-mentioned Acts as aforesaid; "town fund" shall mean the town fund, or the rates or property vested in and under the control and direction of any town commissioners, and applicable to the purposes of any such Acts; "town rate" shall mean the rate or rates authorised to be levied by any such town commissioners; "mayor" shall include Lord Mayor; "clerk" shall mean, as regards an incorporated borough, the town clerk of such borough, and as regards a town in which there shall be town commissioners, the clerk appointed by the town commissioners; "householder," shall mean a male occupier of a dwelling-house, or of any lands, tenements, or hereditaments, within any town or incorporated borough, and entitled, for the time being, to vote at elections of commissioners, aldermen, or councillors in such town or borough.

IV. The council, or board of municipal commissioners of any incorporated borough in Ireland, regulated under the said Act of the third and fourth years of her present Majesty, chapter one hundred and eight, or any charter granted in pursuance of such Act, or any Act passed for the amendment thereof, the population of which, according to the then last census thereof, shall exceed five thousand persons, or the town commissioners of any town in Ireland having such a population as aforesaid, may, if they think fit, appoint a time for a public meeting of the householders of the borough or town, as the case may be, in order to determine whether this Act shall be adopted for the borough or town, and ten days' notice at least of the time, place, and object of the meeting shall be given by affixing the same on or near the door of every church and chapel within the borough or town, and also by advertising the same in one or more of the newspapers published or circulated within the borough or town seven days at least before the day appointed for the meeting; and if at such meeting two-thirds of such persons as aforesaid then present shall determine that this Act ought to be adopted for the borough or town, the same shall thenceforth take effect, and come into operation in such borough or town, as the case may be, and shall be carried into execution, in accordance with the laws for the time being in force relating to the municipal corporation of such borough, or relating to such town.

V. The expenses incurred in calling and holding the meeting, whether this Act shall be adopted or not, and the expenses of carrying this Act into execution in such borough, shall be paid out of the borough fund, and in such town out of the town fund; and the council, or board of municipal commissioners, or town commissioners, may levy as part of the borough rate or town rate, as the case may be, or by a separate rate to be assessed and recovered in like manner as the borough rate or town rate, all monies from time to time necessary for defraying such expenses; and distinct accounts shall be kept of the receipts, payments, and liabilities of the council with reference to the execution of this Act.

VI. Such accounts shall be audited in the same way as all other accounts of such borough or town respectively are audited, and the said council or board or town commissioners shall, within one month after the same shall have been audited, transmit to the Lord Lieutenant, or other chief governor or governors of Ireland for the time being, a true and correct copy of such accounts; and shall also, within the time aforesaid, cause a copy of such accounts to be deposited in the office of the clerk; and the said accounts shall be open to the inspection of all householders of such borough or town respectively, and copies

thereof shall be delivered to any such householder applying for the same, upon payment of a reasonable charge for the same, to be fixed by the council or board or town commissioners, as the case may be.

VII. The town commissioners of every town adopting this Act shall for the purposes thereof be a body corporate, with perpetual succession, by the name of "The Commissioners for Public Libraries and Museums for the Town of , in the county of ," and by that name may sue and be sued, and hold and dispose of lands, and use a common seal.

VIII. The amount of the rate to be levied in any borough or town in any one year for the purposes of this Act shall not exceed the sum of one penny in the pound, and in any such borough shall be assessed, raised, collected, and levied in the same manner as the borough rate, and in any such town shall be assessed, raised, collected and levied in the same manner as the town rate.

IX. The council or board of any borough, and the town commissioners of any town, respectively, may from time to time, with the approval of her Majesty's Treasury, appropriate for the purposes of this Act any lands vested, as the case may be, in a borough in the mayor, aldermen, and burgesses, and in a town in the town commissioners, and may also, with such approval, purchase or rent any lands or any suitable buildings, and the council or board, and town commissioners respectively may, upon any lands so appropriated, purchased, or rented respectively, erect any buildings suitable for public libraries, or museums, or schools of science and art, or both, and may apply, take down, alter, and extend any buildings for such purposes, and rebuild, repair, and improve the same respectively, and fit up, furnish, and supply the same respectively with all requisite furniture, fittings, and conveniences.

X. "The Lands Clauses Consolidation Act, 1845," shall be incorporated with this Act; but the council or board, and commissioners respectively shall not purchase or take any lands otherwise than by agreement.

XI. The council or board and commissioners aforesaid respectively may, with the like approval as is required for the purchase of lands, sell any lands vested in the mayor, aldermen, and burgesses, or board, or town commissioners respectively, for the purposes of this Act, or exchange the same for any lands better adapted for the purposes; and the monies to arise from such sale, or to be received for equality of exchange, or a sufficient part thereof, shall be applied in or towards the purchase of other lands better adapted for such purposes.

XII. The general management, regulation, and control of such libraries and museums or schools of science and art shall be, as to any borough, vested in and exercised by the council or board, and as to any town, in and by the town commissioners, or such committee as they respectively may from time to time appoint, who may from time to time purchase and provide the necessary fuel, lighting, and other similar matters, books, newspapers, maps, and specimens of art and science, for the use of the library or museum, and cause the same to be bound or repaired, when necessary, and appoint salaried officers and servants, and dismiss the same, and make rules and regulations for the safety and use of the libraries and museums or schools of science and art, and for the admission of visitors.

XIII. The lands and buildings so to be appropriated, purchased, or rented as aforesaid, and all other real and personal property whatever presented to or purchased for any library or museum or school of science and art established under this act, shall be vested, in the case of a borough, in the mayor, aldermen, and burgesses, and in the case of a town in the town commissioners.

XIV. If any meeting called as herein-before provided to consider as to the adoption of this Act for any borough or town shall determine against such adoption, no meeting for a similar purpose shall be held for the space of one year at least from the time of holding the previous meeting.

XV. The admission to all libraries and museums established under this Act shall be open to the public free of all charge.

XVI. Upon the coming into operation of this Act in any borough it shall, as regards such borough, be incorporated with the said Act of the third and fourth Victoria, chapter one hundred and eight, and upon the coming into operation of this Act in any town it shall, as regards such town, be incorporated with the Act or Acts in force therein relating to the powers and duties of the town commissioners.

## SOCIETY FOR THE PROMOTION OF INDUSTRIAL ART, CALCUTTA.

The attention of the members is called to the Prospectus and Circular below, issued by the President and Committee of this Institution, in the hope that there may be among them some who may have it in their power to promote the success of this valuable undertaking.

Col. Goodwyn, the active and energetic president and founder of the Society, writes from Calcutta, under date of 8th August last, to the Secretary to the Society of Arts, as follows:—

"I hope your Society will interest themselves in the first School of Industrial Art which, by aid of European friends, I succeeded in establishing here. I had nearly the same apathy and superstition to overcome; and, strange to say, the boys delight in the occupation, though their parents *will* not see the benefit of Art Industrial Education. We have now about seven pupils who learn drawing of all kinds, modelling, and wood engraving. Our funds, however, are very low, and require immense energy and constant stimulus to preserve the school. Better times are coming, I hope."

### PROSPECTUS.

The Society for the Promotion of Industrial Art at this Presidency desire earnestly to call upon all who have at heart the social and mental progress of the natives of this country, to come forward in support of the School of Industrial Art which has recently been established at Calcutta, and in doing so, they would solicit attention to the statement of the objects which they have had in view, as explained in the accompanying circular.

The leading objects of their undertaking may briefly be described as follows:—

1st. The development of new sources of industrial occupation for the more educated classes of the native population.

2nd. The supply of the great and increasing want which is felt in this country of skilled draftsmen, designers, stone and wood engravers; and

3rd. The development of the faculties of taste and inventiveness.

To accomplish these objects, the school was opened in August last for instruction in drawing, engraving, modelling and moulding, pottery and architecture. Such teachers of these arts as could be found on the spot were engaged on liberal allowances, and orders were sent to England for the engagement of a teacher of engraving on wood, stone, and copper.

The encouragement which the undertaking has received in respect to the eagerness with which applications have been made for admission to the different classes has been most gratifying, and not less so the great progress made by the students, who have not only exhibited that faculty of acquiring whatever is communicated to them for which the natives of this country are remarkable, but a degree of taste and skill which was but little expected.

In the department of modelling and moulding, a selection has been made of those pupils who have shown a very decided superiority to the rest in point of ability, and who are willing to devote a larger amount of time daily to this object than is comprised in the hours during which the other students attend the school, and a class of "appren-

tices" has in this way been formed who are to receive credit for a certain portion of the profits made by the school on account of work executed by them and sold to the public,—and the amount of those credits will be paid to such apprentices, on quitting the school, as are considered by the committee to be entitled to a certificate of qualification. This will provide the pupil with a small capital to start in trade with, and secures his attendance at the school until thoroughly qualified to practise the trade which he has learnt.

A similar course will be pursued in the engraving and other departments.

It must, however, be borne in mind, that a school of this description requires no ordinary amount of expenditure to establish and sustain it during the first few years. It must be recollected that there are no persons born or educated in this country to be found available for instruction in the industrial arts above-named, for the arts themselves may be said to be *unknown* in India. The result is that the Society has been obliged to resort to the services of gentlemen born and educated in Europe, and, in the case of the engraving class, to bring out a teacher from England specially for that purpose. This necessarily involves a very heavy outlay, and until the people of this country have been made aware that the exercise of these arts is sufficiently remunerative to make it worth their while to pay high fees for instruction therein, the school cannot be self-supporting, although in course of time, it doubtless will be so.

The present expenses of the School are:—

| | |
|---|---|
| Teacher of modelling, moulding, and drawing (besides a portion of all profits derived from orders and commissions)... | 300 |
| Teacher of engraving and drawing ...... | 300 |
| Servants, and incidental expenses ......... | 120 |
| Total ... | 720 |

To meet which, the Society is in receipt of—

| | |
|---|---|
| Monthly contributions ........................ | 250 |
| Fees from pupils.................................. | 120 |
| Total ... | 370 |

Thus leaving a monthly deficit of 350 rupees.

At first sight of this statement, the financial condition of the Society would appear to be hopeless. Such, however, is not the case, for with reference to the grants-in-aid which are promised in the recent despatch from the Court of Directors to all educational institutions of approved character, the Society may fairly expect to receive a grant equal to the amount of the subscriptions, viz., 250, which would raise their monthly income to 620 Rs. or 100 Rs. per month less than its disbursements. This deficit the Society must look to the public to make up by increasing the amount of their contributions. At present the monthly deficit is met by drawing on the donation fund.

To the natives of this country, the Society would more especially appeal, for every country in Europe is a powerful witness to the immense national, local, as well as individual advantages which have accrued from institutions such as these.

To men of all classes, who, either permanent residents of the soil, or who have in any degree an interest in the welfare of this country, the Society would point out that this is an opportunity of opening a mine of industrial wealth to a nation peculiarly capable of working it to advantage; and of providing increased employment for the increasing number of educated persons among the native community.

Persons of all classes are therefore earnestly invited to become members of the Society, which involves a monthly subscription of only 3 Rs. or a donation of 250 Rs.

## CIRCULAR.

Sir,—We are directed by the Society which has been formed for the promotion of education in industrial art at this Presidency, to solicit your aid in establishing a public school for the instruction of natives and East Indians in the following subjects:—

1. Elementary drawing; drawing from models and natural objects, and architectural drawing.
2. Etching and engraving on wood, metal, and stone.
3. Modelling, including pottery.

The grounds upon which the support of the public is solicited to this undertaking are the importance of stimulating and improving the indigenous manufactures of the country, the great want of skilled draughtsmen and engravers, and the urgent necessity of providing some new field of employment for the large number of natives and East Indians possessing some degree of education who daily experience an increasing difficulty in procuring an honourable livelihood.

Besides these objects of immediate advantage, all who are interested in the moral and material welfare of this country will not fail to perceive that an undertaking of this kind must contribute ultimately to produce results of still greater importance,—that it will tend to supply a great want in the system of native education hitherto pursued. However much we may differ in opinion as to what constitutes education of the highest or the most useful character, it cannot be denied by any that for the classes who have to earn their livelihood, and who at the same time occupy a position above that of the mere labourer or artisan, there must be education, not so much of the *highest* as of the *widest* kind. In other words, there must be instructions in as *many different* branches of human knowledge and skill as possible, so that every individual, whatever his particular capacity, may find an appropriate field for its profitable exercise.

To enable the natives of India to be themselves instrumental in the development of her material welfare, and therefore to occupy *all* departments of human exertion, the instruction of the majority, at least, must be practical as well as theoretical. There is a higher ground even than this. For the perfect regeneration of the national mind, scope must be given for the full exercise of all the mental powers. While education is so partial that only some of the faculties are exercised, there can be no real progress,—especially when there is no provision for that instruction in the practical applications of science to the wants of mankind, which afford the great field for the development of enterprise, inventiveness, and originality.

It is not pretended that the establishment of a school of industrial art will be a complete remedy for the defect in the system of education here pointed out, but it will tend to promote that object; industrial art is one of the many practical applications of science which must be worked, and one which may be appropriately undertaken by a Society, while public instruction in the other departments will probably ere long be provided for by government.

Moreover, the establishment of a school of this kind will be an effectual means for the removal of those barriers to progress which have been created by the ancient system of confining the cultivation of the industrial arts to particular classes, and those the least educated in the community.

This undertaking has for its aim the simultaneous education of the *head* and the *hand*, and the elevation of the industrial arts in the estimation of native society, both by extending their cultivation among the educated,—and their appreciation among all, especially the wealthy and enlightened.

The perfect success of a similar experiment which has been made at Madras enables the society to appeal confidently to the public for support. In the schools established by Dr. Hunter at that Presidency, there has been a larger demand for the productions of the school, as well as for the services of the pupils educated there, than the institution could keep pace with.

It is proposed to obtain the services of persons qualified to teach the various branches above enumerated, either from Madras, or, if possible, on the spot, and to hire school premises in the native quarter of the town, the hours of instruction being so fixed as not to interfere with the arrangements of the other educational institutions, the pupils of which may thus be enabled to attend the Society's school also. That the undertaking may, as far as possible, be self-supporting, moderate fees will be demanded from each pupil, according to the branch of study pursued—but probably in no case exceeding one rupee per mensem.

It is desired by the Society to carry on this experiment at least for a year, and it has been calculated roughly that the amount which it will be necessary to raise for that purpose (including the permanent stock, such as models, furniture, drawing materials, &c.) will be about 7,000 rupees, less whatever amount may be derived from fees.

The Society believe that benevolence cannot be more usefully exercised than when, as in the present case, it is for the purpose of giving large numbers of the community the means of finding an enlarged sphere of remunerative occupation—in fact, of helping men to help themselves.

Donations either in books, drawings, models, or money, are solicited for the formation of the working-stock, say to the value of 2,000 rupees; and *monthly* subscriptions for the current expenditure of the school.

Yours obediently,
HODGSON PRATT, and
RAJENDRALAL MITTRA,
*Honorary Secretaries to the Society for the Promotion of Industrial Art.*

## Home Correspondence.

### THE DECIMAL COINAGE QUESTION.

SIR,—In the number of your *Journal* just received, I find a letter by Dr. Gray, of the British Museum, containing a most extraordinary and unwarrantable attempt to show that a letter of mine on decimal coinage, published in the *Athenæum* more than two years ago, does not contain the views and scheme it has ever since been well known to contain, *and by himself*, as well as every one else, repeatedly admitted to contain, and this by a most unfair and partial extract, when the following words, *which occur repeatedly in the letter*, would have evidently made such a gross misrepresentation altogether impossible. The contents of that letter are quite correctly given in your list of books, &c., on this subject, where it is truly described as "*the first sketch of a plan for introducing, with no compulsory change but that of the* 10*d. for the* 12*d., as one of our moneys of account, and a silver coin to represent this* 10*d.* (*the* 24*th of the pound sterling in value*), *an absolutely perfect practical system of decimal accounts in this country, and an international silver coinage, &c.*"

This statement Dr. Gray asserts to be "incorrect in almost every particular, viz., the date, the contents of the letter, and the class to which it ought to be referred,"—that of plans founded upon the penny.

1st. Dr. Gray is perfectly well aware that the date of that letter *is not incorrectly given*, and further, that it was *omitted* by the editor, in order to squeeze in a postscript, when delayed by press of other matter, expressly forwarded to the editor to call attention to a subsequent letter *by Dr. Gray* in the *Times*, so far going along with its views as to deprecate any decimal system which "does not retain the penny as one of its essential elements"—*of which there are several, but never even mentioning by name, as my letter had again and again, the tenpence, or attempting to propose a practical scheme of any kind* (*the object and result of my letter*) to bring such a system into operation. Dr. Gray could not have overlooked this letter, for as soon as my name became known to him by the publication immediately afterwards of my pamphlet, more fully and accurately developing my proposition than was practicable within the narrow limits, and in the *very hurried* letter prepared for the *Athenæum*, he wrote to me (then a perfect stranger) gratefully acknowledging the notice in the *Athenæum*, afterwards authorising the following statement of his views in the preface I was preparing for a second edition of my book, important with reference to what follows: "I have read your pamphlet *with great care, and agree with you in every part of it*, and consider some of the points as most admirably and strongly put. I should propose to take the penny as the integer, *and have no other coins of account but the* FRANC, but would not object, if preferred, to the ducat of 100 pence, &c."

2nd. The contents, proper class, &c.—a question entirely turning upon the sense in which the word franc is used in my letter by Dr. Gray himself, and, as he has stated, *ever was* by "*all* advocates of the penny system," my own name being specially mentioned. I was not the first to call the English tenpence by the name of franc, this common use of the word having been adopted by Sir John Herschell and others in their evidence before the committee on decimal coinage, but I *was* the first to urge strongly, when I found the misunderstanding to which it led, that our 10d. should be known only by the unmistakable English word tenpence, and I induced poor Mr. Laurie to make this change in *his* works. But when Dr. Gray first appeared as the author of a pamphlet on this subject, *the following year*, *he* still proposed the new term of "Alb" or "Albion," fortunately, I think, never adopted, "but," *he still repeated*, "MR. RATHBONE'S PLAN'—(never hinting that I had, as most certainly I never had more than one)—"*is most nearly in conformity with the principles here proposed. See his very able and most important pamphlet, 3rd edition, &c.*" And after all this, Dr. Gray attempts by a short extract, and the careful omission of all that follows in the letter in the *Athenæum*, to give the impression that, by proposing to substitute francs for shillings, and to keep accounts in francs and pence instead of £. s. d., I was proposing "the present French coinage in all its details" (!) when no one could have, or ever yet has, more carefully guarded himself against such misunderstanding than I have *in that letter*, and when Dr. Gray *even now admits* that the statement to which he objects, *accurately describes* what were *my intentions then.* Again and again are the expressions used,—"the franc, the TENPENNY;" "the *double sou*, OR ENGLISH *penny*;" "single and double sou pieces," to be "*our old familar pence and halfpence*;" and, in the closing paragraphs,—"The ONLY necessary practical change of any moment *in this country*, would, in short, be, *from shillings to*" (the figure 10 *here* obviously omitted by the printer) "*pence*; and here the broad, clear distinction *between* TWELVEPENCE AND TENPENCE" (expressly put in italics), "would put everyone on his guard; and the fact that *three francs would constitute the well-known English half-crown*," *&c.* All that would be necessary, it is stated, to render the simple comprehensive plan proposed general, "*by negotiation* to induce other countries to enact that *their* coinage and accounts should hereafter be some multiple of the franc, the TENPENNY, or twenty-sou piece," *both to be indentical, as repeatedly stated*; and whether by making the franc a 10d., or the 10d. (or 24th of a pound) a franc, in the amount of silver representing those two coins, if done gradually as the existing coins wear out, is wholly unimportant to this country, provided, as stated, that "all coins whatever be multiples or definite portions of this universal European franc, with the exact number and proportion which they represent distinctly impressed upon them in all cases." To cavil at my suggestion that 25 franc, or 250 penny gold coins should be adopted, so that four should make the 100 francs, *leaving the standard of value and existing gold coin wholly untouched*, surely it is most unworthy, when I had at once admitted to Dr.

Gray that this idea was not as clearly explained as it should have been, but that on a little further consideration I had abandoned it altogether as any part of the plan, with which it had no necessary or essential connection whatever, had stated this *the following week*, in explaining the plan at the meeting of the British Association at Hull; and when the exact grounds for preferring or rejecting this proceeding were immediately afterwards explained in the pamphlet Dr. Gray professes to have read with such great care and entire agreement. If accuracy were Dr. Gray's object, he should not have inserted his own newspaper letter in what professed to be only a list of "*Books and Pamphlets*," where it could have no title to appear, and then most certainly my sketch from the *Athenæum* never would have appeared there, for whilst it renders my view sufficiently intelligible, it is a mere imperfect sketch, and I would beg those who really wish to understand and decide upon the merits of a scheme shortly to come before the legislature, to judge it from statements which have had the benefit of upwards of two years of discussion and every variety of objection, not to say cavil, as they will find it in the four pages in which I have just brought both that, and a general view of the whole question, before the Glasgow meeting of the British Association.

Yours, &c.,
THEODORE W. RATHBONE.

Allerton Priory, Oct. 1, 1855.

## WALWORTH WORKING MEN'S READING AND LECTURE ROOMS.

Sir,—Although the above Institution is not in connection with the Society of Arts, it may not be uninteresting to the readers of the *Journal*, promoters as they are of the education of the people, to know that it has been in operation upwards of nine months, and has nearly 150 members, who are *bona fide* working men, the majority of them being of the humbler grade.

The Institution held a highly interesting conversational meeting of a scientific character at the Clayton Schools, York-street, on the 3rd instant, when the walls were hung with works of art, and the tables covered with curiosities from the East, trophies from the Crimea, objects in natural history, productions of skilled labour, &c. A large number of microscopes, stereoscopes, polariscopes, air pump, and other philosophical apparatus, kindly lent by gentlemen who attended to exhibit and explain them, added considerably to the interest of the meeting, which was attended by a large number of working men and their families, who spent a few hours (as many of them said) very profitably in examining the various objects presented to their attention. The President, W. A. Wilkinson, Esq., M.P., addressed a few words of sympathy and encouragement to the people, which were warmly received.

The Institution has a comfortable reading-room in Camden-street, supplied with daily papers, weekly, and other periodicals; there is also a lending library. Lectures are delivered and concerts are occasionally given. Classes are regularly held for the study of arithmetic, grammar, drawing, the principles of social economy, &c., under the care of gentlemen who give their services for this important work.

The object of its promoters was to carry the means of education down to the humblest, and to provide a place of resort, after the hours of labour, as a counter attraction to the public-house, and they have every reason to be gratified with the success that has attended their efforts. With a view to encourage habits of economy and saving, a bank has been established, at which deposits as low as one penny are received at four per cent. interest, and a working man's section of a well-known Life Assurance Society is conducted for the assurance of sums at death, the premiums being received weekly.

It was considered that while it would be inadvisable to make the Institution entirely eleemosynary, yet that the subscription must be very low to meet the class aimed at; it was therefore fixed at one shilling per quarter, which includes all privileges, but does *not* pay the working expenses, so that the Institution is dependant to some extent upon the contributions of such as will aid with money those who by their voluntary labour desire to help on their less fortunate brethren.

The results have been so satisfactory as to lead me to express a hope that similar Institutions may arise in every district of the metropolis.

I am, yours, &c.,
W. R. SELWAY, Hon. Sec.

10, Manor-road, Walworth, 6th October, 1855.

## ON THE WEARING-OUT OF MORTARS.

October 3rd, 1855.

Sir,—The wearing-out of mortars in the Baltic naturally excited considerable interest at the recent meeting at Glasgow, of the British Association for the Advancement of Science; many papers were read on the subject, followed by discussions; but, as it does not appear that any of them were grounded on precise data of the former durability of ordnance, I would beg leave to refer to an official record at the Admiralty of the 25th November, 1803.

That communication enclosed a memorandum from Mr. Bray, who had been entrusted by Sir Sidney Smith with the defence of the town-gates of Acre. Mr. Bray relates in this memorandum, that on a floating battery he fitted five pieces of ordnance, namely, two 68 and one 32-pounder carronades, a 24-pounder long gun, and a 42-pounder howitzer—the latter piece, being of brass, must not be included in this notice of the durability of cast-iron ordnance of former days.

Those four pieces of iron ordnance sustained, probably, a more severe trial than any other example on record, for, to use Mr. Bray's words,* "these guns effectually prevented the enemy's approach to the town gates during the siege, which lasted *sixty* days, although I kept up an incessant fire, particularly during the times when the enemy stormed the town; and then our expense of shells was so great that I was obliged to fill shells in the central djerm, which served as a magazine."

The log-books of the sloops *Arrow* and *Dart*, and of the schooners *Netley*, *Millbrook*, *Redbridge*, and *Eling*, would, doubtless, afford convincing examples of the former durability of cast-iron ordnance, for those vessels were frequently in long-continued actions, often fired their guns double-shotted, and with unprecedented rapidity.

Amongst the many causes assigned for the wearing out of the mortars in the Baltic, it does not appear that the greater strength of the gunpowder now used has been noticed; that formerly issued for sea-service having been made with charcoal burnt in common modes, the quality made with charcoal distilled in Dr. Fordyce's iron cylinders having been thought too strong for ship's guns; whereas, it is believed that no other than this latter quality is now made by the Ordnance department. This may possibly have occasioned the recent wearing-out of mortars.

Very sincerely yours,
M. S. BENTHAM.

## FINE ARTS EXHIBITION AT PARIS.

Sir,—Having lately devoted a day to the collection of Modern Paintings which forms so distinguishing a feature of the Paris Exhibition, I venture to send you some notes extracted from my Journal, by way of supplement to the article on this subject which appeared in the last number of our *Journal*. You will see at once that they are not the criticisms of an artist, but merely the memoranda of one of the public, who draws his notions about art chiefly from our annual exhibitions in Trafalgar-square:—

* "Naval Papers," No. 7, p. 33.

"In the Fine Arts Department, France appears to occupy about five-eighths of the whole space. Great Britain nearly one-eighth, and Belgium about one-sixteenth. Prussia and Austria come next, and then the Netherlands, Spain, Switzerland, and Norway and Sweden. The other States show but little, except, perhaps, Denmark.

"In the French part one remarks at once the great number of large historical paintings, some of monstrous size, representing Alma, actions in Algeria, and passages in the revolution of 1789-93. Delacroix and Ingres have several large pieces, ecclesiastical, historical, and allegorical, all in the French classical style. I noticed the battles of Nancy and Poictiers. Ingres exhibits an 'Apotheosis of Napoleon,' lately painted for the Hotel de Ville. Horace Vernet has a room almost entirely to himself. His 'La Smala' occupies the whole of one side. Some of Vinchol's pleased me, more especially 'Saint Cyr's Volunteers on the 22 Janvier, 1792,' and 'Boissy d'Anglas in the Convention, 1795.' These historical paintings are generally about 30 feet by 20. They are far better as paintings than the battle-pieces of Louis XIV. at Versailles. Gerome, a pupil of Paul Delaroche, has a great painting of the 'Augustan Age,' the Emperor on his throne, and the Child Jesus in the fore-ground. Ch. Louis Müller has a vast picture of the 'Victims of the Reign of Terror.' Winterhalter has some Court pictures, good of their kind, but bearing evidence of having been painted to order. The pictures that really pleased me were one by Rosa Bonheur, in the Landseer style, and superbly coloured—a hay cart with oxen, and blue sky, in Auvergne; and still more, a whole series of sea-pieces by Gudin, many of them on the coast of Aberdeen, vessels in distress, &c.; and others by the same artist, in Turner's style, of Venice and Constantinople. Theodore Gudin was born at Paris. He gained his second-class medal in 1824, and his first-class in 1848. The younger Maréchal, of whom France expects great things, does not exhibit. Except Gudin's sea-pieces, and some *pièces de paysaye*, by Coignant, France contributes few *domestic* pictures. In France the chief demand comes from hotel-de-villes and churches, in England from dining-rooms and drawing-rooms.

"England is well represented. Eastlake exhibits some of his best pictures—the 'Escape of Francesco of Carrara,' the 'Pilgrims in sight of Rome,' and the 'Evegliarina.' Stanfield and Landseer are excellent. Millais sends his 'Ophelia,' 'Order of Release,' and the 'Return of the Dove.' Hunt his 'Light of the World.' Eddis his Naomi, Ruth, and Orpah. But the great and almost singular distinction of our share in the Exposition is our water-colours: France has none, and except a very few from Holland, no other nation sends any.

"Of the Continental paintings, exclusive of France, the Swiss and the Prussian seemed to me the best. Among the latter, Karl Müller and Ittenbach well represent the Dusseldorf school of Sacred Art. The 'Annunciation' and the 'Holy Family' of Müller, in the exquisite tenderness of treatment and softness of the hair, remind me of the Van Eycks and Hemlings. But this school is altogether mediæval. The Swiss, on the contrary, have a few pictures of the English style of truly modern art—*home* luxuries—comic and quiet interiors by Louis Grosclaude, and Lake scenery, by Alexander Calame and Jacques Ulrich. The excellence of these pictures was to me a pleasant surprise. Norway and Sweden send characteristic pictures of snow and pines. America contributes hardly anything to the Fine Arts. The only paintings that pleased me were three unfinished studies by William Hunt, in the Spanish manner. Spain and Italy show no symptom of vigour or originality, only some good copies. One by Antoine Sapo, of Florence, of Angelico's 'Paradiso,' was very successful.

"In Sculpture, Austria sends most, in proportion to its paintings, but I was sorry to see the veiled figures again. They seem to me calculated rather to lead the public taste away from what is truly excellent to an over-appreciation of what, after all, is merely a clever trick of art."

I am, sir, yours, &c.,

J. P. NORRIS.

October 10th, 1855.

## Proceedings of Institutions.

WINDSOR.—The first annual meeting of the Berks and Bucks Lecturers' Association was held at the town hall on Tuesday evening, September 25th. The walls of the two rooms of the hall were ornamented with a large variety of diagrams illustrative of anatomy, mechanical power, the steam-engine, geology, natural history, historical or missionary objects, lent for the occasion by the Hants and Wilts Educational Society, and by the Working Men's Educational Union. Three physiological plates attracted much attention on account of the beauty of their execution. It appeared that they had been printed off in one impression on a new principle, the plates, press, &c., having been specially constructed for producing them. The first plate represented the skeleton and the ligaments of the human body; the second, the muscles, joints, and the mechanism of the body generally; the third was illustrative of the internal organs—such as the structure of the lungs, and the other respiratory organs. In addition to these, there was exhibited a variety of models, including anatomical models, the steam-engine, the gasometer, the pump, &c. There was also a box of books, being a specimen of the circulating libraries of the Society. It contained about fifty volumes, comprising elementary treatises on art and science, agriculture, with some of the lighter literature of the day. The Council Chamber room likewise contained a large collection of diagrams and models, illustrative of practical physiology, the preservation of health, as well as others relating to the telescope, the microscope, the barometer, mechanical powers, &c. Some excellent specimens of photographic printing, furnished by the Society of Arts, were also exhibited. The company in attendance, which was numerous, included several ladies, and comprised all classes. Among those present were J. Clode, Esq., Mayor, who occupied the chair, the Hon. and Rev. S. Best, the Rev. Lord W. Russell, the Very Rev. the Dean of Windsor, the Revs. T. H. Tooke, E. Hale (Secretary to the Association), Glossop, Tarver, R. Nash, H. Hawtrey, S. Hawtrey, Robertson, Le Bas, T. T. Carter, S. F. Marshall, R. P. Bent, F. H. Morgan, J. Macfarlane, C. J. Waterbourne, Messrs. Bedborough, C. Knight, Godwin, &c., and a deputation from the Egham Institute. The MAYOR, on taking the chair, said "he felt it incumbent upon him to contribute all the aid in his power to the promotion of an institution like the present, which was designed for the moral as well as the material benefit of his neighbours. For many years past he (the Mayor) had witnessed the advantages accruing from the operations of the Literary and Scientific Institution, in connexion with which they had the privilege of hearing excellent lectures, together with enjoying the use of a good library. Having themselves experienced the benefits arising from such institutions, they could easily understand how desirable it would be to extend the advantages of such societies to the rural districts, the residents of which had not hitherto participated in such privileges. They would sometimes hear the observation that societies intended for the dissemination of knowledge were not required in the rural districts, and that it was not desirable to promote them. He (the Mayor) had that very day been in a rural district, in which he heard fears expressed that servants and labourers would know too much. Observations like these had the effect of convincing him that such neighbourhoods ought, if he might use the term, to be thoroughly invaded by the friends of education and of progress. Societies such as these provided perambulating libraries, which are sent about from village to village. These of themselves were very desirable aids

to the acquisition of knowledge; but they were infinitely more valuable when accompanied by lectures suited to the capacity, and adapted to the circumstances of those for whose advantage the institutions are designed. He would now call upon the Hon. and Rev. Mr. Best, who had taken so active a part in connexion with the Hants and Wilts Society, and he would be followed by Mr. Godwin and other gentlemen." The Hon. and Rev. Samuel Best remarked, "that perhaps, in advocating the interests of a kindred Society, the meeting would forgive him if he entered into a few details in reference to the Hants and Wilts Educational Society, in which he took a considerable interest. An allusion had already been made to the fact that, in some quarters, fears had been expressed that in the rural districts they already knew too much. In corroboration of the existence of this feeling, he might state that when they started their Society two years ago, in reply to his circulars, he had received from nearly all to whom he had applied—the exceptions were very few—letters of a most desponding and discouraging character. 'They had too many such projects;' 'they were not wanted in rural districts;' they were 'raising people above their position;' that they were 'destroying those who would otherwise make good labourers, housemaids, &c.' On the part even of those from whom they expected better things, they met with every description of discouragement. This was in 1853. They, notwithstanding, went on, and established their society. The year 1855, however, brought them very different answers. Even from some of those whose communications had previously been of a most discouraging character, they received letters begging the promoters of the Society to come over and help them. Education, to be of any service in after life, must be progressive. They could not stop short. After they educated their children, and advanced them to a certain point of knowledge, were they to be told that they must rest and advance no further? Had they any controlling power by which they could keep the human mind at the point at which they had left it? Were they possessed of any contrivance by which to determine the point at which education ought to stop? The fact was, that if you did not advance with education, and teach the boy, as he grew up to manhood, good things, the probability, or at least the chances would be that he would pervert his education to bad purposes. The object of such societies as that they had assembled to promote was to provide means to carry out this education, by reading-rooms, libraries, &c. These would be aided by occasional lectures. He was not one of those who would place lectures in the first rank as a means of education. He would use them as an auxiliary. Such was the general outline of the plan which had been adopted in the establishment of the Hants and Wilts Educational Society. They commenced by the collection of diagrams and models of the kind now in that room, on which about £150 had been expended. The next thing was to secure the service of lecturers. He had not the list by him, but about 18 gentlemen lectured for the last year, and this year they had about 35 lecturers, while the number of lectures would be between 160 and 200. The operations of the Society had, in the first instance, been confined to four parishes in the north west of Hants. Then they took in the whole of the county, and, eventually, Wiltshire. All this had been accomplished within two years. With a view of creating an interest in the proceedings of the Society among as many people, and in as many districts as possible, they had held their meetings at Winchester, Salisbury, and Southampton. The hon. and rev. gentleman entered into some further details on this point; also, with reference to certain privileges enjoyed by the association, in connection with the Society of Arts, who had waived, in their favour, the rule requiring an annual subscription of £2 2s., an amount which could not always be got up in small parishes, where the number of members would be very few. Books they were also enabled to obtain through that Society, at a reduction of 25 or 30 per cent. The institution was perfectly unsectarian in its character. They had nothing to do with parties in or out of the church. Their great object was to promote the education of adults, and in accomplishing this, they had done what some parties would view as most reprehensible. They had enabled the ploughmen and other inhabitants of the rural districts to read the *Times* and the other daily papers. It was astonishing to witness the interest those people took in the news of the day. Every person could contribute some amount of aid. They did not require much money. If only two or three persons in a parish were desirous of forming such a club, let them meet and apply for a class-room in the national school; and, in the first instance, let them ask the clergymen, or any other gentlemen in the parish, to let them have the *Times* after he had read it. They would thus soon form the nucleus of a society. After further remarks on the advantages of such institutions, the rev. gentleman concluded by expressing his readiness to afford any further information required, so as to further the interests of the Berks and Bucks Society." Mr. Godwin, F.R.S., editor of the *Builder*, next addressed the meeting. "Many persons," he said, "would attend a library to read books who could not be induced to join a class in a Mechanics' Institution, or regularly to attend lectures. In this respect he believed that the amended Act of the last session, with the view of enabling towns to establish museums and libraries, would prove to be a great boon. He trusted that, in time, its provisions would be brought into operation in the majority of the towns of England, so as to enable the population to have opportunities for mental culture and amusement. The opportunities which these libraries would afford children who had been brought up in our national and other schools, to read, would be the means of enabling them to preserve what they had learnt, and to perfect their education. It was never intended that man should devote all his powers to the maintenance of his animal existence only. The progress of events greatly tended to shorten the hours of labour, so that man might be enabled to devote his time to mental improvement and the benefit of his fellow men. After alluding to the wonderful progress which this age has made in science, to the improvements in photography, which enabled the countenances of those who were so bravely fighting our battles in the Crimea to be handed down to posterity; to the still more wonderful invention of the electric telegraph, by means of which the directors of the East India Company in London could, in an incredibly short space of time, communicate with the millions of inhabitants peopling that vast empire; Mr. Godwin proceeded to observe that it was the fashion among some people to despise the theorist, and talk contemptuously of his projects—they said that they wanted 'practical men.' He (Mr. Godwin) admired the practical man, but he did not, on that account, say that 'the thinker'—the theorist—did not produce an equal amount of benefit to the community. All these mighty projects—these con quests of mind—to which he had referred, a very few years ago, were simply 'dim obscure thoughts' in the minds of men who would be deemed mere theorists. They thought and pondered, and laboured hard to perfect these wonderful inventions, and having perfected them, thousands of practical men employed their powers to carry them out. The mere practical man could make no progress without the theorist, who could aid him in the application of his practice for the benefit of his fellow men. It was said that England was an old country. In his opinion it was only now commencing its career of progress. All these great achievements had been brought about within the last hundred years, and compared with what would be developed, he believed they were yet in their infancy. It had been argued by some people that Bacon had never given expression to the sentiment "Knowledge is power;" but whether he had used it or not, they had the fact before them, and its truth could not be controverted. In his opinion, it was not only the

interest, but the duty of the State to educate the people." The Chairman then called upon Mr. Charles Knight, who after taking a retrospective view of the period of his connexion with Windsor thirty years ago, and comparing that period with the present—a comparison which afforded a striking illustration of the advancement of knowledge and the progress of the community—observed that, "with very few exceptions, the only place of resort which the agricultural labourer had, after the day's labour, was the beershop. No doubt could be entertained on the point that that was about the worst school he could have. The object of societies similar to that they were assembled to promote was to provide him with means of recreation, amusement, and instruction, in lieu of the beer shop. The great improvement which had recently taken place was in a great measure due to the newspaper press. He knew of no more powerful engine for the diffusion of knowledge. Let the agricultural labourer, therefore, read the newspapers; let this be aided by lectures on interesting topics, illustrated by such diagrams as they saw in that room; let him have access to a library,—and the agricultural labourer would make strides in advancement almost beyond what they could now contemplate. The fear that the people would be elevated above their own rank, and that they would be discontented with their positions, was rapidly passing away. He would say, let them do their best to develop talent among all classes. Let all have an opportunity to learn. They did not attempt to make 'village Hampdens' or 'glorious Miltons.' True genius would develop itself wherever found, but their object was, in addition to producing 'a bold peasantry, their country's pride,' to have also an 'intelligent peasantry,' which would be the source of still greater pride." The Rev. Mr. Tooke next addressed the meeting, and remarked that "he looked upon their association as a channel of communication between the Society of Arts and the population of the rural districts. By means of it they would be able to follow up the instruction given in the day chools. They would follow nearly the same plan as that adopted in the conduct of the Hants and Wilts Society, making such variations as would be applicable to the wants of the district. They would require a moderate amount of money for the purpose of furnishing their libraries. As yet they had only received about £20, and could not, therefore, accomplish much. His friend Mr. Bent would inform them of the success of their efforts, with only one box of books, at Burnham. Courses of lectures had been delivered at Egham, Colnbrook, Burnham, Slough, and all the surrounding rural districts. The Rev. Mr. Bent referred, in very encouraging terms, to the ready manner in which the people of Burnham availed themselves of the privileges afforded by the Society. Already it had a very good effect in alluring people from the demoralising habits of excessive drinking. Among those who had made them presents of books was his Grace the Duke of Sutherland and Lord Borton. The former had contributed thirty volumes of Charles Knight's works. They had commenced on a very small scale indeed; they had now 72 members, who subscribed 5s. a year, which was little more than a penny a week. In the onset they could only take the *Times* into the reading-room on the second day, but recently they had taken it in on the morning of publication. The books contained in the 'perambulating library' were also perused with avidity. The rules permitted two games only to be played by the members—draught and chess. Young and old might be seen engaged in these amusements, and it was astonishing to see the progress made by them with chess. There being iron founderies in Burnham, the room was frequented by a considerable number in fustian and corduroy, but he (Mr. Bent) was desirous of seeing more of the 'smock frocks.' There appeared to be an impression on the part of the labourer that they were not to be placed on the same footing as the mechanic. This notion must be dissipated, and it could only be done by the course of training contemplated by the promoters of the society." The Hon. and Rev. Lord W. Russell had had "considerable experience of the habits of the rural population, and he believed that the agricultural mind was beginning to open. The hon. and rev. gentleman proceeded to give illustrations of the fact. In a village in his locality a wretched imposter recently endeavoured to excite the sympathy of the charitable by stating that he had just returned from the Crimea, where he had been engaged in the assault on the Redan, on Sept. 8th. This was before any vessel had arrived home. One of the boys of the village, hearing the statement, said to him, 'Did they send you home by telegraph, old chap.' (Laughter.) The Very Rev. the Dean of Windsor briefly proposed a vote of thanks to the Mayor, which was carried amidst applause. The Mayor, in acknowledging the compliment, proposed a similar vote in reference to Mr. Knight and Mr. Godwin, who had kindly attended to take part in the proceedings.

## To Correspondents.

Erratum.—In Mr. Minasi's letter in the last number, page 741, col. 2, line 2, for "decimal *florin*," read "decimal *form*."

## PATENT LAW AMENDMENT ACT, 1852.

### APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette October 5th*, 1855.]

*Dated 25th August*, 1855.

1928. C. F. Stansbury, 67, Gracechurch street—Shirt wristband. (A communication.)

*Dated 10th September*, 1855.

2047. E. Sharpe, Swadlincote, Derby—Water-closet pans.
2049. A. E. L. Bellford, 32, Essex-street, Strand. Paddle wheels. (A communication.)
2051. T. Craven, Nelson-street, Goodman's-fields—Furnace bars.

*Dated 11th September*, 1855.

2053. H. Bull, Staines—Permanent way.
2057. M. Curtis and J. Wain, Manchester—Spinning machinery.
2058. J. C. G. Kennedy, St. James's-street, Piccadilly—Electric telegraph apparatus, &c. (A communication.)
2059. E. C. Z. Bouchard, Paris—Gas.

*Dated 12th September*, 1855.

2061. J. Macintosh, Great Ormond-street—Springs.
2063. F. G. Spilsbury, Chaud-fontaine, Belgium, and F. W. Emerson, Stable Hobba, near Penzance—Paints and pigments.

*Dated 13th September*, 1855.

2065. B. Barber, Tring, J. Butterfield, and T. Austin, Great Berkhampstead—Mangles.
2067. P. B. de Lucenay, Paris—Batteries of guns and pistols.
2069. J. Blissett, 322, High Holborn—Revolving-chamber fire-arms.
2070. J. H. Tuck, Pall-mall—Apparatus for submarine operations. (A communication.)
2071. A. Longbottom, 41, Moorgate-street—Gas.

*Dated 14th September*, 1855.

2073. J. P. Garbai, Paris—Tooth powder.
2075. T. Gomme, jun., and C. E. A. Beaugrand, Paris—Metal working machinery.
2077. G. Dewdney, Fenchurch-street—Chest and throat protector.
2079. W. F. Thomas, St. Martin's-le-Grand—Sewing machines.

*Dated 20th September*, 1855.

2118. H. Deacon, Widnes Dock, near Warrington—Solutions of carbonate of ammonia and caustic ammonia.
2120. J. Palmer, Stockton-on-Tees—Reaping machines.

*Dated 21st September*, 1855.

2122. J. Dale, Manchester—Appropriating waste products arising in chemical manufactures.
2124. U. J. Brasseur, Paris—Machinery for winding weft. (A communication.)

*Dated 22nd September*, 1855.

2126. J. Eaton, Charing-cross—Shuttles and cop-tubes.

*Dated 24th September*, 1855.

2128. H. Mottet, jun., Verviers—Scouring woollen goods during the action of fulling or otherwise.
2130. J. M. Marchinton, Sheffield—Vices.
2132. C. Manby, 25, Great George-street, Westminster, and W. Piper, Palace-road, Stangate—Machinery for cutting stone. (A communication.)

2136. G. Simmonds, Bennett-street, Stamford-street—Bedsteads.

*Dated 25th September, 1855.*

2138. W. and J. Wright, Stamford—Crushing grain.
2140. C. F. Whitworth, Halifax—Railway signals.
2142. F. R. Ensor, Nottingham—Lace machines.

*Dated 26th September, 1855.*

2144. G. Huguenin, Greek-street—Watches.
2146. J. Norbury, Salford—Hydraulic presses.
2148. J. Nasmyth, St. Germain-en-Laye, France—Motive power.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2150. T. Deakin, Hazelwell Mills, near King's Norton, Worcester—Machinery for manufacturing bayonets, matchets, and swords.—26th September, 1855.
2164. T. Clegg, Massachusetts, U.S.—Loom harness.—28th September, 1855.
2166. T. Barrows, Massachusetts, U.S.—Treatment of wool preparatory to its being carded, spun, or woven.—28th September, 1855.
2174. Captain W. N. Martin, Newman-street, Oxford-street—Folding and portable crates, boxes, baskets, packing cases, and huts.—29th September, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed October 5th, 1855.*

756. Thomas Squire, Latchford, Chester—Improvements in removing hairs from hides and skins.
757. William Goostrey and George Hulme, and Charles Hough, Chedderton, Stafford—Improvements in machinery or apparatus for manufacturing paper.
758. Isidore Carlhian, 26, Rue du Sentier, Paris, and Francois Isidore Corbière, 27, Castle-street, Holborn—Improvements in apparatus for making soda water and other aerated liquids. (A communication.)
768. Robert William Waithman, Bentham-house, York—Improvements in machinery or apparatus for the manufacture of lint or similar substances.
771. Henry Gerner, Moorgate-street—Improvements in polygraphic or writing and drawing apparatus.
772. Richard Stones, Kingston-upon-Hull—Improvements in taps or cocks for drawing off fluids.
773. Joseph Hull, Liverpool—Improvements in the machinery and apparatus for grinding corn.
774. Joseph Aresti, Greek-street, Soho-square—A method of obtaining improved effects upon drawings washed or painted on stone.
780. Lieut. Edward O'Callaghan, 51st Regiment—Improvements in ordnance and in projectiles applicable to ordnance and small arms.
784. William Ricketts and Thomas Bulley, Stepney—Improvements in producing ornamental designs on painted or japanned table covers.
787. Alexander Chaplin, Glasgow—Improvements in steam boilers, and in the combustion of fuel.
788. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in machinery or apparatus for combing wool and other fibrous substances. (A communication.)
796. John Alderman, Denmark-street—Improvements in the construction of adjustable couches, chairs, and other similar descriptions of furniture for invalids.
807. Soren Hjorth, Copenhagen—An improved electro-magnetic machine.
821. Richard Archibald Brooman, 166, Fleet-street—Improvements in the treatment of fatty and resinous matters, and in preparing them for the manufacture of candles and other articles.
858. John Lawson and Somerville Dear, Leeds—Improvements in machinery for combing and cleaning flax, tow, wool, and cotton, and other fibrous substances.
872. François Jacot, 18, Rue du Jeuneuse, Paris—An improvement in the manufacture of starch, and in obtaining and treating the gluten.
880. Hypolite Macé, Paris—Improvements in transferring colours or metals in design on and from paper and stone on to surfaces. (A communication.)
1156. Joseph Morgan, Manchester—An improvement in the manufacture of plaited or platted wicks used in the making of candles.
1253. Richard Peyton, Bordesley Works, Birmingham, and Alexander Southwood Stocker, Poultry—Improvements in the manufacture of bedsteads.
1271. William Henry Graveley, 40, Upper East Smithfield—An improved apparatus for cooking purposes, and improvements for the production of fresh water for ship and land use.
1474. Capt. Christopher Jelinger Symons, Hereford—Improvements in steam engines.
1644. George Conner, 68, Byrom-street, Liverpool—An improvement in the manufacture of brushes.
1824. Paul Pretsch, Islington—Improvements in the application of certain designs obtained on metallic surfaces by photographic and other agency.

PATENTS ON WHICH THE THIRD YEAR'S FEE AND STAMP DUTY HAVE BEEN PAID.

146. Edwin Lewis Brundage, Jewin-crescent—Improved machinery for forging nails, brads, and screw-blanks. (A communication.)
156. Joseph Brown, Leadenhall-street—Improvements in beds, sofas, chairs, and other articles of furniture, to render them more suitable for travelling and other purposes.
160. Joseph Burch, Crag-hall, near Macclesfield—Improvements in building and propelling ships and vessels.
188. John Weems, Johnstone, N.B.—Improvements in obtaining and applying motive-power.
205. Martin Billing, Holborn, and Charles Henry Street, Birmingham—Improvements in the combination of metals having different capacities of vibration, to be used in the construction of certain useful articles.
210. Henry Webb and Joseph Froysell, Willenhall—Improvements in fastening knobs to door and other locks.
222. Aristide Balthazard Bérard, Paris—Improvements in the construction of jetties, breakwaters, and docks, and other hydraulic constructions.
231. George Walker Nicholson, Pendleton—Improvements in screw bolts, nuts, and washers, and in the machinery or apparatus for making the same.
234. John Balmforth, William Balmforth, and Thomas Balmforth, Clayton—Improvements in steam-boilers, and in fixing the same.
254. Robert Shaw, Portlaw, Waterford—Pre-arranging, ascertaining, and registering the rate of travelling of locomotive-engines and of railway or other carriages.
259. George Walker Nicholson, Pendleton—Improvements in vices, and in the means or method used for fixing the same.
280. William Bissell, Wolverhampton—An improved cramp or improved cramps for cramping floors, doors, and joiners' and ship work generally.
282. John Blair, Ducie Bridge Mill, Manchester—Improvements in the manufacture of waddings, and in the machinery for making the same.
292. Samuel Rainbird, Norwich—Improvements in grappling and raising sunken vessels and other submerged bodies, and in apparatus for that purpose.
298. Edward Joseph Hughes, Manchester—An improved method of purifying and concentrating the colouring matter of madder, munjeet, and spent madder. (A communication.)
321. Samuel Hardacre, Manchester—Improvements in machinery or apparatus for blowing, scutching, opening, cleaning, and sorting cotton-wool and other fibrous substances, parts of which improvements are applicable to other purposes.
448. James Otams, 2, Horton-villas, Camden-road, Holloway—Improvements in the manufacture of manure.
277. Admiral the Earl of Dundonald, Belgrave-road—Improvements in coating and insulating wire.
399. Joseph Hopkinson, jun., Huddersfield—Improvements in steam boilers.
400. Simon Pincoffs, Manchester, and Henry Edward Schunck, Ph. D., Rochdale—Improvements in the treatment of madder and other plants of the same species, and of their products, for the purpose of obtaining dyeing materials.
415. William Beckett Johnson, Manchester—Improvements in stationary steam-engines.
441. John Kealy, Oxford-street—Improvements in machinery or apparatus for cutting or slicing roots.
588. George Fergusson Wilson, Belmont, Vauxhall, and Edward Partridge, Wandsworth—Improvements in the instruments or apparatus used when burning candles.
600. George Fergusson Wilson, Belmont, Vauxhall—Improvements in the manufacture and treatment of oils.
619. George Fergusson Wilson, Belmont, Vauxhall—Improvements in the preparation of materials for and in the manufacture of candles and night lights.
620. George Fergusson Wilson, Belmont, Vauxhall—Improvements in treating wool in the manufacture of woollen and other fabrics.
667. William Frederick De la Rue, Bunhill-row, and George Waterston, Edinburgh—Improvements in writing-cases.
756. Francis Montgomery Jennings, Cork—Improvements in preparing flax, hemp, China grass, and other vegetable fibrous substances.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3764 | October 5. | Hermis-carpon, or Wrist-supporter. | Wright, Underwood, & Burt | 18, Paternoster-row, and 18, Thomas-street, Bristol. |

Journal of the Society of Arts.

*FRIDAY, OCTOBER* 19, 1855.

## PREMIUM LIST.

Members who visited Paris and others are requested to be good enough to communicate to the Secretary any suggestions which may have occurred to them as desirable for the Society's forthcoming Premium List.

## PARIS EXHIBITION.

### Economic Gallery.

(From the *Moniteur* of 1st October.)

His Imperial Highness Prince Napoleon yesterday visited this recently-formed department of the Exhibition. The Prince, accompanied by Col. Desmarets, was ushered into the gallery by Messrs. Le Play (the Commissioner-General), Arles Dufour, and Thibeaudeau (the general Secretaries of the Commission), M. de Chaucourtois (Assistant Commissioner), M. Blaise (the Secretary), and M. Varcollier, jun. (Assistant Secretary of the Juries).

Several of the members of the Special Commission charged with the formation of this department, as well as the members of the Jury who have lent their aid to it, were presented to His Imperial Highness on his entrance.

The Special Commission is composed of Messrs. de Melun (President), A. Cochin (President-mayor of the 10th arrondissement of Paris), Audiganne (one of the secretaries of the Imperial Commission), Baudon, De Bausset-Roquefort, Delamare (Deputy, and manager of *La Patrie*), Dubois, Dupetiaux (Brussels), Lord Ebrington, M.P., Gautier de Claubry, Fleury (chef de la division du Commerce Exterieur), Julien (chef de la division du Commerce Interieur), Le Gentil, jun. (one of the International Jury), Michel (manager of the *Bulletin de l'Instruction Primaire*), Moreno (directeur de la manutention de la Chambre de Paris), De Saint Leger (member of the General Council of Nièvre), Twining (member of the Society of Arts of London), Viande-Patray (Geneva).

The Commission was assisted in its labours by Messrs. Bareswil, Gervais (Caen), Gourlier, Lainel, Mélier, le Baron Seguier (members of the Jury), and the following officers of the Exhibition—Messrs. Savoye, Rossigneux, Audley, Villemot, and de Pelanne.

The idea of such a gallery as this, it is well-known, had its origin in the Society of Arts of London,* and received from the first great encouragement from the Emperor and Empress, and has been just put into practical operation by H.I.H. Prince Napoleon.

The gallery is specially devoted to the display of objects which minister to the daily wants of life, and which by their cheapness, good quality, and utility, are fitted to promote the well-being of the masses.

These objects are arranged under four separate heads or groups, classed according to the purposes for which they are intended.

The first contains alimentary substances and substances used for heating, lighting, and washing.

The second includes furniture and articles for household use.

The third contains textile fabrics of every description, linen, ready-made clothes, and everything connected with dress.

The fourth shows examples of apartments, with specimens of the furniture fitted for each description of room.

His Imperial Highness has long had his attention fixed on this first attempt at an exhibition of domestic economy, and he has repeatedly expressed his great satisfaction that France should have had the good fortune to initiate it, and his firm belief that her example cannot fail to be followed in future exhibitions.

For more than an hour the Prince remained in the gallery, examining minutely all the most interesting articles. He made many inquiries as to the mode of manufacture, the hand-labour employed, the rate of wages, and the price for sale, and thus showed how much importance he attached to the means of increasing the well-being of the many, and to the bringing the first necessaries of life within the reach of all by cheapening their supply. But whilst encouraging cheapness, the Prince pointed out the danger which would result to industry if it were obtained by lowering the wages, and thus injuring the condition of the workman, curing one evil by producing another still greater. In his Imperial Highness's views, true cheapness results not merely from lowness of price, but more particularly from improvements which, by rendering the article more lasting, more commodious, and more easy to keep in repair, produce for those who use them a daily saving of time and money.

Among the articles of food the Prince specially remarked the preserved vegetables, fruits, and meats, which have already rendered—or must hereafter continue to render—such important services in providing food for the people.

The Prince observed particularly in the second group, the pottery and china of French manufacture, which compete successfully for cheapness and beauty of form with those of England and Belgium; the household articles in tin ware and enamelled cast-iron; heating apparatus, serving at the same time for cooking; lighting apparatus, remarkable for their cheapness; iron bedsteads and spring mattrasses, admirably adapted for health and comfort; furniture of native woods, thus promoting national industry, at the same time that the price is suited to the humble means of the million.

The group of linen and clothes struck his Imperial Highness as the most complete of the whole Exhibition; for example:—

Men's Dress.—Boots and shoes of strong make at very low prices, from 4fr. to 12fr. Shoes with wooden soles, at 2fr. 50c. Wooden shoes (sabots), at very low prices.

Knitted materials for waistcoats, drawers, long pantaloons, and coats, remarkably strong make, and well suited to resist the cold, furnished to the army in the Crimea; long drawers for soldiers, with elastic waistbands, at 2fr.

Excellent alpacas, and at a low price. English velvet at 1fr. 50c. the metre; Austrian cloths; French cloths of good quality and cheap; cloths of "Vire" manufacture, 7fr. the metre—remarkable for their superior quality.

Women's Dress.—Stays at 1fr.; caps; knitted petticoats from 70 cents. to 2fr. 50c.; shoes and boots from 1fr. 50c. to 7fr. 50c.; shawls, all wool, at low prices and good quality.

In order to give further encouragement to this philanthropic work, which, in the Prince's opinion, must become the germ of more complete and permanent, and therefore more useful exhibitions, his Imperial Highness determined that a special jury should be named for examining this department, and that special medals should be awarded to the exhibitors in it.

The exhibition of these articles has already begun to bear fruit. The public have flocked to visit it, and numbers are seen to make notes of such objects as appear to possess the more important conditions of cheapness and excellence. On all sides there is a feeling of gratitude to the Emperor for having at once appreciated the original idea of forming such a gallery, to H.I.H. Prince

* See Mr. Twining's Memorandum on the Establishment of Economic Museums for the Working Classes, copies of which may be had on application to the Secretary of the Society of Arts.

Napoleon, who determined on its execution and so energetically followed up its realisation, and to the Commissioners charged with its practical formation.

The establishment of an "Economic Gallery" is a further development of the sentiment expressed in the speech delivered by him at the opening of the *Exposition Universelle*, when he said "that the Exhibition must become a vast practical inquest, a means of bringing together the powers of industry, the raw material within the reach of the producer, and the manufactured article to the knowledge of the consumer. It is a further step towards improvement—that great law of creation—that first want of humanity—that indispensable condition of social organisation."

(From the *Moniteur* of the 3rd October.)

Paris, 2nd Oct.—In conformity with the wishes of H.I.H. Prince Napoleon, the Imperial Commission met this day at the *Palais de l'Industrie*, the Prince in the chair, for the purpose of nominating a Special Jury to examine the articles exhibited in the Economic Gallery.

It will be the duty of this Jury to examine with great care those articles which, by their cheapness, excellence of make, and utility, are most likely to come into use for the benefit of the largest class of the population. It will further be the duty of this Jury to look specially to those articles whose cheapness, in the Prince's opinion, is not to be measured by lowness of price, but by those improvements in them which render an article of ordinary use more durable, more useful, and more easy of repair, and thus provide for the consumer a daily saving in time and money.

Besides this, the Jury will have to make a report to the Commission, and to award medals to those exhibitors whose articles fulfil the above conditions in the highest degree.

In order to carry out this object, the Commission, on the proposition of his Imperial Highness, found it necessary to create a new Jury class for the purpose, and proceeded to nominate the following to be members of it:—Messrs. Cochin, Chev. Michel, de Beaussett, de Saint-Leger, Twining, Gaultier de Claubry (membre de l'Academie Impériale de Medecine), Fleury, Jullien; together with the following members of the International Jury:—Messrs. Mélier (12th class), Fouché Lepelletier (11th class), Michel-Chevallier (V.P. 15th class), Gervais (Caen, 25th class), Barreswil (15th class), Diergaedt (21st class), Neil Arnott (9th class), Lucy-Sedillot (19th class), Gausset (20th class).

### Nottingham Trade Report.

(From the *Times*, 15th October.)

The exciting events of the war, combined with pecuniary alarms at home, have prevented due attention being paid to the Paris Exhibition, but the opinion is becoming prevalent that Nottingham has not been fully represented there, and that it would have been well had something more been shown. The mistake made, if mistake there has been, was in all our manufacturers neglecting or refusing to combine in one united effort to exhibit every specimen requisite to test both price and quality. This was attempted, but numbers said, "It is no use. If we show our best things they will only be copied by the French, who refuse to allow us to send there one single rack of lace, except for the purposes of the Exhibition. If we show our cheapest things—clothing for the million—neither the population of France nor ourselves can be benefitted by it, as we are not allowed to sell there even one single pair of stockings." These views deterred many, and only a comparative few exhibited. The result is, notwithstanding the praiseworthy efforts of the self-sacrificing and far-seeing few, Nottingham is not well represented there; full justice is not done either to her skil, taste, or enterprise, for even those who have exhibited have, for the most part, taken care to show only such things as can do them no harm. And this to some extent was the case also in the English Exhibition of 1851. It was, however, unwise to exhibit in Paris on too limited or niggardly a scale, as is shown by subsequent events, for the existing relations of the two countries must result in a considerable modification of the French tariff, for which the Nottingham manufacturers would do well to prepare themselves by a careful study of Parisian taste and habits, by a close examination of the contents of the Exhibition, and by observations to be made out of doors.

## Home Correspondence.

### NORTHAMPTONSHIRE IRON ORE AND UTILIZATION OF SLAG.

Sir,—Permit me once more to call the attention of the public to these important subjects, as I have lately been informed by Mr. Jenkin, of Eyham, near Bakewell, Derbyshire, that by the use of his double reverberatory furnace for calcining and reducing lead and copper ores, he can melt from 20 to 30 tons of slag in 24 hours with only two and a-half tons of coal, and having, in my letter to the Society of Arts (*vide* ante, page 611), calculated on melting only five tons of slag in the same time, with nearly double the quantity of fuel; and taking into consideration the simple application of the waste heat of these furnaces for generating steam and other purposes, and the quantity of iron that would be thus obtained in the iron ore districts, not included in my calculations for melting clay; also contrasting the employment of the proper alkalies and acids, for varying when requisite the colour, texture, and other properties of the slag, also the simple process of casting the articles in iron moulds, either plain or ornamental, which in less than two minutes are sufficiently set to be removed into the annealing oven, and the mould ready to use again, with the laborious hewing and fashioning of blocks of marble and other stones from remote distances, or even with the most improved system of manufacturing common bricks, pipes, tiles, &c., together with the cost of plant requisite for each, I believe it will be found that no other process can possibly equal it for expedition at all seasons of the year, economy and simplicity of manufacture, durability and applicability to every locality.

I am, sir,
Your obedient servant,
W. G. ELLIOTT.

Blisworth, October 3rd, 1855.

### DECIMAL COINAGE.

Sir,—The following letter appeared in the *Economist* on the 11th of September, 1852. As its publication seems to have escaped the observation of Dr. Gray, and preceded the appointment of the Select Committee of the House of Commons, whose report has been the subject of so much criticism, perhaps you may not think it unworthy of a place in the *Journal*:—

"To the Editor of the *Economist*."

"Sir,—When the florin was first issued a letter appeared in the *Times*, signed, 'A Member of the Commission for the Restoration of the Lost Standards of Weight and Measure.' The writer, alluding to the then recent issue of florins, asked what future measures were necessary to obtain completely and speedily the desirable object of a decimal coinage. 'What new coins,' he says, 'are to be issued? What old coins withdrawn from circulation or newly subdivided or named.' He then proposed to consider the florin as the primary unit, to divide it into 100 equal parts called cents, and to have

Copper Coins of
1 Cent, $2\frac{1}{2}$ Cents, 5 Cents.
Silver Coins of
25 Cents, 50 Cents, 100 Cents.

"In your last week's paper is another letter on the same subject, signed 'Decimal.' Now, sir, as in endeavouring to bring about a great change in either our political, fiscal, or monetary systems, a large amount of antiquated prejudice has to be got rid of, it is clear that the more simple and more easily comprehended the proposed system is, the sooner is the public mind likely to be prepared for its adoption. It appears to me that not only do both your correspondents and that of the *Times* fail in simplicity, but that the proposed coinage, neither of the one nor of the other, would preserve the decimal system so closely as it ought to do.

"In the first place there seems no reason to depart from the natural *unit* in our money (if it may be so called), the pound sterling. Taking, then, the sovereign as the unit, we ought to have its tenth, its hundredth, and its thousandth part; and as this one-thousandth part would only be, as both observe, 4 per cent. less than the present farthing, I see no reason why we should not retain for this piece the ancient and accustomed appellation of farthing, transferring to the next piece the name of Cent, that being the one-hundredth part of the unit, the sovereign, or pound sterling.

"What might be called the coins of computation would then be:—1st, the sovereign; 2nd, the florin; 3rd, the cent, and 4th, the farthing. Now, besides the sovereign, there are now current in gold the double-sovereign and half-sovereign. Would it not be more simple, as well as more in accordance with the decimal system, to have coins in the same proportion to each of these. The coinage would then stand as follows:—

| | | | |
|---|---|---|---|
| | | GOLD COINS. | |
| | Double Sovereign. | Sovereign. | Half-Sovereign. |
| | | SILVER. | |
| 10ths. | —Double Florin, (or 4s. piece.) | Florin, (or 2s. piece.) | Half Florin, (or 1s. piece.) |
| 100ths. | —Double Cent, (or 20 farthings.) | Cent, (or 10 farthings.) | |
| | | COPPER. | |
| | | | Half-Cent, (or 5 farthings.) |
| 1000ths. | —Double Farthing. | Farthing. | Half-Farthing. |

"It will be observed that the cent, or 10-farthing piece, is proposed to be in silver. If the sovereign is estimated at 25 French francs (it has usually ranged at rather more), the cent would in size and value exactly represent the French quarter-franc, an agreeable and convenient little coin.

"As all advocates of a decimal system in money are agreed in preferring that principle to the present one of £ s. d., the only difference between us lies in the mode of effecting the alteration. The less change the less prejudice to be overcome, and the more easily would the new system be comprehended, and when comprehended (if founded in good sense), the sooner approved. To propose, therefore, to change the whole language of money, is simply to raise an amount of prejudice that must retard rather than prepare the public mind for the new system. It is on this ground more particularly that I trouble you with these observations, for I claim no merit for originality. Professor Babbage and others have already paved the way. The present time appears to be well fitted for the change, for when the price of almost every article of consumption is following the reduction in price of the great staple of life, 'wheat,' it seems but reasonable that five pence should purchase what cost sixpence before. In other words, the double cent, or 20-farthing piece, would supply the place of the sixpence withdrawn, and the florin in the same way of the half-crown.

"Your obedient servant,

"W. G."

"Brantham, September 8th, 1852."

Such being my faith in 1852, it is almost superfluous to say that that faith remains unchanged. While I can move in company with such men as the Astronomer Royal, the late Master of the Mint, Professor De Morgan, Mr. Arbuthnot, of the Treasury, Mr. Miller, of the Bank of England, and other distinguished men whose name is legion, I must respectfully, and I hope without intolerance, refuse my adhesion to that school (I am inclined to think) more noisy than numerous, who swear by the penny. Consistent neither with one another nor with themselves, some advocate a decimal coinage which rejects the decimal system both at the top and bottom of the scale; others who, wavering in their allegiance between the French franc and English sovereign, would have a "tenpenny," which is one day the 25th and another the 24th of the pound sterling, while they fail to perceive that in the perfect decimal system proposed by the Committee, they would have practically, through the cent, that assimilation to the French franc which they profess to consider of so much importance.

Your obedient servant,

W. GURDON.

Brantham, October 11th, 1855.

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## IS A COMPLETE DECIMAL SYSTEM PRACTICABLE IN THIS COUNTRY?

SIR,—In a former letter I have referred to the circumstance that in France and Holland the change from a non-decimal to a decimal system *did not alter the currency* of either country, the *sou* and the *stiver* being merely deprived of their distinctive columns in accounts, and entered as 5-hundredths of the *franc* and the *florin* respectively. This important fact seems to have escaped the notice of the numerous advocates of a change amongst ourselves, and the difference between a decimal *system of accounts* and a decimal *coinage* has certainly not received sufficient attention.

In common with France and other countries, the utmost we can reasonably hope to effect is the *simplification of our accounts*. We must not venture beyond our neighbours in attempting to alter the ratio between existing measures of value. It could not be accomplished without creating immense confusion amongst all classes, and inflicting serious injury upon a very large proportion of the community. Any alteration of this nature would, in short, never be patiently submitted to in a such a country as this.

Now, to arrive at the best mode of simplifying our accounts, we have to recollect that we actually make use of two standards of value decimally incommensurable—the pound as a *commercial* unit, and the penny as a *market* unit. The shilling may be regarded in the light of a money of convenience between both. The ratio of the penny to the pound being as 1 to 240, it is of course impossible to decimalise the *whole* of our currency, without altering either the *commercial* or the *market* standard of value. Such a proposal, therefore, as the *millesimal* division of the pound, as the basis of a new system, must be abandoned; for not only would it alter the market standard of value, but the substitution of "mils" for pence would undoubtedly increase the difficulties of at least *mental* calculation in small transactions. On the other hand, the sacrifice of the pound would be attended with enormous inconveniences, for which the advantages of the best possible decimal system would by no means be an adequate compensation. If, then, we make any change, we must be satisfied with a *partially* decimal currency, for many years to come at all events.

It is almost self-evident that the *nearest approach* we can make to a decimal system, without getting rid of either of our standards of value, is to consider the pound as being made up of 1,200 parts, which will give the factors 100 and 12. We have thus the choice of two new moneys of account—the *hundredth* of a pound, and the *twelfth* of a pound. By the adoption of the former, division

by 12 is pushed five times lower down in the scale than in our present system, and the *penny* may accordingly be ignored in the *bank* and in the *counting-house* without inconvenience, as I have explained in a former communication. The alternative of the *twelfth* of a pound (20 pence) as a money of account, would make the fifth of a penny the elementary unit, and render our system *almost identical with that of Holland.* The shilling would be conveniently entered in accounts as 60 units, and 1,000 units would be equivalent to 16s. 8d., a desirable value for a gold coin.

With reference to the "tenpenny system" as advocated by Mr. Theodore Rathbone and others, I would observe that there exists a grave *philological* objection against its adoption, in addition to its impracticability in other respects. It contemplates no less than a serious change in the idiom of our language, by requiring people to say *two tens* for twenty, *three tens* for thirty, *four tens* for forty, and so on up to a hundred, as if the form of expression "*two tens and five* pence" were colloquially preferable to "*twenty-five* pence." The neglect of the French *decime* and the American *dime* as moneys of account is unquestionably to be accounted for on this principle. For instance, *forty-four cents* sounds better in American ears than *four dimes and four cents*, and the corresponding figures are accordingly set down in accounts without an intervening point. Hence, a *centesimal* ratio is found by experience to be preferable to a decimal one between *moneys of account*, as francs and centimes, dollars and cents, roubles and copecks, &c. In fact, the "tenpenny system" is tantamount to a scheme for keeping accounts *in pence only*. The penny unit would infallibly be the leading idea up to a hundred, and 8s. 4d. would necessarily become the next money of account. The *tenpence* would be useful merely as a *coin of circulation.*

| Table I. | Table II. |
|---|---|
| 12 doits = 1 cash ($2\frac{2}{5}$d.) | 100 centimes = 1 cash (20d.) |
| 100 cash = 1 pound. | 12 cash = 1 pound. |
| 5 doits to a penny. | 5 centimes to a penny. |

Note.—In France and Holland the following subdivision *popularly* prevails:—

5 centimes = 1 sou (or stiver).
20 sous (or stivers) = 1 franc (or florin).

I am, Sir, your obedient servant,
SAMUEL A. GOOD.

H.M. Dockyard, Pembroke Dock,
15th October, 1855.

## Proceedings of Institutions.

Brighton.—The nineteenth course of lectures at the Athenæum was commenced on the 26th ult., by the delivery of a lecture on the "Patriotic Songs of England," by Mr. Henry Phillips. There were nearly 900 persons present, by whom the lecture was exceedingly well received. The chairman of the committee, Mr. W. D. Savage, presided on the occasion, and in introducing Mr. Phillips, congratulated the members on the continued success and prosperity of the Institution.

Bury St. Edmunds.—A bazaar has just taken place for the benefit of the funds of the Athenæum, and has been attended with most gratifying success. The total amount of receipts during the three days of the bazaar is £747 1s. 7d., which, after deducting all expenses, allows £665 to be carried to the credit of the Athenæum, in the following manner:—For the repayment of loans advanced, and mortgages upon the building, £450; for additions to the library, £100; for the placing of shelves, cases, and specimens in the museum, £100; for completing the lighting of the lecture-hall, £15. The immediate effects of the great success will be to reduce the annual expenses £20, to render the library equal to the increasing demands on its resources, and to make the museum its interesting and able auxiliary. This truly pleasant result is mainly owing to the exertions of Lord Arthur Hervey, president of the Institution, whose name at the close of the bazaar was received by such a burst of acclamation as must have gone far to convince his lordship that his unremitting endeavours to serve the Athenæum were duly appreciated by those for whose especial benefit they had been made.

Coalbrookdale.—The second anniversary of the Literary and Scientific Institution was celebrated by a *soirée* on the 13th of last month. The lecture-room was decorated for the occasion with festoons of drapery, evergreens, and flowers, together with flags tastefully grouped; and choice paintings by Cooper and other artists of eminence graced the walls. Tea being finished, the music class played an overture. The Mayor of Much Wenlock (Mr. H. Dickenson) was then called to the chair, and on taking it he spoke of the advantages of self-education and improvement, and claimed for institutions like those whose anniversary they were met to celebrate, the merit of being peculiarly adapted to aid in this work, whenever the first elements of knowledge had been mastered. Mr. Fox, the honorary secretary, then read the annual report, from which it appears that the number of ordinary members has not increased so much as could have been desired, but that the Institution still continued to receive very liberal support from its honorary members, to which class there had been an addition of two during the year. The report then went on to regret that the committee had been unable to add a reading-room to the present building, and that no substitute in all respects suitable could be found. The recent formation of the library, and the consequent freshness to the members of a large portion of its contents, appeared to the committee to be sufficient reasons for abstaining during the year from the purchase of new books, especially as the means for preserving an increase to it are insufficient. Donations of (in the whole) 79 volumes of books have however been made to it by several honorary members, and among them that by Mr. Crookes, of forty volumes of the Parlour Library, has largely added to a class of works much in demand. During the winter ten lectures were delivered by paid lecturers, whilst others were gratuitously given by the Rev. John Hayes, on "Distinguished Musical Composers;" by Mr. Crace Calvert, on "The Adulteration of Substances used for Food;" and by the Hon. and Rev. O. W. W. Forester, on "Sebastopol." The report proceeds to observe, that although there may have been wanting a connexion through the series that would have rendered the whole more useful for educational purposes, or as a course of instruction, yet it must be acknowledged that a mass of information in a popular form, and opportunities of agreeable entertainment, have been brought within reach of the members and of their friends. The privilege of admission to lectures of a friend by each member, without doubt deprives the Institution of some addition to its income. It is therefore deserving the consideration of members if they should not induce their friends, whom they frequently gratify in this manner, to become subscribers. The secretaries' cash account for the year showed the total receipts (including balance from last year of £9 5s. 1d.) to be £50 5s. 8d.; the expenditure had been £43 3s. 8d., leaving a balance of £7 0s. 2d. to be carried to next year's account. At the conclusion of the report, addresses were delivered by the Rev. John Bartlett, the Rev. John Hayes, Mr. C. Crooks, Mr. Abrahams, and others, and after the usual complimentary votes of thanks had been passed, the meeting separated.

Coventry.—On Monday sennight, the annual meeting of the Coventry Institute took place at St. Mary's Hall, being the first since the amalgamation of the two Societies previously existing in that city, under the respective names of "The Mechanics' Institution" and "The Religious and Useful Knowledge Society." The meeting was very numerously attended by persons of both sexes, and of all resident classes of society. The walls of

the hall were closely hung with a number of pictures and drawings, the production of students in the Coventry branch of the Government School of Art. The Mayor having taken the chair, Mr. Drake said the first business would be to appoint scrutineers, to take and examine the votes for the election of a committee. Mr. Revel, Mr. Bushell, and Mr. May were accordingly appointed for that purpose. The scrutiny resulted in the appointment of the following gentlemen on the committee:—Messrs. J. Gulson, J. Cash, E. Brown, W. Lynes, E. Jephcott, T. Soden, J. Alcott, H. Smith, T. Weddle, T. Jenkins, J. E. Bankes, H. Welch. In compliance with the request of the chairman, Mr. Drake then read the report, which stated that the result of the amalgamation of the two societies bids fair to justify the confidence with which the committee recommended the subject to the members. Among the earliest fruits of the increased number of subscribers, the committee hope to reckon the reduction of the terms of subscription to mechanics and artisans, and the enlargement and improvement of the reading room. Among the more distinctive features of the past year must be reckoned the visits which the members have paid to the deer-park at Stoneleigh, and to the noble domain of the Duke of Devonshire at Chatsworth, the former by the kindness of their noble president, the latter under the auspices of Sir Joseph Paxton, M.P. On this last occasion nearly 500 members joined the Institute, that they might qualify themselves to accept of the invitation of Sir Joseph Paxton. One great advantage of the amalgamation has been the increase to the number of volumes in the library; but, notwithstanding this, the committee have to express at once their satisfaction and their regret that the demands upon the library are more than the books now in it can fully satisfy, the exchanges at the present time being greater than had ever been experienced during the whole of the Society's existence. During the year ten lectures were delivered by Messrs. A. Bunn, W. Parsons, W. Hughes, E. Wheeler, Rev. J. F. Hodgson, Rev. H. Davis, B. S. Richardson, and G. Grossmith. The receipts of the year, from all sources, had been £376 16s. 8d., and the expenditure £356 9s. 3d., leaving a balance in hand of £20 7s. 5d. The building fund now amounts to £52 14s. 9d. After the reading of the report, Mr. J. S. Whittem rose to move the first resolution,—"That the report be adopted, printed, and circulated." In doing so, he remarked, that when the Coventry Mechanics' Institution was first established, there were very great apprehensions amongst the best-intentioned persons as to the results of the education of the people. Happily, those apprehensions had been removed, and he would say without fear of contradiction, that with many of those who at that time treated education as a means that would lead to innovation, it was now the received conviction that the education of the people was the soundest principle of conservatism, and the means of ensuring deference to the laws. With reference to the amalgamation between the two Institutions, he observed that nothing could be more anomalous than to have two societies exist in the same town, both for the diffusion of useful knowledge, and keeping up an expensive staff, and employing the same lecturers. Mr. Whittem then alluded to the library, on which he set great store. He always held this to be the main feature of the institution, for, however attractive the lectures might be, they were only so far useful as leading to further inquiry after knowledge; they were useful as a stimulant for further inquiry. The resolution having been seconded by Alderman Sergeant, was carried unanimously. Mr. Alderman Browett moved the next resolution, which was to the effect that the rules, as revised by the united committees, be adopted. The only alterations were in the second and fourth rules, the first being to reduce the rate of admission to the working classes, and the other to increase the number of the committee by six members, and extend their service from six to twelve months. It was thought that by the latter alteration a better or more numerous attendance at the committee meetings would be secured. This resolution was seconded by Mr. Lynes, and, like the preceding, was carried unanimously. Sir Joseph Paxton, M.P., in moving the third resolution—which was to the effect that institutions such as that whose anniversary they were met to celebrate, deserved their best and most cordial support—spoke of a meeting of a similar kind, over which he presided last year, at Huddersfield, where there was a most flourishing Institute, and offered that if they would send a deputation to inquire thoroughly into the working of that Institution, he would himself contribute half the expense, as he believed they would derive great benefit from such a proceeding; and further, if they followed out his proposition, and would go heart and hand into the inquiry, and make a report to this Institution, he would himself come down on that occasion, and endeavour to assist them by the best advice in his power to put the Institute on a proper foundation. C. Wren Hoskyns, Esq., the high sheriff, seconded this resolution, and said that the human mind, like the body, required not only a stimulant, but some degree of excitement; it required some amusement—some lighter amusement for the spare moments; it required rest, and according to the laws of the mind, it found the greatest rest in change. The most busy men—members of the House of Commons and the higher branches of the law—all confessed they did not know what rest was in that sense understood by idleness; the only rest they knew except sleep was in the change from one subject to another, from the heavy to the lighter, varying the action of the powers of the mind. He concluded by suggesting, as an addendum to the resolution, that the proposal of Sir Joseph Paxton be adopted. The resolution was carried unanimously. Mr. Kirby, in rising to move the next resolution,—"That a subscription be opened to liquidate the debt [£800] on the Institute,"—suggested, as a means of doing so, the encouragement of subscriptions of a small amount from a large number of subscribers. The motion having been seconded by Mr. A. B. Herbert, was unanimously adopted. The Rev. Father Pratt moved the next resolution, expressive of cordial acknowledgments to Lord Leigh and the Duke of Devonshire for throwing open their parks, grounds, and picture galleries to the members of the Institute. Mr. C. Bray seconded the motion, observing, amongst other things, that lectures were but the play of an Institution, and what he wanted to see was the work of it. This must consist in the establishment of classes, and the pursuit and study of particular subjects, till those subjects were completely mastered. On the motion of Mr. W. H. Hill, seconded by Mr. Luke Dresser, it was resolved that Mr. Webster and Mr. T. Robinson be appointed Hon. Secretaries to the Institution for the ensuing year. Votes of thanks were then passed to Sir Joseph Paxton, M.P., to the lecturers of the past year, to the outgoing officers, and to the Mayor for his kindness in presiding.

Darlington.—As Her Majesty and His Royal Highness Prince Albert were coming south the other day, the royal train stopped at the Darlington Bank-top station, when the chairman and committee of the Polytechnic Exhibition lately held in the town, in connection with the Mechanics' Institute, presented an address to His Royal Highness, stating that the object of the Exhibition had been the liquidation of a debt of £800, incurred in the building of the Institute. During the six weeks the Exhibition was open, it was visited by all classes, and its educational character was well sustained by a series of lectures and concerts.

Huddersfield.—The first annual distribution of prizes at the Mechanics' Institution took place on Saturday sennight. The Directors of the Mechanics' Institution, anxious to afford its numerous members the stimulus which the excitement of offered reward generally gives, have instituted prizes for proficiency in particular departments, general excellence, or that regularity of attendance and conduct which marks the youth who, although without any brilliant qualities, may possess the pre-eminently

English faculty of sustained perseverance. On the evening in question a very numerous audience assembled, composed generally of the parents and relatives of the members, who were themselves present in full force. On the platform there was a goodly number of the old friends of the Institution; amongst others, Joseph Batley, Esq., of Armitage Fold, who occupied the chair; Mr. Edmund Eastwood, President of the Institution; Messrs. James Hanson, J. Rothery, and Charles Kaye, Vice-Presidents; the Rev. R. Storrey; Messrs. Samuel Hiley, Charles Sikes, James Shaw, D. Johnston, W. M. Nelson, Ben Thornton, John Dodds, Washington Teasdale, William Moore, W. Heslop, — Knight, C. Ramsden, J. Wood, H. Wood, Frank Curzon, *Secretary*, J. Sharp, W. Senior, J. Dearden, — Brewer, &c. The hall was appropriately decorated with wreaths of laurel, and behind the platform a transparency, the work of Messrs. Knight, Hardy, and Jackson, was raised, the motto on which, "Excelsior," carried its own high thought and aim with it. Banners were hung here and there, and gave a pleasant relief to the eye. From the walls depended specimens of writing, maps, &c., the works of the competitors for the various classes. There were also two or three admirable drawings, contributed by the architectural and mechanical drawing class, whilst near them were placed some unobtrusive outlines drawn by the pupils of the junior freehand class. Although at first passed by without remark, on returning to them you could not help noticing the masterly precision with which difficult and elaborate circles and other leading forms in design had been wrought out. The drawings of the advanced classes were reserved for the *soirée*, and will doubtless form an attractive feature at that festival. On Saturday last, however, the walls were not wholly without a proof of what the pupils in the drawing classes of the institution can do, a piece of modelling in high relief being exhibited, displaying considerable artistic skill, and from which, when informed that it was sculptured by Joseph Morton, South-street, without other aid than his previous education in the Institution, one could not but see that these classes might be made, under the continued kind guidance of Mr. Tomlinson, who has so disinterestedly and unfalteringly devoted himself to the work, a very valuable means of bringing out the graphic talent of our young Yorkshiremen. The CHAIRMAN said he was sensible of the kindness and respect which the president and committee had shown in inviting him to preside on that occasion, and they had done him no more than justice when they supposed that he felt a deep interest in the progress of the Huddersfield Mechanics' Institution. He took it for granted that the supporters of the Institution would approve of the resolution which the committee had adopted, of giving prizes to those pupils who had distinguished themselves by close application to study, rapid progress, good behaviour, and regular attendance. The beneficial effect of giving prizes for merit had been long ascertained. It was done in our universities, and had always been found to be a stimulus to exertion, because the gift was estimated, not according to its value, but by the importance attached to it. These honorary distinctions were not confined to our educational institutions, but in our army and navy prizes were given to those who distinguished themselves in engagements. He thought that they ought to reward those boys who struggled to overcome their love of ease and the bad examples of those around them, in order to elevate themselves by studying at these institutions; also those who by their assiduity raised themselves to honorary distinction, were deserving of reward. He was glad that the committee had adopted a plan of showing their appreciation of these labours by granting rewards. They were now met for the purpose of distributing those rewards, and it gave him pleasure to know that they were well merited. In the higher walks of life, those who attended our high schools and universities, had the whole day in which to pursue their studies, whilst many a poor lad who attended the Mechanics' Institution had to work at the mill all day, and could only attend to his studies in the evening. He thought those who thus attended to receive instruction, and made progress in spite of all difficulties, were well deserving of encouragement, and he was very glad that in Huddersfield many had rendered themselves worthy of reward. He would take the opportunity to express his gratification at the interest evinced, and the support given by the good people of Huddersfield, to their Institution. So long as such Institutions flourished, he felt assured that England would never sink in the scale of nations. Mr. CURZON, the secretary, reported that the classes in the Institution numbered 73, and were divided into nine departments. The largest proportion of the classes were entirely devoted to elementary teaching. There were 16 reading, 10 writing, 13 arithmetic, and four spelling and grammar classes, making a total of 45 devoted to elementary education, the remaining 28 being for more advanced culture. In the earliest, as well as the more advanced reading classes, geography and history were superadded. These classes were taught by 40 voluntary and 13 paid teachers. In the prize awards, the directors had been governed by the principle of giving to the most numerous and important classes the largest number and most important prizes. After enumerating the number of prizes awarded to each class, he stated that those given for general excellence combined proficiency, progress, perseverance, and good conduct; and in addition to the prizes awarded, a number of parties had been commended for the manner in which they had striven for the prizes. Mr. J. HANSON, vice-president, rose to give some explanation of the mode in which the examinations had been conducted. Their objects in giving the prizes were several, but they were principally anxious to encourage and reward the really industrious, and they were likewise anxious to bring into play the principle of emulation. The chairman had remarked that this principle was one encouraged in our large Institutions, and he (Mr. Hanson) ventured to say that probably nowhere ought it to be more encouraged and rewarded than in an Institution like this. In schools and colleges, learning was the business of the lives of the pupils, and if industry and diligence were deserving of reward there, surely amongst boys who spent their days in warehouses and shops, diligence and industry was deserving of encouragement. It had been said that the principle of giving prizes might be attended with evil. He asserted that there was nothing connected with the principle of competition but what was perfectly right and honourable. In giving prizes for attendance, their decisions had been made from the tabulated statement of attendance. The prizes for general progress and good conduct had been awarded by the teachers. Those for excellency had been decided by the answers given by the pupils to prepared and printed questions. Each of these questions had a certain value attached to it in figures, and the pupil could thus choose the easy or more difficult ones, the result being decided by adding up the value in figures attached to questions answered, the one with the largest number receiving the prize. In conclusion, he conceived that the distribution of prizes would be attended with the most beneficial effect. The prizes, of which we give a list below, were then presented to the successful candidates by the chairman, who accompanied each with some suggestive and appropriate remark.

AWARD OF PRIZES.—ADULT CLASSES.—READING.—1st, Joseph Naylor, 18, wheelwright, Fartown, Foster's Essays; 2nd, F. Dyson, The Useful Library—Landmarks in the History of England. ARITHMETIC.—1st, E. Mellor, 20, weaver, West-parade, Dalton, The Working Man's Way in the World; 2nd, Thos. Rhodes, 20, Lindley, near the church, Lessons on the Phenomena of Industrial Life. GRAMMAR AND COMPOSITION.—1st, J. Townend, 21, finisher, Rashcliffe, Wilmot's Pleasures of Literature. PHYSICAL GEOGRAPHY.—1st, Joseph Moorhouse, 20, spinner, Paddock Cliff, Humboldt's Views of Nature; 2nd, Benjamin Walker, A Woman's Journey round the World,

Elementary.—Writing, &c.—Edwin Hoyle, 16, blacksmith, Hillhouse, Chambers's Tracts. Drawing.—*Upper Division.*—Ornamental, 1st, Geo. Clayton, 16, house painter, Dalton, English Forests and Forest Trees. *Second Division.*—Ornamental, 1st, J. W. Pickersgill, 18, cabinet maker, Hebble-bridge, Essays on Painting and the Fine Arts. Architectural: 1st, J. B. Freeman, 13, piecer, Lane Dyehouse, Working Men. Mechanical: 1st, John Acheruley, 12. warehouse boy, Dale-street, Mechanics and Mechanism. Writing.—1st, William Bartlam, Life of Edmund Burke; 2nd, William Kaye, 20, warehouseman, Birkby, Wilmot's Pleasures of Literature. Phonography.—1st, George Halliday, 15, silk dyer, New-street, Paddock, The Lecturer. Junior.—Drawing.—*Upper Division.*—1st, John Ackernley, 12, warehouse boy, Dale-street, Materials for Thinking; 2nd, J. Armitage, 16, spinner, Paddock, Book of Amusement; 3rd, Sydney Howe, 15, piecer, Rashcliffe, Peeps at Nature. *Second Division.*—1st, John Balmforth, 15, smith, Fenton-row, English Poets—Campbell; 2nd, W. Gelder, 19, finisher, Lindley, Strife and Peace; 3rd, R. Swindlehurst, 26, smith, Lockwood, Madeline, Music.—1st, J. H. Riley, 15, piecer, Rashcliffe, Longfellow's Outre Mer; 2nd, Tom Lewis, 13, errand boy, Chapel-hill, Voices of the Night; 3rd, H. Rawlinson, 16, Longroyd-bridge. Thom's Poems. Grammar.—*Advanced Grammar and Composition.*—1st, J. W. Hirst, 16, pupil-teacher, Spring-street, Burke's Speeches; 2nd, J. B. Hirst, 14, warehouse boy, Spring-street, Marmion. *Parsing.*—1st, William Howe, 14, piecer, Allen-row, Paddock, Bryant's Poems; 2nd, Walker Wrigley, 17, Clough-bottom, The Cousins.—*Etymology.*—1st, John Balmforth, 15, smith, Fenton-row, Buffon; 2nd, Seth Bottom, Rose and Lillie, Stanhope. Simultaneous.—*Spelling.*—F. G. Allan, 9, Pilgrim's Progress. *Grammar.*—William Boothroyd, wheelwright, The Hand of Providence. Writing.—*Advanced Class.*—1st, James Haigh, 15, book-keeper, Bath-terrace, Dawnings of Genius; 2nd, Joseph Beckworth, 17, woolsorter, Dog-kennel-bank, Evangeline. No. 5.—1st, J. T. Brown, 13, piecer, Hill-house, Sketches on Natural History; 2nd, Wm. Marchant, Amber Witch. No. 4.—1st, John Crossley, 11, finisher, Leeds-road-limekiln, Seed Time and Harvest. No. 3.—1st, G. H. Senior, 15, schoolboy, East-parade, Wood Notes of a Wanderer; 2nd, Fred. Sykes, 12, Pen and Ink Sketches. No. 2.—1st, Colonel Bradley, 15, wool sorter, Victoria Mill, Old Humphrey; 2nd, Henry Eastwood, 14, finisher, Primrose-hill, Mary Bell; 3rd, J. P. Crowther, 14, mason, Crosland-moor, Pleasant Words; 4th, A. Taylor, 10, schoolboy, Chapel-hill, The Whisperer. Arithmetic.—*Advanced Classes.*—1st, Isaac Swallow, 14, finisher, Deighton, Joyce's Scientific Dialogues; 2nd, J. W. Hirst, 16, pupil teacher, Spring-street, Prescott's Ferdinand and Isabella, vol. 1. *Rule of Three Class*—1st, W. Lockwood, sen., 12, watchmaker, Joyce's Scientific Dialogues; 2nd, William Howe, 14, piecer, Allen-row, Paddock, Paley's Natural Theology. *Compound Rules.*—1st, G. H. Senior, 13, schoolboy, East-parade, Woman's Journey round the World; 2nd, T. Pollitt, 16, mechanic, Paddock, Drake, Cavendish, and Dampier. *Long Division.*—1st, John Crossley, 14, finisher, Leeds-road, Woman's Journey round the World; 2nd, William Boothroyd, wheelwright, Steadfast Gabriel. *Short Division.*—1st, Samuel Jackson, Moral and Entertaining Anecdotes; 2nd, Alfred Taylor, 10, school boy, Chapel-hill, Truth and Trust. *Multiplication.*—1st, J. P. Crowther, 14, mason, Crosland-moor, Thomson's Seasons; 2nd, Henry Eastwood, 14, finisher, Primrose-hill, Wonders of Nature and Art. *Subtraction.*—1st, William H. Brown, 13 school boy, 47, Bradford-road, Fireside Companion; 2nd, Wilson Townend, 17, Leeds-road, True Heroism. *Addition.*—1st, J. W. Booth, 9, school boy, Swallow-street, Anson's Voyages; 2nd, C. Heaton, 13, piecer, Paddock-brow, Self-Denial. Reading, &c.—*Reading with Elementary Science.*—1st, William Howe, 14, piecer, Allen-row, Paddock, White's Selborne; 2nd, Isaac Swallow, 14, finisher, Deighton, Aceldama. No. 5.—1st, B. Schofield, 13, warehouse boy, Dock-street, Sandford and Merton. No. 8.—Robert Graham, Practical Facts in Chemistry. No. 9.—B. Howe, Kirke White's Poems. Attendance.—1st, J. Townend, 21, finisher, Rashcliffe, Watt's on the Mind; 2nd, G. Dyson, 15, carver, Rashcliffe, Ruins of Sacred and Historic Lands; George Shaw, 8, schoolboy, Success in Life; James Sykes, 16, finisher, Upperhead row, Events in the History of England; 1st, S. Howe, 15, piecer, Rashcliffe, Footsteps of Famous Men; 2nd, Oliver Bradley, 14, finisher, Manchester-road, Works of Campbell; W. Howe, 14, piecer, Allen-row, Paddock, Longfellow's Poetical Works; Joseph Jagger, The Enchanted Lake; P. Duffy, Uncle Sam's Money Box. General Excellence, &c.—John Payne, 17, architect, 82, King-street, Crabbe's Poetical Works; J. W. Hirst, 16, pupil teacher, Book of Sports; A. Roberts, 16, warehouseman, Newtown, Longfellow's Complete Works; James Sykes, 16, finisher, Upperhead-row, Phillips's Shower of Pearls; John Worth, 11, schoolboy, Back Ramsden-street, Boyhood of Great Men; James Haigh, 15, book-keeper, Bath-terrace, Arabian Nights Entertainments; David Kirk, 14, joiner, Lockwood, Footprints of Famous Men; J. B. Hirst, The Lady of the Lake; William Lockwood, sen., 12, watchmaker, Take Care of Number One; John Hellawell, John's Book of Poetry; Walker Wrigley, 17, Clough Bottom, Goldsmith; G. H. Giles, 15, warehouse boy, Towning-row, History of England; J. B. Berry, 15, piecer, Tolson-sq., Mold-green, Pfeiffer; John Pearson, 13, piecer, Kilner Bank, Robinson Crusoe; J. Pagden, 15, pupil teacher, Northgate, Gautier's Spain. History and Geography.—1st, J. W. Hirst, 16, pupil teacher, Spring-street, Prescott's Ferdinand and Isabella, 2nd vol.; 2nd, J. B. Hirst, 14, warehouse boy, Spring-street, Stewart's Geographical Dictionary. *Junior Classes.*—1st, J. Booth, 9, student, Beast market, Salad for the Solitary; 2nd, A. Blackburn, 13, warehouse boy, Thomson's Seasons. Correspondence Class.—B. Thompson, 14, clerk, Fitzwilliam-street, The Bible and the Working Classes. Advanced History and Essay.—Allan Broadbent, 20, warehouseman, Crosland-moor. *Junior Essay Class.*—R. H. Holroyd, 13, West-parade, Battle Fields of Yorkshire. Persons Commended.—William Hemdingway, Wm. Donkersley, W. B. Rayner, Henry Kaye, Wm. Appleyard, B. D. Walker, Henry Taylor, B. Thompson, Oliver Bradley, H. Schofield, W. H. Barrett, E. Mellor (adult), — Roberts, Godfrey Netherwood, Batley Hanson, William Horsfall, Charles Cook, Joe Dyson, John Cudworth, Henry Whitwam, G. W. Bolland, Tom Milnes, James Hilton (adult), J. Crosland, John Hoyle, James Horsfall, R. H. Armitage, Alfred Walker, W. H. Charlesworth, Joe Morton, W. Howe, James Johnson, J. Gelder, W. H. Jessop, Tom Johnson, G. Riley, Edward Jagger. A gentleman of the neighbourhood kindly presented to each of the parties commended a copy of that valuable little book, now so popular, entitled "Good Times." To show how effectively the Institution does its work in educating the members of the working classes, it will be interesting to give an analysis of the occupations of the recipients of the prizes. We find, on referring to the schedule of prizes awarded, that they are thus designated:—Finishers, 13; piecers, 12; schoolboys, 10; warehouse boys, 5; errand boys, 5; warehousemen, 4; smiths, 4; wheelwrights, 4; spinners, 2; cabinet makers, 2; pupil teachers, 2; book-keepers, 2; wool sorters, 2; masons, 2; carver, 1; silk dresser, 1; architect, 1; clerk, 1; watch-maker, 1; machinist, 1; weaver, 1. Some bore off more than one prize. Mr. Hanson then moved the first resolution:—"As classes in Mechanics' Institutions constitute means by which the children, youths, and adults of the working population may acquire a systematic knowledge of the various branches of education, this meeting regards classes as the most important feature of these institutions, and as the agencies best calculated to secure the legitimate objects of such establishments." He remarked, the great object of Mechanics' Institutions was the sound education of the

working classes. To effect this end libraries or lectures were insufficient. The only mode of giving continuous instruction to the great body of the people was by the agency of class instruction, and in this, the legitimate and proper sphere of a Mechanics' Institution, the Huddersfield institute had been singularly successful. The Rev. R. Storrey, in seconding the resolution, insisted on the necessity of dwelling for a sufficient time on the elementary branches of education, and the Institution appeared to have taken a peculiarly practical view of the matter, beginning with the beginning, and teaching the youths that it was only by labour, and sustained labour, they could acquire sound or valuable knowledge. Mr. W. M. Neilson, in a few warm words, the train to Leeds being about to start, rendering his departure imperative, moved the next resolution:—"That the Huddersfield Mechanics' Institution, as comprising a series of classes, in which instruction is imparted in all the useful departments of knowledge, affords to the labouring population of the neighbourhood great facilities for remedying their defective early training, or of securing for themselves a sound, practical education." Mr. James Shaw briefly but cordially seconded the resolution. Mr. E. Eastwood, the president of the Institution, moved the next resolution:—"That the cordial thanks of the meeting be given to the gentlemen who have kindly presented books to be awarded as prizes on the present occasion; and the meeting trusts that, in future years, their example will be followed by a larger number of the friends of popular education." He said that he believed more than fifty of the prizes had been given by gentlemen residing in the immediate neighbourhood. He thought the giving of prizes was an object that deserved support. One fault of Mechanics' Institutions was that their advantages had not been enjoyed by the class for which they were intended, but by a class higher in the social scale, who had the means of employing professional teachers. In the Huddersfield Mechanics' Institute, not only were the directors, teachers, and pupils, working people, but they were *workers*. When they had similar distributions he should call upon all manufacturers, merchants, and tradesmen to aid them, for it would be contributing to their own interest and to the general good of the country. Mr. W. Moore had great pleasure in seconding it. The object of the Institution was a high one, it was to train the minds of the boys and fit them for the battle of life. Mr. Rothery, V.P., moved the thanks to the teachers. He had taken pains in examining the classes, and he could speak of the great efficiency of their teachers, and they were well worthy of their thanks and support. He felt honoured by being in connection with the Institution and its teachers. Mr. Rothery then moved the following resolution:—"That the thanks of the meeting be given to the teachers, and to the voluntary teachers, for their valuable assistance in the work of conducting the classes." Mr. Dodds seconded the resolution, praising the teachers of the classes for their patience, energy, and sympathy with the objects of the Institution. Mr. Teasdale moved their thanks to the secretary. He knew no secretary equal to their secretary. He was like their Institution—a model one, and he was sure their thanks were due to him. There, said he (pointing to the lads), are the soldiers; here is the parliament (the directors), and here is the commander-in-chief (the secretary.) Mr. Teasdale then moved the following resolution:—"That the best thanks of the meeting be presented to the secretary for his unwearied exertions in the examination and in preparing for the distribution of prizes." Mr. Kaye, V.P., seconded it with great pleasure. The secretary brought untiring industry and great skill to bear upon the work of the Institution. He was always at his post, endeavouring to stimulate them, never disposed to shirk any duty the interests of the Institution required. Messrs. Batley and Moore spoke in favour of it, and it was carried by acclamation. A vote of thanks to the chairman was then proposed by Mr. Eastwood, president, and seconded by Mr. Hiley, amidst the applause of the meeting. Mr. Batley briefly responded, and the audience separated shortly after ten o'clock.

The following is the series of printed questions referred to in the foregoing report:—

Examination Paper for Class No. 5.—Arithmetic.—Rule of Three and Practice.

Master, Mr. J. Sharp.

No. 1.—If 1 yard of cloth cost 3s. 4d., what will 65 yards come to at the same rate? (Numerical Value 5.)

No. 2.—If 1 pair of shoes cost 5s. 8d., what will 89 pair come to at the same rate? (N. V. 5.)

No. 3.—What will 58 yards of cloth come to if 5 yards cost £1 17s. 8d.? (N. V. 10.)

No. 4.—If a man travel 38 miles in 3 days, how far will he travel in 54 days at the same rate? (N. V. 10.)

No. 5.—If 74 yards of cloth cost £48 19s. 8d., what will 7 yards come to at the same rate? (N. V. 10.)

No. 6.—If 7 men build a house in 45 days, in how many days will 10 men build it? (N. V. 10.)

No. 7.—If $7\frac{1}{2}$ yards of cloth cost £4 12s. 8d., how many yards can be bought for £21 10s.? (N. V. 15.)

No. 8.—If a man earn 30s. per week by working $11\frac{1}{2}$ hours per day, what will his wages be if he work 10 hours per day? (N. V. 15.)

No. 9.—How many yards of cloth can be bought for £24 10s., if $7\frac{3}{4}$ yards cost £3 19s. 8d.? (N. V. 15.)

No. 10.—If one cwt. of sugar cost £2 17s. 8d., what is the price of 4 cwt. 3 qrs. 15 lbs. at the same rate? (N. V. 20.)

No. 11.—If 1 cwt. of sugar cost £3 8s. 9d., what will $3\frac{1}{2}$ lbs. come to? (N. V. 20.)

No. 12.—If $8\frac{1}{2}$ lbs. of soap cost 3s. $2\frac{1}{2}$d., what will 4 cwt. 2 qrs. 19 lbs. come to? (N. V. 20.)

No. 13.—If 7 pieces of cloth, each $27\frac{1}{2}$ yards, cost £89 10s., what will $8\frac{1}{2}$ yards come to? (N. V. 25.)

No. 14.—How many yards of cloth can be bought for £2 10s., if 9 pieces, each 29 yards, cost £106 10s. 8d. (N. V. 25.)

No. 15.—From 11 pieces of cloth, each $32\frac{1}{2}$ yards, how many suits of clothes may be cut, each $5\frac{1}{2}$ yards. (N. V. 25.)

No. 16.—518 yards of cloth at 8d. per yard. (N. V. 5.)

No. 17.—108 yards of cloth at 10d. per yard. (N. V. 5.)

No. 18.—362 yards of cloth at 7d. per yard. (N. V. 5.)

No. 19.—463 yards of cloth at 3s. 5d. per yard. (N. V. 10.)

No. 20.—584 yards of cloth at 4s. 7d. per yard. (N. V. 10.)

No. 21.—476 yards of cloth at 2s. 9d. per yard. (N. V. 10.)

No. 22.—$218\frac{1}{2}$ yards of cloth at 1s. 7d. per yard. (N. V. 15.)

No. 23.—$1084\frac{1}{2}$ yards of cloth at 2s. $9\frac{1}{2}$ per yard. (N. V. 15.)

No. 24.—$72\frac{1}{2}$ yards of cloth at 6s. 3d. per yard. (N. V. 15.)

No. 25.—What will 7 pieces of cloth come to, each 32 yards, at 4s. 8d. per yard? (N. V. 20.)

No. 26.—What is the price of 9 pieces of cloth, each 29 yards, at 8s. $1\frac{1}{2}$d., per yard? (N. V. 20.)

No. 27.—What will 10 pieces of cloth cost finishing, each 31 yards, at $3\frac{1}{2}$d. per yard? (N. V. 20.)

No. 28.—What will 8 pieces of cloth come to, each $35\frac{1}{2}$ yards, at 6s. 8d. per yard? (N. V. 25.)

No. 29.—What will 9 pieces of cloth cost finishing, each $33\frac{1}{2}$ yards, at $3\frac{3}{4}$d. per yard?

No. 30.—What is the price of 12 pieces of cloth, each $30\frac{1}{2}$ yards, at 9s. $10\frac{1}{2}$d. per yard? (N. V. 25.)

Examination Paper for Class No. 5.—Senior Youths.—English History, with Geography as an Auxiliary Study.

Conducted by the Secretary, Mr. Curzon.

1*st.—Chronological and Dynastic.*
2*nd,—Social, Domestic, and Biographical.*
3*rd.—Geographical.*

Give a definition of the term History.

1st.—Chronological and Dynastic.

No. 1.—From what did the ancient Britons claim descent? (Numerical Value 6.)

No. 2.—Give the date and place of Julius Cæsar's landing in Britain, and detail some circumstances attending that invasion. (N. V. 3.)

No. 3.—What cause first brought the Saxons to England?—and give the immediate results. (N. V. 3.)

No. 4.—Who was the greatest of all the Saxon kings?—and give some particulars of his reign. (N. V. 5.)

No. 5.—At what period did the Norman conquest take place?—and describe some of its immediate consequences. (N. V. 1.)

No. 6.—What king distinguished himself in the Crusades?—and recount some of the events during those wars. (N. V. 3.)

No. 7.—Whence did the English kings derive the surname of Plantaganet?—and who was the first that assumed it? (N. V. 1.)

No. 8.—In whose reign did the Wars of the Roses commence?—and explain their origin. (N. V. 5.)

No. 9.—Relate the particular events that transpired during the reign of Henry 8th. (N. V. 10.)

No. 10.—Who succeeded James 2nd?—and name the most remarkable events of his reign. (N. V. 8.)

No. 11.—Give a list of the Sovereigns from the Conquest to the reign of George 2nd. (N. V. 6.)

No. 12.—How many kings have died violent deaths? (N. V. 3.)

No. 13.—How many have died out of England? (N. V. 3.)

No. 14.—What Queens have reigned in their own right? (N. V. 1.)

No. 15.—Give the three longest and the three shortest reigns. (N. V. 2.)

No. 16.—Enumerate all the great victories, with their successful generals. (N. V. 7.)

No. 17.—Give the periods of the Union with England, of Wales, Scotland, and Ireland. (N. V. 5.)

No. 18.—Under whose reigns were our colonies acquired? (N. V. 6.)

No. 19.—Which of the principal cities suffered sieges, and in whose reigns? (N. V. 7.)

2nd.—Social, Domestic, and Biographical.

No. 20.—By whom, and where was Magna Charta granted, and what were its constitutive elements? (N. V. 10.)

No. 21.—Give some account of the Feudal Law. (N. V. 8.)

No. 22.—When were members first summoned to parliament? (N. V. 3.)

No. 23.—Define the Saxon Wittengamote, a Norman parliament, and the British House of Commons. (N. V. 25.)

No. 24.—Describe a Roman colony in the time of Claudius,—a Saxon borough during the reign of Alfred,—and a Norman city of the time of Henry 2nd. (N. V. 25.)

No. 25.—Give the meaning of the terms Danegelt, Poletax, and Shipmoney. (N. V. 10.)

No. 26.—Give the best idea you have of a dwelling-house during the reign of Elizabeth. (N. V. 15.)

No. 27.—Give the names of the scientific men from the Conquest downwards. (N. V. 10.)

No. 28.—Name the prominent statesmen between 1630 and 1650. (N. V. 5.)

No. 29.—Enumerate the principal discoveries made from the Conquest to the end of the 16th century. (N. V. 20.)

No. 30.—Give an account of the different inventions during the same period, and also their dates. (N. V. 20.)

No. 31.—Name the dates of the introduction of various articles of domestic use. (N. V. 20.)

No. 32.—Enumerate the Poets from the Conquest to the end of the 16th century. (N. V. 8.)

3rd.—Geographical.

No. 33.—Give a definition of the term Geography. (N. V. 5.)

No. 34.—What were the earliest names of Great Britain, and why so called? (N. V. 10.)

No. 35.—Which are the ten most populous cities of England? (N. V. 3.)

No. 36.—Give the seats of the principal manufactures. (N. V. 3.)

No. 37.—Give the arsenals and principal seaport towns, naval and mercantile. (N. V. 3.)

No. 38.—Give the Collegiate cities. (N. V. 3.)

No. 39.—Name the principal rivers and mountains in England. (N. V. 4.)

No. 40.—Give the natural boundaries between England and Wales, Yorkshire and Lincolnshire, Yorkshire and Durham, Somersetshire and Gloucestershire, Lancashire and Cheshire, Middlesex and Surrey, Lincolnshire and Norfolk. (N. V. 6.)

No. 41.—Name some of the principal natural productions of the different counties in England. (N. V. 10.)

No. 42.—Name the counties that stretch along the Eastern, Western, and Southern coasts. (N. V. 4.)

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Examination Paper for Class No. 9.—Arithmetic Class, from Practice upwards.

Master, Mr. Cullen.

Practice.

No. 1.—What will 156 cwt. of anything come to at 18s per cwt.? (Numerical value 4.)

No. 2.—At 15s. per cwt., what will 336 cwt. cost? (N.V. 4.)

No. 3.—What will 16lbs. of anything cost at £3 13s. 6d. per cwt.? (N.V. 8.)

Interest.

No. 4.—What is the interest of £220 for one year, at 4 per cent. per annum? (N.V. 6.)

No. 5.—What is the interest of £479 18s. for 2 years, at $4\frac{1}{2}$ per cent. per annum? (N.V. 10.)

No. 6.—What is the interest of £427 13s. 9d. for 1 year and 8 months, at 3 per cent. per annum? (N.V. 12.)

Discount.

No. 7.—What is the present worth of £795 11s. 2d. for 4 months, at £3 10s. per cent. discount? (N.V. 20.)

Barter.

No. 8.—How much sugar at 8d. per pound must be delivered in exchange for 20 cwt. of anything at £3 per cwt.? (N.V. 20.)

Profit and Loss.

No. 9.—At what rate must I sell 1 cwt. which cost £3 10s. to gain 10 per cent.) (N.V. 12.)

No. 10.—At what rate must I sell 1 cwt. which cost £3 10s. to lose 10 per cent.? (N.V. 12.)

Fellowship.

No. 11.—A and B gained £182; A put in £300 and B £400; what share of the profit has each? (N.V. 16.)

No. 12.—A father left an estate of £1,000 to three sons, in such a way that for every £2 that A gets, B shall have £3, and C £5, what sum shall each have? (N.V. 18.)

Exchange.

No 13.—How much sterling money must be paid in London to receive in Paris 800 crowns, exchange at 56d. per crown? (N.V. 18.)

No. 14.—A London merchant remits £200 to Paris; what is the value in French crowns at 56d. per crown? (N.V. 18.)

Vulgar Fractions.

No. 15.—What is the $\frac{2}{3}$ of $\frac{3}{4}$ of £1? (N.V. 16.)

No. 16.—What is the $\frac{5}{6}$ of £1? (N.V 14.)

No. 17.—Add the $\frac{2}{3}$ of 1s. to the $\frac{4}{5}$ of £1. (N.V. 18)

No. 18.—Multiply $\frac{3}{4}$ by $\frac{1}{2}$ of $\frac{2}{3}$. (N.V. 14.)

### DECIMAL FRACTIONS.

No. 19.—Reduce $\frac{4}{7}$ to a decimal. (N.V. 12.)

No. 20.—Reduce 11s. to the decimal of £1. (N.V. 12.)

### SQUARE ROOT.

No. 21.—What is the square root of 4,096? (N.V. 22.)

No. 22.—An army consisting of 213,444 men, I desire to know how many rank and file? (N.V. 23.)

### CUBE ROOT.

No. 23.—What is the cube root of 157,464? (N.V. 24.)

No. 24.—What is the cube root of 21,952? (N.V. 23.)

### DUODECIMALS.

No. 25.—Multiply 12 feet 4 inches by 8 feet 6 inches. (N.V. 18.)

No. 26.—A room 24 feet 3 inches by 18 feet 4 inches, what is the area of its floor? (N.V. 22.)

### MISCELLANEOUS QUESTIONS.

No. 27.—Divide $\frac{6}{7}$ by $\frac{2}{3}$ of $\frac{1}{6}$. (N.V. 20.)

No. 28.—In 1,000 dollars of 4s. 6d. each, how much sterling money? (N.V. 16.)

No. 29.—What is the brokerage on £847 6s. 4d. at 5s. 6d. per cent.? (N.V. 20.)

No. 30.—Multiply 2·674 by 4·46. (N.V. 14.)

No 31.—If the area of a circle be 460 yards, what is the side of the square? (N.V. 24.)

No. 32.—What is the cube root of 175616? (N.V. 24.)

No. 33.—What is the price of a marble slab, whose length is 4ft. 8in., and breadth 2ft. 4in., at 5s. per foot? N.V. 25.

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## EXAMINATION PAPER FOR CLASS No. 9.—GRAMMAR AND COMPOSITION.

### MASTER, MR. W. SCHOFIELD.

No. 1.—What are the four parts into which grammar is divided? Give a short account of each. (N. V. 5.)

No. 2.—Name the parts of speech which are inflected, and give instances to show how each is inflected. (N. V. 6.)

No. 3.—What is an adverb? Give three sentences showing how it qualifies verbs, adjectives, and other adverbs. (N. V. 4.)

No. 4.—What do you understand by transitive and intransitive verbs? Give examples of each. (N. V. 3.)

No. 5.—Give a list of regular and irregular verbs, and explain what you mean by those terms respectively. (N. V. 3.)

No. 6.—What is the meaning of concord and government as used in grammar? Give two rules under each. (N. V. 4.)

No. 7.—Parse the following—

> "Hope, like the glimmering taper's light,
> Adorns and cheers the way;
> And still, as darker grows the night,
> Emits a brighter ray."

No. 8.—What is a sentence? Of how many parts does it consist? (N. V. 4.)

No. 9.—In the following, what is the subject, predicate, and object, respectively? "To pay attention pleases your teacher." (N. V. 3.)

No. 10.—What are the adjuncts of the subject, predicate, and object in the subjoined sentence? "The white lap-dog tries very much to please its mistress." (N. V. 3.)

No. 11.—Into how many classes are adjuncts of the predicate divided? What are they? (N. V. 4.)

No. 12.—Write out as many times as you can the following sentence, by merely changing the position of the several adjuncts. "For the sake of future happiness, never, in youth, give way to idleness." (N. V. 4.)

No 13.—What do you understand by co-ordinate and sub-ordinate sentences? Into how many classes may each be subdivided? (N. V. 7.)

## EXAMINATION PAPER FOR CLASS 9.—SENIOR YOUTHS.—ASTRONOMICAL AND PHYSICAL GEOGRAPHY.

### MASTER, MR. WILLIAM SCHOFIELD.

No. 1.—Of what shape is the earth, and how may it be proved to be of that particular shape? (Numerical Value 4.)

No. 2.—What is the cause of day and night? (N. V. 3.)

No. 3.—How do you account for the seasons? (N. V. 4.)

No. 4.—Describe the mariner's compass, name its chief points, and state its use. (N. V. 6.)

No. 5.—Define a great circle, and say into how many parts each circle is divided. (N. V. 5.)

No. 6.—What will be the exact time, at two places, one of which is situate 136° west, and the other 170° 30, east of Greenwich, when it is 12 o'clock at noon there. (N. V. 3.)

No. 7.—Into how many classes are planets divided? To which of these classes does the moon belong? (N. V. 3.)

No. 8.—What effect has the moon upon the earth? (N. V. 4.)

No 9.—Of what is the atmosphere chiefly composed, to what height does it extend, and what are its chief properties? (N. V. 6.)

No. 10. How may the clouds which float in it be accounted for? (N. V. 4.)

No. 11.—Define dew and mist, and state the difference which exists in the formation of snow and hail. (N. V. 6.)

No. 12.—Write a short account of winds, stating their origin and use. (N. V. 6.)

No. 13.—What is it which distinguishes the simoon, typhoon, and hurricane from ordinary winds? (N. V. 5.)

No. 14.—Name the principal terms used in Geography for the various portions of the land, and give examples of each. (N. V. 4.)

No. 15.—How many oceans are there? What are their boundaries? (N. V. 3.)

No. 16.—What are the chief inland seas connected with the Atlantic Ocean? (N. V. 3.)

No. 17.—Name as many peninsulas as you can which point southward. What are the two exceptions? (N. V. 4.)

No. 18.—What are volcanoes and earthquakes? Give examples showing the destructive effects of each. (N. V. 6.)

No. 19.—What are the chief mountain ranges on the globe, and where are they situated? (N. V. 3.)

No. 20.—Name the most remarkable rivers of Europe and America. (N. V. 2.)

No. 21.—Explain the meaning of source, confluence, tributary, and estuary as applied to rivers. (N. V. 5.)

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## ADULT CLASSES.

### MASTER, MR. JOHN DEARDEN.

*Miscellaneous Questions in Arithmetic, for the Annual Examination, September, 1855.*

No. 1.—What is the difference between the price of 743 ounces of gold at £3 17s. 10½d. per ounce, and that of the same weight of silver at 62d. per ounce? (Numerical value 4.)

No. 2.—A gentleman distributed £5 13s. 4d. among poor people, giving to each 6s. 8d.; How many poor were there? (N. V. 3.)

No. 3.—A labourer earns 23s. 4d. per week; How much should he spend weekly, to save £11 in the year for rent and clothes? (N. V. 5.)

No. 4.—Divide £115 10s. among 5 men and 6 women, and give to each man thrice the share of a woman. (N. V. 8.)

No. 5.—If a man's wages in a year are £89 12s. 6d., what should he receive from the 1st of May to the 18th of December? (N. V. 6.)

No. 6.—A bankrupt's debts amount to £9,356; How much will he pay at 11s. 6d. in the pound? (N. V. 6.)

No. 7.—Suppose a greyhound makes 27 springs while a hare makes 25, and their leaps are of equal length; In how many leaps will the hare be overtaken if she is 50 leaps before the hound? (N. V. 10.)

No. 8.—In the copy of a work containing 327 pages, a remarkable passage commences at the end of the 156th page; At what page may it be expected to begin in a copy containing 400 pages? (N. V. 9.)

No. 9.—A landlord abates $\frac{1}{3}$ in a shilling to his tenant; the whole abatement amounts to £76 3s. $4\frac{1}{3}$d.; What is the rent? (N. V. 12.)

No. 10.—If $\frac{1}{3}$ and $\frac{1}{10}$ of a garden comes to £4 10s., what is the worth of the whole? (N. V. 14.)

No. 11.—When mercury in the barometer stands at a height of 30 inches, the pressure of the air on every square inch of surface is 15 lbs.; What is the pressure on the human body—supposing its whole surface to be 14 square feet, and that the barometer stands at 31°? (N. V. 20.)

No. 12.—80,000 cwt. of ammunition are to be removed from a fortress in 9 days, and it is found that in 6 days 18 horses have removed 4,500 cwt.; How many horses must be employed to carry the remainder in 3 days? (N. V. 18.)

No. 13.—Divide 960 into parts, having the proportion of 1, 3, and 5. (N. V. 16.)

No. 14.—Bought carpets at 3s. 10d. per yard; How many yards must I sell at 4s. $1\frac{3}{4}$d. per yard to gain £10? (N. V. 13.)

No. 15.—A square plantation contains 670,761 trees, which were planted at the distance of 19 feet; Required the length of the side of the square. (N. V. 21.)

No. 16.—A ladder is to be fixed in the ground, 15 feet from the base of a wall 20 feet high; How long must the ladder be to reach the top? (N. V. 22.)

No. 17.—In a gentleman's pleasure ground are two circular ponds, the one is 4 times as large as the other whose diameter is 60 yards; Required the diameter of the other. (N. V. 24.)

No. 18.—A person after spending $\frac{1}{3}$ and $\frac{1}{4}$ of his money, had 2s. 6d. remaining; What sum had he at first? (N. V. 17.)

No. 19.—$\frac{1}{5}$ of a pole is in the water, 10 feet are in the mud, and $\frac{3}{4}$ are above water; Required its length. (N. V. 19.)

No. 20.—A cistern has two pipes, the first of which will empty it in 8 hours, and the other in 10 hours; In what time will it be emptied if both be left open, supposing the current always alike? (N. V. 25.)

No. 21.—A person passed $\frac{1}{6}$ of his age in childhood, $\frac{1}{12}$ of it in youth, $\frac{1}{7}$ of it + 5 years in matrimony; he had then a son, whom he survived 4 years, and who reached only $\frac{1}{2}$ the age of the father; At what age did the father die? (*Algebra.*) (N. V. 30.)

No. 22.—Given, $4x - \frac{x}{36-x} = 46$; Find the value of $x$. (N. V. 28.)

No. 23.—What number is that to which if 24 be added, and the square root of the sum be extracted, the root shall be less than the original quantity by 18. N. V. 32.)

No. 24.—How many 4-inch cubes can be cut out of a 12-inch cube? (N. V. 26.)

No. 25.—A maltster has a kiln that is 18 feet square, but he intends to pull it down and build a new one that may dry 3 times as much; What must be its length, if its breadth be 24 feet? (N. V. 34.)

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EXAMINATION PAPER FOR ADULT CLASSES.—SERIES OF QUESTIONS ON SYNTAX.

MASTER, MR. JOHN DEARDEN.

No. 1.—What is Syntax? (Numerical value 1.)

No. 2.—What is a sentence? (N.V. 2.)

No. 3.—How many kinds of sentences are there? How define them? (N.V. 5.)

No. 4.—What are the principal parts of a sentence? Define the parts. (N.V. 6.)

No. 5.—What is concord? (N.V. 4.)

No. 6.—What is government? (N.V. 4.)

No. 7.—In what case should the subject of a verb be (N. V. 8.)

No. 8.—When a sentence begins with a verb, where i the nominative to the verb to be found? (N.V. 7.)

No. 9.—In the construction of a sentence, what are the two methods or orders? (N.V. 10.)

No. 10.—Which order is most frequently adopted by the poets? (N.V. 9.)

No. 11.—When several nouns in the singular number form the joint subjects of the verb, should the verb be singular or plural? (N.V. 12.)

No. 12.—When several nouns come together in the possessive case, to which of them should the sign be annexed? (N.V. 11.)

No. 13.—Are two negatives in the same sentence, and when negation is intended, proper? Why? (N.V. 13.)

No. 14.—In the use of adverbs and adjectives, what ought to be your guide? (N.V. 15.)

No. 15.—After a verb of motion, ought the adverbs *here* and *there* to be used? Why? (N.V. 14.)

No 16.—When ought the comparative degree to be used, and when the superlative? (N.V. 16.)

No. 17.—How does the comparative degree consider the objects compared, and how the superlative? Give an example of both. (N.V. 18.)

No. 18.—Do the class of pronouns called distributive require verbs, nouns, &c., agreeing with them to be singular or plural? Why? (N.V. 15.)

No. 19.—Ought a clause of a sentence to be placed between a possessive case and the word which governs it? Why? (N. V. 12.)

No. 20.—When an article is used before a noun, is the noun to be taken in a limited, or in its widest sense? (N. V. 12.)

No. 21.—Ought the last of two nouns after the comparative degree, to have an article before it, when the two nouns refer to the same person or thing? Why? (N. V. 19.)

No. 22.—What nice distinction is made by the use or omission of the article *a?* Instanced by example. (N. V. 20.)

No. 23.—Of what use is the ellipsis, and to what may it be aptly compared? (N. V. 21.)

No. 24.—What is the danger attending too free a use of the ellipsis? (N. V. 23.)

No. 25.—On what occasion do two or more singular nouns, coupled with *and*, require the verb and pronoun to be in the singular number? (N. V. 24.)

No. 26.—When may we be said to be disappointed of, and also disappointed in, a thing? (N. V. 20.)

No. 27.—What is that case called which comes before a participle, independently of the rest of the sentence? (N. V. 21.)

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## Miscellanea.

PUBLIC LIBRARY FOR THE CITY OF LONDON.—At the meeting of the Court of Aldermen on Wednesday last, the LORD MAYOR informed the Court that, in consequence of a communication made to him of a resolution of the Court of Common Council upon the subject of the establishment of public libraries, &c., in the City, in conformity with the recent Act of Parliament, he had appointed the 5th of November for a meeting in the Egyptian-hall of the Mansion-house, to take that important question into consideration. Alderman SIDNEY thought the meeting ought to be held in a place of large dimensions, as no doubt vast numbers of the citizens would wish to vote against what would prove to be a permanent tax upon themselves, to the amount of £4,000 to £5,000, without producing any corresponding benefit. Alderman FAREBROTHER did not think it necessary that the Lord Mayor should alter his intention with respect to the place of meeting, and his lordship said he would preside upon that occasion at the time dated.

## PATENT LAW AMENDMENT ACT, 1852.

**APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.**

[*From Gazette October 12th*, 1855.]

*Dated 27th September*, 1855.

2152. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Forging iron. (A communication.)
2154. M. Atkinson, Wandsworth, and B. Ridge, M.D., Putney—Steam boilers, &c.
2156. J. Newman, Birmingham—Railway wheels.
2158. J. Nottidge, Chemical Works, Walworth—Manure.

*Dated 28th September*, 1855.

2160. J. H. B. Thwaites, Bristol—Teeth.
2162. J. T. Pitman, 67, Gracechurch-street—Screw wrench. (A communication.)
2166. R. Robey and G. L. Scott, Lincoln—Boilers.
2168. J. Good, Lincoln—Straw shakers of thrashing machines.

*Dated 29th September*, 1855.

2172. W. B. Herapath, M.D., Bristol—Surgical instruments.

*Dated 1st October*, 1855.

2176. J. Gedge, 4, Wellington-street South—Braid. (A communication.)
2178. J. Gedge, 4, Wellington-street South—Preservation of grain. (A communication.)
2182. G. Wilkinson, Poplar—Steering apparatus.
2186. J. F. V. Augier, Paris—Extracting aroma from plants and flowers.
2188. T. Dickins, Middleton—Doubling and throwing silk, &c.
2190. G. C. Hope, Hastings—Producing designs upon textile fabrics for the purposes of needlework.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed October 9th*, 1855.

783. Auguste Edouard Loradoux Bellford, Essex-street, Strand—Improvements in pumps. (A communication.)
789. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in machinery or apparatus for preparing cotton and other fibrous substances. (A communication.)
797. James Fletcher, Facit, near Rochdale—Improvements in and applicable to machines for spinning and weaving cotton, wool, and other fibrous materials.
799. Jean Vincent Marie Dopter, Paris—Improvements in printing fabrics.

*Sealed October 12th*, 1855.

809. Alfred Thomas Richardson and George Mallinson, Manchester—Improvements in the manufacture of certain piled fabrics.
815. Jean Baptiste Bagary and Claude Perron, Paris—Improved knitting machinery.
823. George Turner, Northfleet—Improvements in the construction and fitting of tents and marquees.
892. William Hadfield, Manchester—Improvements in looms for weaving.
900. William Charles Theodore Schaeffer, Bradford—Improvements in the treatment of the waste wash waters of wool and other mills.
926. John Black, Hampstead-road—Improvements in axles, shafts, and bearings.
936. Samuel Draper, Lenton, near Nottingham—Improvements in apparatus for retarding and stopping railway trains.
1098. William Fawcett, John Lamb, and Francis Best Fawcett, Kidderminster—Improvements in the manufacture of carpets and other similar fabrics, and in machinery and apparatus to be used therein.
1268. Peter Augustin Godefroy, 3, King's-mead-cottages, New North-road, Islington—Improvements in the treatment of gutta percha.
1540. Emile Kopp, Accrington—Improvements in mordants used in printing and dyeing.
1550. John Coulson, Penzance—Improvements in apparatus for ventilating mines, which improvements are also applicable to other purposes where ventilation is required.
1604. Adam Burdess, 763, Old Station, Rugby—Improvements in the construction of oil feeders for lubricating machinery.

*Sealed October 15th*, 1855.

836. John Cowley, Quennington Paper Mills, Gloucestershire, and Daniel Peyton Sullivan, Stockwell—Improvements in the manufacture of paper.
845. Edward Ellis Allen, 376, Strand—Improvements in steam engines.
846. Phillip Levy, Edinburgh—Improved wrapper for travelling and personal wear.
873. William Savory, Gloucester—Improvements in machinery for crushing grain and other substances, and for cutting chaff.
875. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture of articles of hard india rubber or gutta percha, or compounds thereof, and in coating or covering articles with the like materials.
881. Claude Laurent Victor Maurice, St. Etienne (Loire)—Improvements in carbonizing coal and in apparatus to be employed therein.
895. William Prior Sharp and William Weild, Manchester—Improvements in the manufacture and in machinery for the manufacture of spun or thrown silk threads.
901. Samuel Walsh and John Henry Brierley, Stannary Works, Halifax—A clasp or fastener for belts, bands, or straps.

## Patents on which the Third Year's Stamp Duty has been Paid.

*October 8th.*

330. Henry Moorhouse, Dewton, Lancaster—Improvements in machinery or apparatus for cleaning woollen, cotton, or linen rags and waste, which machinery or apparatus is applicable to cleaning and tempering clay or other similar purposes.
356. Joseph Robinson, Southampton—Improvements in ventilators.
557. Robert Mallet, Dublin—Improvements in fireproof and other buildings and structures.

*October 9th.*

357. Thomas Barnabas Daft, Isle of Man—Improvements in inland conveyance.
358. William H. Smith, Montgomery and State of Pennsylvania, America—Improvements in the manufacture of lava ware.
426. George Wilson Lenox, Billiter square, and William Roberts, Millwall, Poplar—Improvements in machinery for raising and lowering cables and other chains.
432. Edwin Heywood, Glasburn, York—Improvements in looms.
464. John Gilbert and Samuel Nye, 79, Wardour-street—Improvements in mincing meat and other substances.
731. Edward Davy, Crediton—Improvements in the preparation of flax and hemp.

*October 10th.*

382. William Chisholm, Holloway—Improvements in the purification of gas, and the obtention of certain products during the process of such purification.
396. James Lochhead, Kennington, and Robert Passenger, Union-street, Southwark—Improvements in the manufacture of glass and other vitrified substances, and in ornamenting and annealing the same.
413. Charles Tiot Judkins, Britannia Works, Manchester—Improvements in machinery or apparatus for sewing or stitching.

*October 11th.*

362. William Tatham, Rochdale—An improved mode or improved modes of preventing accidents on railways.
370. Robert Pinkney, 26, Long Acre—Improvements in cases for holding marking materials.
430. Richard Archibald Brooman, 166, Fleet-street—Improvements in vices.
452. John Carnaby, 130, St. John-street, Clerkenwell—Apparatus for turning, managing, and regulating the main taps of gas-pipes laid on to houses or buildings at a part of the house or building distant from the main tap.
489. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in apparatus for essaying silk, cotton, and other similar fibrous substances. (A communication.)

*October 12th.*

366. Joseph Nash, 3, Thames-parade, Pimlico—The treatment and refining of sugar.
374. Christopher Hill, Great Western Railway, Swindon—Improvements in the manufacture of lubricating matters.
380. Alfred Augustus de Reginald Hely, Cannon-row, Westminster—An improved waiter or tray.
384. Joseph Henry Tuck, Pall-mall—Improvements in stuffing-boxes, and in packing to be used in stuffing-boxes, bearings, pistons, and valves.
406. Andrew Blair, Mary-hill, Lanark, N.B.—Improvements in printing or ornamenting fabrics.

*October 13th.*

409. Evan Leigh, Manchester—Improvements in machinery or apparatus for carding cotton and other fibrous materials.
493. George Price, Birmingham—Improved gas stove.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3765 | October 11. | Improved Pack-saddle | Joseph Stoker | 57, Old-street. |
| 3766 | ,, 12. | A Socket Bush for Blocks | Winnal Thomas Dalton & Son | Narrow-street, Ratcliff. |
| 3767 | ,, 13. | Paragon Portmanteau | Leake and Dodds | 35, Wigmore-street. |
| 3768 | ,, 13. | Lever Counterpoise | Crichley, Wright, and Co. | Burton-Weir, Sheffield. |
| 3769 | ,, 17. | Self-adjusting Window Frame for Carriages | William Blackford | 19, John's-terrace, Camberwell-gate. |

Journal of the Society of Arts.

*FRIDAY, OCTOBER* 26, 1855.

## GENERAL MEETING.

Friday, October 19, 1855.

A General Meeting of the members, specially convened for the purpose of altering and revoking the existing Bye-laws, and making others in their place, was held on Friday, the 19th instant, the Rev. Dr. Booth, F.R.S., Chairman of Council, in the chair.

The Secretary read the Bye-laws under the authority of which the meeting was convened, the notice convening the meeting, together with a copy of the motion intended to be brought forward at this meeting, which had been duly suspended in the Society's rooms during the seven days previous, and also the notice of the meeting, which had been twice duly advertised in the *Times* and *Daily News* newspapers.

The following motion, of which notice had been duly given, was proposed by Mr. Joseph Glynn, F.R.S., and seconded by Mr. G. F. Wilson, F.R.S., and carried unanimously:—

"That the existing Bye-laws be revoked, and that in the place thereof the following be the Bye-laws of this Society."

### BYE-LAWS.

#### I. The President.

1. The President shall be elected annually.

#### II. The Vice-Presidents.

2. The number of Vice-Presidents shall not exceed twenty, and they shall be elected annually.

#### III. The Treasurers.

3. The Treasurers shall be elected annually.
4. They shall have the custody of the Common Seal.
5. All moneys except investments, and except a sum not exceeding thirty pounds, shall be kept at the bankers of the Society, in the joint names of the two Treasurers, who shall thereout, by cheques on such bankers, signed by either of them, and countersigned by the Secretary, discharge such liabilities of the Society as shall severally exceed five pounds.
6. No cheques shall be drawn without a previous vote of the Council.
7. All receipts shall be signed by one of the Treasurers.

#### IV. The Council.

8. The Council shall consist of the President, the Vice-Presidents, the Treasurers, and twelve other members of the Society.
9. It shall, at its first meeting elect, by ballot, a Chairman. The Chairman of the preceding year shall not be re-elected to that office.
10. The Chairman of the Council shall deliver an address to the Society at its first ordinary meeting after his election, declaratory of the policy which the Council propose to follow during its year of office.
11. The Council shall nominate all Committees.
12. The Chairman shall be *ex officio* a member of all committees.
13. It shall be the duty of the Council to prepare the balloting-list in the manner hereinafter provided and directed by the bye-laws.
14. A Special Meeting of the Council shall be called by the Secretary on the requisition of the Chairman, of a Treasurer, or of any three members thereof.
15. At all meetings of the Council three shall be a quorum, except when otherwise directed by these bye-laws.
16. The Common Seal of the Society shall not be affixed to any deed or instrument except on the authority of a previous order or resolution of the Council, and in the presence of the Chairman or one of the Treasurers, and of the Secretary.
17. No order or resolution for affixing the Common Seal to any deed or instrument shall be valid unless made or passed at a meeting of the Council specially summoned for the purpose, at which not less than six members of the Council shall be present.
18. The Council shall have power to suspend the Secretary or Collector and Financial officer from his duties.
19. The Secretary or Collector and Financial officer shall be dismissed only by a vote of a General Meeting on the report of the Council, which shall alone be competent to convene such meeting.
20. The Assistant Secretary shall be appointed by the Council.

#### V. The Auditors.

21. There shall be two Auditors of Accounts.
22. The Auditors shall examine the accounts of the Society, and call for such vouchers and receipts or other information with respect to them as they may think fit, and shall examine the Annual Statement of Receipts, Payments, and Expenditure, and of Assets and Liabilities, and report thereon to the Annual General Meeting.
23. The Auditors may attend the meetings of the Council.

#### VI. The Secretary.

24. There shall be a paid Secretary elected annually, and an Assistant Secretary if necessary, who shall not be members of the Society.
25. The Secretary, or the Assistant Secretary if required, shall attend all meetings of the Society, the Council, and the Committees; and discharge all duties which usually appertain to the office of Secretary.
26. The Secretary shall issue all the notices of meetings, and shall prepare, under the direction of the Council, an Annual Report of the state of the Society.
27. He shall also have the charge of the house, furniture, library, pictures, papers, models, and other effects belonging to the Society, and be bound to keep a correct inventory thereof.
28. He shall lay before the Council all communications addressed to the Society, and under the direction of the Council shall conduct the correspondence and business of the Society. He shall *ex officio* be the responsible Editor of the Society's Journal, and shall superintend through the press all papers printed by order of the Council.

#### VII. The Collector and Financial Officer.

29. There shall be a Collector and Financial Officer, elected annually, who shall not be a member of the Society.
30. He shall give security to the satisfaction of the Council, for the faithful discharge of his duties.
31. He shall collect the subscriptions and other monies from the members as they become due, and shall pay the same into the Society's bankers whenever they shall amount to thirty pounds, and report such payments to the next meeting of the Council.
32. He shall attend at all meetings of the Society, and shall superintend the ballot for members.
33. He shall attend the meetings of the Council when required.
34. He shall from time to time prepare lists of those members whose subscriptions are in arrear, and report the same to the Treasurers.

35. He shall, under the direction of the Treasurers, keep the accounts of the Society.

VIII. Committees.

36. The Council shall proceed, as soon as convenient after the Annual General Meeting, to form lists of those who may be considered specially eligible to serve with others on such Committees of reference as may be appointed from time to time. To these committees the Council may refer for examination, advice, and report, such discoveries, inventions, improvements, and novelties, in Arts, Manufactures, and Commerce, and other matters, as shall from time to time be brought under its notice. The names of the members so selected to serve on the several Committees of reference shall be published in the *Journal* of the Society, and due notification of the Council's desire to obtain their co-operation and advice shall be given to each member.

37. The Council shall from time to time nominate such other Committees as may be necessary.

38. No act, order, or resolution of any Committee shall bind the Society, unless it be done or made by the direction and authority of the Council, or be ratified by them.

39. It shall be competent for the Council to invite the co-operation of persons not members of the Society, but who are eminent in Arts, Manufactures, and Commerce, and in the applications of science to their development, and to associate such persons with the Committees of reference.

IX. The Annual General Meeting.

40. There shall in every year be held one General Meeting of the Society, to be called the Annual General Meeting.

41. This Meeting shall be held on the last Wednesday in June of each year, and the chair shall be taken at four o'clock in the afternoon.

42. At this Meeting the Council shall render to the Society a full account of all their proceedings, and a statement of the funds of the Society, and of the Receipts, Payments, and Expenditure during the past year, and a copy of such statement shall be published in the *Journal* of the Society on the Friday before such General Meeting.

43. At this Meeting, the President, the Vice-Presidents, the Treasurers, with the other Members of the Council, the Auditors, the Secretary, and the Financial Officer, shall be elected in the manner and form laid down in Sec. XIV.

44. At this Meeting there shall be no election of members or any other business whatever transacted, other than that specially appointed by these bye-laws, unless notice thereof in writing, containing a clear statement of the business to be proposed, and signed by two members, shall be delivered to the Secretary two days before such Meeting.

45. Notice of the holding of the Annual General Meeting, shall be given in the Society's *Journal*, and in one of the London morning papers.

46. The Council shall have power to hold the Annual General Meeting on the next or next but one following Wednesday at the same hour, should they consider it necessary so to do. But in such case, they shall give seven clear days' notice of such Annual Meeting, twice in two of the London morning papers of general circulation, and also in the Society's *Journal*.

47. None but members, officers of the Society, or persons specially invited by the Council, shall be permitted to be present at the Annual General Meeting.

48. At this Meeting the chair shall be taken by the President, the Chairman of Council, or one of the Vice-Presidents.

X. General Meetings.

49. At General Meetings the chair shall be taken by the President, or in his absence by one of the Vice Presidents, or by the Chairman of the Council, or in their absence by some member to be chosen by the meeting.

50. The Council may convene a General Meeting for any special purpose whenever they think necessary.

51. The Council shall convene a General Meeting, for a special purpsoe, upon a requisition to that effect signed by not less than twelve members of the Society.

52. Notice of every General Meeting for a special purpose, and of the purpose for which it is convened, shall be hung up in the Society's room seven days previous to the holding thereof, and advertised during that interval in the Society's *Journal*, or elsewhere.

53. No business shall be transacted at a General Meeting for a special purpose other than that for which it shall have been convened.

54. No Member whose subscription is in arrear shall be entitled to be present, debate, or vote at any General Meeting.

55. Motions made at General Meetings of the Society shall be in writing, and signed by the mover and seconder.

XI. Of the Session and the Ordinary Meetings.

56. The Session shall commence on the third Wednesday in November, and shall end on the last Wednesday in June.

57. There shall be Ordinary Meetings of the Society on every Wednesday evening at eight o'clock during the Session, unless otherwise directed by the Council.

58. At each of the Ordinary Meetings, a paper or papers on some one or more subject or subjects relating to inventions, improvements, discoveries, and other matters connected with Arts, Manufactures, or Commerce, or the encouragement thereof, shall be read and discussed.

59. No decision on the merits of the papers so read shall be taken at the meeting.

60. No business of any kind, other than the foregoing, shall be transacted at such Ordinary Meetings, except the proposition of candidates and the election of members.

61. No paper shall be read at an Ordinary Meeting of the Society unless it shall have been approved of by the Council, but this approval shall not be taken as expressing an opinion upon the statements made or the arguments used in such paper.

XII. Of the Admission of Members, &c.

62. Candidates for admission as Members must be proposed and recommended by not less than three Members of the Society, according to the form following:—

"We hereby propose and recommend" [*here state Christian name, rank, profession or business, and usual place of residence of the Candidate*] "as a fit and proper person to become a Member of the Society for the Encouragement of Arts, Manufactures, and Commerce." [*Here must follow the signatures of three Members of the Society, one of whom must have personal knowledge of the Candidate.*]

The paper thus signed shall be read at an Ordinary Meeting of the Society, and afterwards hung up in the Society's room until the second following Ordinary Meeting, when the Candidate shall be balloted for; and if three-fourths of the Members then balloting shall vote in his favour, he shall be declared elected a Member.

63. Every person so elected, on paying his first annual subscription, shall thereby become a Member of the Society, and his name shall be inscribed in the register of Members.

64. No person shall be entitled to any of the privileges of a Member, until he shall have paid his annual subscription, or such other sum as is specified by these bye-laws as a composition in lieu of annual subscriptions, and shall have signed the following Form:—

"I, the undersigned, having been elected a Member of the Society for the Encouragement of Arts, Manufactures, and Commerce, do hereby promise that I will submit and conform in all respects, and be governed by the terms and provisions of the Charter and the Bye-laws made in pursuance thereof; provided that whenever I signify in writing to the

Secretary that I am desirous of ceasing to be a Member thereof, I shall be free from this obligation, after payment of any Annual Subscription or arrears which may be due from me at that period."

65. The annual subscription of every Member shall be Two Guineas at least.

66. Every Member elected previous to the 15th day of March, 1848, shall continue to be liable to pay the same subscription or other sum that he would have been liable to pay under the previous rules and regulations of the Society, if the same had not been repealed.

67. The annual subscription becomes due in advance, and is payable for each year at its commencement, such commencement to be reckoned from the quarter-day next preceding the day of election.

68. Any Member may commute or compound for all future payments, and become a member for life, by payment of a sum of not less than Twenty Guineas.

69. Ladies may be elected Members.

70. The Council shall have power in each year to admit five persons eminent in Arts, Manufactures or Commerce, or in the application of abstract Science to the same, as Life Members of the Society, without the ordinary formalities of election, and without payment of any subscription whatever.

71. Foreigners and persons not residing in Great Britain or Ireland, duly proposed and elected, may become Corresponding Members, without payment of any subscription, and may attend, but not vote at General or Ordinary Meetings.

72. Due notice of their election shall be sent immediately to the newly-elected Members, together with the Form of assent (64) for signature.

73. Every Member shall continue such, and be liable to pay his subscription, until he shall have complied with the following bye-law.

74. Any Member desirous of withdrawing from the Society must give notice in writing of his desire to that effect to the Secretary, and on payment of all subscriptions and arrears which may be due from him up to that period, he shall thenceforth cease to be a member of the Society.

75. If the annual subscription of any Member residing in the United Kingdom shall be in arrear for three years, the Collector and Financial officer shall give notice thereof to the Member; and if the said subscription shall continue in arrear at the expiration of six months after such notice, the Council having through the Secretary given the defaulting Member due notice of their intention, shall have power to strike the name of such Member off the register, and he shall thereupon cease to be a Member of the Society.

76. Any person whose name shall have been struck off under the fore-going bye-law may, on payment of his arrears, be re-admitted by the Council.

77. It shall be the duty of the Treasurers to recover from persons who shall have ceased to be Members, any arrears which may remain unpaid.

78. A meeting of the Council, consisting of not less than five members, shall have power to remove any member from the Society, upon receiving a requisition to that effect, with the reasons stated, signed by not less than twenty members of the Society.

79. Every Member whose subscription is not in arrear is entitled—

To be present at, and take to part in, the proceedings of all the Ordinary Meetings of the Society, and to introduce visitors at such Meetings, subject to such rules as the Council may frame from time to time.

To be present at and to vote at the Annual and all other General Meetings of the Society.

To receive the Society's Journal.

To introduce, either personally or by note addressed to the Secretary, any number of friends to inspect the models, paintings, and works of art in the Society's house, between the hours of ten and four o'clock on any week-day, except Wednesday, and such other days, and under such conditions, as the Council may direct.

To the use of the Society's library, and to borrow books therefrom, under such regulations as the Council shall from time to time prescribe.

The Society's house will be closed to visitors during the month of September.

### XII. Associated Institutions.

80. The Council may admit into union with the Society, Literary and Scientific Institutions, Philosophical Societies, Mechanics' Institutions, Chambers of Commerce, and other Societies whose primary objects shall be the promotion of Arts, Manufactures, and Commerce, the Chartered objects of this Society.

### XIV. Election of Officers.

81. The President, the Vice-Presidents, the two Treasurers, and the twelve other members of the Council, the Auditors, the Secretary, and the Collector, shall be elected annually by ballot, at the Annual General Meeting for the election of officers, as in Sec. IX. appointed to be held, and shall go out of office at the next Annual General Meeting.

82. Previous to the Annual General Meeting the Council shall by ballot prepare a list of persons to be President, Vice-Presidents, Treasurers, and other members of the ouncil, Auditors, Secretary, and Collector and Financial officer, for the ensuing year, and such list shall be framed as follows, viz.—

a. To contain the name of one member of the Society as President.

b. The names of twenty members of the Society as Vice-Presidents, provided that four at least shall not have served the office of Vice-President during the then current year.

c. The names of two members of the Society as Treasurers for the ensuing year, provided that one of them shall not have served the office of Treasurer during the then current year.

d. The names of twelve members of the Society as members of the Council for the ensuing year, provided that four at least of such twelve persons shall not have served on the Council at any time during the then current year of office.

e. The names of two members of the Society as Auditors for the ensuing year, provided that one of such members shall not have filled that office during the then current year.

f. The names of the persons proposed respectively to fill the offices of Secretary and Collector and Financial officer, one name for each office; such persons not to be members of the Society.

83. The list so prepared shall be suspended in the Society's room for seven days previous to and until the General Meeting, and shall be the balloting-list at such General Meeting.

84. The balloting list shall be published with the Journal of the Society on the Friday previous to the day of election, and a copy sent to every member of the Society.

85. The ballot shall be taken at the Annual General Meeting, and shall remain open not less than one hour, and shall take place in the following manner:—

The Council shall cause to be provided for the use of members voting thereat a sufficient number of copies of the balloting-list; and no other balloting-lists than those so provided shall be received.

Every member intending to vote at the election of officers may, if he shall think fit, erase any name or names from such balloting list, and may substitute in the place thereof the name or names of any other duly qualified person or persons, and shall hand in to the Chairman such balloting-list as aforesaid, either with or without such erasure and substitution of names.

On the receipt of such list from the voter, if the voter's qualification to vote be not objected to, or if objected

to, and the Chairman shall be satisfied that the voter is duly qualified, the Chairman shall deposit such list in the balloting-box. The decision of the Chairman in the matter shall be final.

Two Scrutineers shall be nominated by the Chairman, who shall examine and cast up the votes, and report the names of the persons so elected and the number of the votes to the Chairman, who shall thereupon declare the same to the meeting.

Any balloting-list containing a greater number of names proposed for any office than the number to be elected to such office, shall be absolutely and wholly void, and shall be rejected by the Scrutineers.

If the votes in any case be equal, the Chairman shall give the casting vote.

86. In the event of a vacancy occurring in the Council, or in the office of Auditor, Secretary, or Collector and Financial officer, the Council shall duly fill up the same till the next Annual General Meeting.

XV. Alteration of Bye-Laws.

87. Bye-laws may be altered, varied, or revoked, and new and other bye-laws made, at General Meetings only.

88. No motion to alter, vary, or revoke any existing bye-law, or make any new or other bye-law, shall be entertained by a General Meeting, unless the same shall have been proposed by the Council; or unless notice in writing, signed by twelve Members containing the substance of the proposed motion for altering, varying, revoking, or making any new or other bye-law shall have been given to the Secretary ten days at least previous to the holding such General Meeting.

## ON NEW FARINAS AND STARCHES.

By P. L. Simmonds.

I cannot but think that too little attention has been given to the subject of utilizing, in a commercial point of view, the very many edible seeds, fruits, and roots, of the Colonies which yield farinaceous substances, and a stimulus might probably be given to production for export of many useful and cheap farinas and starches, which would prove useful both for food and for the services of our manufacturers, who now trench largely upon grain for starches for stiffening purposes.

The tuberous-rooted plants—the varieties of yams, eddoes, cocos, &c., are exceedingly numerous and exceedingly prolific. I learn by recent advices from Jamaica, and I know it from experience of old, that there are parts of that island and of many others, such as Trinidad, and I may also name Demerara, where the yams are raised so abundantly, that although they send much to other localities, they grow more than they can find a market for, and hence they are obliged to feed the hogs on them.

The yam hills and provision grounds could be made to yield much more if it were generally known that excellent bread may be made out of the meal or flour, and that a demand could be created in England for the meal.

At a late meeting of the Council of the Jamaica Society of Arts, a small quantity of loaves was produced, made from yam flour, under the superintendence of John Daughtrey, Esq., of the Kingston Penitentiary, which were pronounced excellent by all who tasted them, and the following were the directions given for making the bread:—

"Take one lb. of flour of white yam, (which is prepared by slicing, drying, and beating in a mortar, and is then passed through a sieve, or prepared in the same way as arrowroot,) out of which take five ozs. and make a leaven. When the leaven is fit for use, add the remainder of the yam flour and mix it into a dough, then add four ozs. of wheaten flour; rub them up together and the bread is prepared. The reason of adding the wheaten flour is to make the yam flour knit together."

At the monthly meeting of the Society of Industry for the parish of Hanover, held at Lucea, Jamaica, on the 7th of August, the hint was also worked out. Mr. Gordon produced 3 lbs. of flour made from 25 lbs. of the negro yam by grating, which was perfectly white and pure, and it was stated that the refuse of the yam, after undergoing the grating process, was still valuable for feeding stock, and even for human food.

The secretary, Mr. W. Browne, also produced several new kinds of flour. Two specimens from the negro yam; one made by grating, as arrowroot is usually made, and another, coarse kind, produced by beating the yam (after being sliced and dried in the sun) in one mass. Cakes made from this latter description of flour were produced.

Two specimens of flour from the bread fruit were also shown, made in the manner above described.

Cakes made from the plantain without any admixture of flour were also produced. The fruit was merely cut up, dried, and pounded.

A cheap grating or rasping machine for roots for making starches is much required, and I have had frequent applications for such an one from colonists. Attention is now being paid to the production of arrowroot in Honduras, Natal, Moreton Bay, and other colonies, and a specimen of arrowroot I received a day or two ago from Natal, will compare favourably with most of the West India starches for colourand grain.

Ceylon has also gone into the manufacture, and if some of our merchants would give encouragement to the introduction and sale of arrowroots, tapiocas, cassava flour, batatas, sagos, &c., they might be much cheapened and employed for many other purposes even than nourishing food for the rising population.

The high prices commanded by grain in Europe, renders the present a remarkably favourable time to ascertain what can be done in this branch of tropical agriculture.

The sweet potato (*Convolvolus batatas*) of Linnæus, is another common root in the West Indies, and one of the most valuable vegetables of the Southern States, but not so generally prized or cultivated as it ought to be. The crop is always sure,—at least I have never heard of any blight befalling them. They are easily cultivated, and, with proper care, may be kept through the winter and spring, till new ones come. There are several varieties, and some of them grow to a great size, weighing several pounds.

The French horticulturists have been experimentalising successfully in the introduction of several new tuberous roots to aid the potato. Several of these, and a variety of other useful plants, for food and manufacturing purposes, I called attention to a year ago, in my work on the Commercial Products of the Vegetable Kingdom.

The green bitter cassava, when properly cultivated, will yield 25 tons to the acre, and this will give one fifth of its weight in starch. Five tons of starch, at say 6d. the pound, would give £56 per acre. Such a return as this would enable the West India colonies to inundate Great Britain with food, and at a rate which would make flour be considered a luxury. The meal of the cassava is in extensive use all through Africa and the Antilles, and is almost the only kind of farina used in Brazil. It is the moussache of the French colonies, and sometimes comes into commerce under the name of Brazilian arrowroot.

The coco or eddoe (*Arum esculentum*) is the chief support of the negroes.

Although seldom cultivated with much attention or care as to the amount of yield, an acre of land is capable of producing 4½ tons of yams and the same quantity of sweet potatoes within the twelve months, or nine tons per acre, whilst, as an article of food, the tropical root is twice as nutritious as the ordinary potato. Some mode might probably be adopted of drying these roots for export. In Peru, potatoes are dried by the severe frosts in

the mountains, and powdered; they are called chimo, and will keep for any length of time. Another plan there is to boil and peel them, and dry them in the sun.

Various species of Canna furnish the large shipments of amylaceous substance imported from the West Indies under the name of Tous les mois. The manner in which salep has been cheapened by the introduction of other equally useful feculas shows the importance of greater attention to this profitable branch of tropical culture.

People in general know but little how much of the staff of life is consumed in stiffening their collars. In the United States the production of starch is on an enormous scale. There is one starch factory at Oswego, in New York, the buildings connected with which cover nearly three acres of ground, and where they consume 200,000 bushels of Indian corn, and turn out 4,000,000 pounds of pure starch, and 300,000 pounds of pulverised, for culinary purposes, annually; and yet they are unable to supply the demand. The process is extremely simple. The corn is first soaked in pure water, then ground, and passed between heavy iron rollers, which press out the gluten, and all diluted with filtered water, passed off into vats, of which there are 284, holding 280,000 gallons. It is then left for a few minutes to settle, when the starch-water, drained off by syphons, is passed into other vats, where it is left until the starch settles in cakes at the bottom. The water is then drawn off, and the starch, cut up in blocks, is placed in the drying-house, heated by steam, and afterwards prepared for putting up. Potatoes, as is well known, are also largely consumed for starch both in America and on the continent. One manufacturer at Hampden, in the United States, uses 2,500 bushels per day. Another manufacturer at Mercer, Maine, grinds from 16,000 to 24,000 bushels annually, and makes 140,000 to 240,000 lbs. of starch. In a single district in Bavaria, 400,000 lbs. of sago and starch are made from potatoes, 100 lbs. of the root furnishing about 12 lbs. of starch; in some kinds analysis shows 15 per cent. of starch, and the proportion of water in the root is about 75 per cent.

In the East, arrowroot is obtained in large quantities, and new sources of farinaceous supplies are daily being found; witness the zamias of St. Domingo and Western Australia.

The per centage of starch yielded by the different tropical roots, according to the investigations of Dr. Shier at Demerara, were as follows (but, as a matter of course, the quantity yielded will vary with the season, the soil, the climate, age, ripeness, and length of time the roots have been out of the ground):—Sweet cassava, 27 per cent.; bitter ditto, 16 to 25 per cent.; common yam, 24½ per cent.; arrowroot, 17 to 21½ per cent.; Barbados yam, 18¾; tannia (*Caladium sagittefolium*), 15½ to 17; Guinea yam 17; buck yam, 14 to 16; sweet potato, 16½; plantain meal, 17 per cent. In view of the largely extended culture of the plantain by companies now organising for its fibrous products, it is worth while to consider what uses its meal may be applied to as a commercial article. As food for children and convalescents it would probably be much esteemed in Europe, and it deserves a trial on account of its fragrance, and its being exceedingly easy of digestion. In respect of nutritiveness, Dr. Shier classes it above the pure starch, on account of the proteine compounds it contains. The sun dried cores might be exported, leaving the grinding and sifting to be performed at home. 20 to 25 per cent. of meal is obtained from the plantain, or 5 lbs. from an average bunch of 25 lbs.; and an acre of plantain walk, of average quality, producing during the year 450 such bunches, would yield over a ton of meal, this, even at 6d. a lb., would be a gross return of £56, exclusive of the stem for fibre and paper. The riper fruit, dried in the sun, as in Mexico, where it is known as *plantado pasado*, would sell readily at home.

5, Barge-yard, City, Oct. 25th.

## ON VESSELS OF WAR.

By Lady Bentham.

Whether a given amount of force be the more efficient if concentrated in large vessels of war, or whether if divided in a number of small vessels, is a question that seems worthy of more ample discussion than it has yet received. The subject was indeed considered by the late Brigadier-General Sir Samuel Bentham, in his "Naval Essay," p. 68 to 90, and as that essay is extremely rare, an abstract of it may not be unacceptable to readers of the *Journal of the Society of Arts.*

Sir Samuel stated his observations on the matter under the head of "General Efficiency of the Vessel of War." He enumerated the several advantages of large vessels, and then specified those resulting from a division of a given force in small vessels, those vessels being of a light draught of water, and armed with ordnance of a large calibre. He first mentions, as the chief objects of vessels subservient to naval warfare: the distressing the enemy "on his own coasts" and interior waters, as well as on the "open sea;" the defence of our own country against hostile attacks, by impeding the navigation of the enemy's commercial vessels; the protection of the commerce of our own country; the prevention of contraband trading; the conveyance of the military personnel; the transmission of orders." These various services may well, he says, be supposed to require different descriptions of vessels, nevertheless it must appear highly desirable that every vessel, when prepared for one of these services, should at the same time be more or less fit for the other services.

The chief desiderata in a vessel of war are as follows:—warlike force, "accessibility to all places to which navigation can be extended," spaciousness of stowage room, power of locomotion, strength of structure, continuance of efficiency, including security against destruction.

Considering that the armament of vessels actually employed in naval warfare varies from a single gun to "as many as 120" (now still more), "and that, if requisite, the bulk of a vessel might be increased so as to admit of a far greater number, it seems highly important to investigate the advantages and disadvantages of large and small vessels."

"In favour of large vessels mounted with many guns," * * * it may be said that "their action is concentrated, and therefore more efficient when the attack is directed against one particular object," that some of the guns in a large vessel are in a more elevated position than they can be in a small one, therefore may in some cases be rendered more efficient; that the guns may be traversed for the purpose of taking aim, the large vessel being less tossed about than a small one in a rough sea; that the sides of a large vessel are thicker than those of a small one, therefore are better protected from the enemy's shot; that the large vessel may be more susceptible of locomotion than a small one.

On the other hand, in favour of small vessels it may be observed that, the larger the vessel, the more liable it is to be struck by the enemy's shot, especially when her broadside is turned towards him, as it must be in firing a broadside; supposing the shot thrown by the small vessel to be of a large size, and of the most destructive kind in use, a single one of such shot may be sufficient to destroy even the largest ship; that in all small vessels, above what are denominated boats, not more than half the number of guns can be brought to bear upon the enemy; a given number of guns mounted in small vessels, instead of large ones, might either be directed against different parts of the same object, or towards different objects, at pleasure; supposing a single gun, or a few guns only, to be mounted on a small vessel, either at the head or at the stern, and so fixed as either to be elevated or depressed, the horizontal pointing may be effected by directing the vessel itself, whereby the guns may be duly pointed, worked with fewer hands, and fired much oftener in a given time, than if mounted as usual on board a large vessel,—as in the

latter case they must be traversed on the deck by hand-spikes; guns so mounted would be *all* of them efficient in all weathers, whereas no more than half the number can be brought to bear upon an enemy if mounted as usual, on both sides of a ship; in a large ship a less number of guns can be used when the weather obliges the lower deck port-holes to be closed; if larger guns than any now in use should be employed, the mischievous effects of recoil would be less than in a large vessel, since a small one would itself easily yield to recoil; the smaller the vessel, the less likely it is to be struck by the enemy's shot; the destruction of a small vessel would occasion but a small loss of either money or effective force; supposing a fleet of small vessels to be attacked by a superior force, the greater number of them could retreat whilst that superior force was engaged with a single small vessel; small vessels can be rowed, a circumstance of minor importance since the introduction of steam-vessels; the masts of a small vessel can be lowered so as to avoid their destruction; small vessels can lie nearer the wind than large ones; a single well-directed efficient shot is capable of destroying the largest vessels; "when several such small vessels are *united under one command*, they may be arranged in a line, × ×, or in any other figure, conformably to the rules of tactics." "But the greatest advantage of a small vessel in point of efficiency for naval warfare, especially when such bulk as is indispensable is obtained by length and breadth, arises from its capability of being navigated in *shallow water;* its destructive apparatus may be brought to act against the enemy's vessels in the smallest and shallowest of their ports and harbours, unobstructed by the bars and shoals by which the entrance to many of them is closed." "Another advantage of a small vessel, arising from its little draught of water is, superior co-operation to the land-service, bringing the material and personnel close into the shore, affording the protection of guns during the time of debarkation." A small vessel drawing little water may in shallow water often escape the pursuit of a much superior force.

The General then observes that should attention be directed to the employment of vessels drawing little water, the question would present itself of "What is the specific number of guns with which each vessel should be armed? and, what should be the size and draught of water of the vessel?" These questions, he says, can only be decided after investigation of the size and description of shot found to be the most efficient; but for the purpose of forming some idea on the subject, he says, it might be assumed that guns of the largest size known should be employed, as those used for the defence of the Dardanelles, which threw shot of above two feet in diameter, but as this might really be beyond a desirable size, all circumstances considered, he assumes that a shot of eighteen inches diameter would be the largest requisite.

He then alludes to many difficulties which would occur on mounting even so many as ten such guns on board the same vessel, stating that "ten such guns on board of as many vessels, would in most cases be found to constitute a fleet more formidably efficient than any that has yet existed;" that such a fleet could be "built, equipped, and manned, in less time and at less expense than is requisite to provide a single ship of the description now thought necessary for the attainment of the general object of naval warfare."

He then considers the specific size of a vessel suited for armament with such a gun, supposing the services required should not demand an absence of many weeks from a supply of stores, and that it be provided with the established greatest supply of shot and ammunition, a hundred rounds; and says, that although ten or twelve men might be a sufficient crew, yet, doubling that number, "I may venture to mention a length of sixty feet, with an extreme breadth of sixteen, and a draught of water of about four, as amply sufficient for the purpose." But as cases often occur when it is desirable not to destroy, but to capture, an enemy's vessel, it may, he adds, be advisable, in addition to powerful ordnance, to arm such a vessel with a long gun of small calibre, "perhaps a six-pounder turning on a pivot, without recoil, and half-a-dozen very light pieces of the same bore, mounted like swivels, and removable to either side of the vessel." Even smaller craft have been safely navigated in the open sea. He adds, however, that "it does not follow that all the vessels in every armament should be limited to this size."

He then observes that "the chief objections to great bulk apply to the great draught of water, and that no insurmountable objection has yet presented itself to extending the length and breadth of a vessel."

His next consideration is that of fitness for the conveyance of the material and personnel requisite in warfare, a subject not entering into the object of this abstract.

Sir Samuel concludes this subject as follows:—"Should the above considerations render it apparent that small vessels might for most services be made more efficient, as in all cases they would be more economical, than vessels of the largest sizes, still the prospect of abandoning the use of large ships can scarcely be looked upon without sentiments of deep regret. Who that has beheld a first-rate, armed, manned, and under sail, guided in its rapid course by the easy effort of a single hand, can forget the sensations of delight and admiration created by this imposing spectacle? Accustomed to consider such a ship as the finest specimen of perfection in the highest branch of constructive art—as a locomotive engine containing within itself the most complete concentration of warlike force—or as that tower of strength by means of which our national security and honour has been created and maintained—with such sentiments, who would not be anxious for the continuance of its use? And those who have passed the greater part of their lives in these floating castles, who by their skill and valour in the employment of them have gained the highest professional fame, and great national rewards, with what reluctance must not they entertain the idea that these objects of their early attachment are no longer to be depended upon for the support of our naval superiority? Yet it can scarcely be deemed prudent that, yielding to such sentiments, we should neglect the introduction of that description of vessel which investigation shall have shown to be the best for the general purposes of warfare, waiting until its superior efficiency shall have been proved to us by the success of some enemy,—until we may be thus compelled in self-defence to become the followers when we ought to be the leaders in naval improvement."

## Home Correspondence.

### CORT'S INVENTIONS.

No. III.

Sir,—One of your correspondents has proposed the formation of local committees in the seats of the iron trade, to aid Mr. Richard Cort in bringing his unparalleled claims on public justice before the House of Commons in the ensuing session, and that a central committee for concentrating their exertions should be formed of members of the Society of Arts in London. That the successful agitation of measures to obtain redress for the greatest "discouragement" to improvers of "Arts, Science, and Commerce" ever inflicted in the history of merit,—acts more barbarous than the confinement in Paris of the first inventor of the steam-engine as a lunatic,—would redound to the honour of your Society and the objects for which it is instituted, tenfold more than any effort which can possibly at present engage their attention, no one will venture to deny. But the first step towards any success is to have a full appreciation of the difficulties to be encountered. We all know that it is not mere abstract justice, but what is called *influence* and example which

moves masses of men and public bodies. Justice is blindfolded, and sits with the scales to weigh what is brought before her. She is impassible, and, being sightless and seated, cannot move. It was not unaided justice which brought the pillaged inventor his wretched pension of £200 a year. It was the "influence" of Samuel Thornton, M.P., Robert Thornton, M.P., John Hunter, M.P., Alderman Curtis, M.P., Alderman Le Mesurier, M.P., Sir George Jackson, M.P., Brook Watson, M.P., Francis Annesley, M.P., George Smith, M.P., Robert Smith, M.P., Sir Watkin Lewis, William Chute, S. and J. Angerstein, J. Ewer, and S. M. Wilson, bankers and merchants of London, who of their personal knowledge of the high character and conduct of Mr. Cort, and the miserable red-tape treatment, to call it no worse, under which he had been sacrificed as the return for unexampled national benefits, addressed Mr. Pitt in his behalf in 1794, and obtained the paltry pension thus accorded to influence which to justice had been denied. The names of those men are for ever honourable for so using that influence, and we cannot and must not doubt that even out of the limbo of joint-stocks and jobbing which has since been created in the metropolis, that fifteen names equally honourable are at any time ready to lend their influence to vindicate the national honour; but these noble characters *knew* the inventor and the facts; the present difficulty is now, after such a lapse of time, to succeed in impressing such a body of men with the force and sense of the true facts. It is true that lapse of time has magnified, to a degree that would have been deemed incredible, the claims upon public gratitude. Those who will take the trouble to inquire into the realities, know past controversy, that but for the merits of Mr. Cort, the commerce not only of this country but of the whole world would have been comparatively at a stand-still. It is not merely the money saving of 300 millions in the cost of iron in the past 63 years that has to be taken into the account, we have to ask where was the amount of iron which made that value to have come from? If the 75,000 tons of foreign iron imported at the date of these inventions cost an average rate of £35 per ton, where could any supply have been obtained at any price commensurate to the demands of the war which followed? Indeed, I should be glad to hear how that war could have been carried on at all and brought to a triumphant issue but for the gifts of Mr. Cort. A great deal has been said upon the surprising elasticity evinced by the resources of this country during that prolonged struggle. The mechanical skill in appliances developed in numerous manufactures, has been rightly assigned as the supporting principle which imparted that vital energy which threw off increasing burdens "like dew-drops from the lion's mane." *Vires acquirit eundo* was the motto of the tremendous contest, and our machinery was doubtless the prime mover in the energetic march. But whence came that machinery; its rise and its results are admitted as a notoriety, but where were the main-springs of the creation? I say in the inventions of Henry Cort for puddling and rolling bar iron, inventions for which the government gratitude was to plunder him in his life, and the national gratitude to honour the memory of his name by leaving four surviving children advanced beyond the span of threescore years and ten in INDIGENCE. Oh! great dishonour to a nation whose fleets now cover the seas, and whose armies boast to be engaged in vindicating the progress of civilisation from oppressors. Can any man know the facts of the treatment of Mr. Cort and his descendants, and look in his neighbour's face without shame, in the midst of so much pompous hypocrisy? It is only very lately that I have become acquainted with the *full* particulars of the case, and I am appalled at their aspect. Surely those who believe that great crimes are followed by great judgments, and that ingratitude is the blackest stain that can deface God's image, either in the individual or in the aggregate, must look with dread on the outrage and neglect received by that man and his descendants who was the instrument, under Providence, of making this country what it is, and saving it from what it *might have been*. I, for my part, feel a relief in knowing that the opportunity for some atonement is not entirely past. What has *been done* cannot be recalled. We cannot order the declining shadow on the dial of life to go back even one degree; it is but little that now remains to do for the future, but that little *is possible*, and every true lover of his country may thank God that He has yet spared us some living altars where offerings of expiation may be laid. Examine without evasion or extenuation the simple facts. The price of iron of a serviceable quality before the commencement of the last war, was £35 to £40 per ton, *and we were dependent on foreign countries for that supply* for the mere ordinary demands of our shipping, and the then by comparison infinitely limited home consumption. Now, I ask, what after half a dozen years of that war would have been the price of iron if in the interval Mr. Cort's new machinery had not enabled 20 tons of iron to be made with the same labour, in the same time, previously required to make one ton, and that one ton of a quality useless for the purposes to which the 20 tons equal to the best foreign could be applied? Would £100 a ton have covered in 1800, without Mr. Cort's inventions, the price of serviceable iron, and, subsequently, when the depreciation of our internal currency was at its height, would £200 a ton have covered it? Assuredly not, if it could have been bought at all, to the extent of those innumerable uses which puddling and rolling had enabled us to create. But it neither could nor would have been bought; those uses would not have been created; machines made that vast development of wealth which enabled us to support the war, *but it was Cort's iron which made the machines*. They could never have been constructed by the purchase of the infinitely costly foreign iron. If the steel of our weapons in the field won the immediate victory, it was the *bars of iron* at home which furnished the sinews of the war; and I leave it to statists to disprove if they can this assertion, which I make in the broadest and most unqualified sense, that but for the inventions of Cort it would have been utterly impossible for this nation to have withstood the efforts of the great Emperor who had subjugated Europe, and made its whole combined resources of men and material available for our ultimate conquest. I do not hesitate to say, whether or not it has been said before, that but for the internal resources developed by the inventions of puddling, and especially the rolling of bar iron in grooved rollers, it would have been by a miracle only if this country had not succumbed *before superior force*. God willed it otherwise, and we have rewarded the instrument of his mercy. Rewarded him as national benefactors are wont to be rewarded by *our laurel crowns*. Foudrinier, who by applying a similar process of rolling to the production of paper, wrought a similar development of that manufacture, and has thereby given us the *Times*, was ruined and beggared by our patent laws, though most happy I am to see that the eminent manufacturers have lately been engaged in a subscription for his destitute family.

Now though these facts are not denied, for they are undeniably established by the letters of Mr. Robert Thompson, uncle of the late lamented Alderman Thompson, and of a host of the contemporaries of Mr. Cort, as seen in Mr. Richard Cort's review, that generation of ironmasters has passed away. Multitudes of those now using Cort's processes, know nothing of their origin. Some think that rolling came by nature, and was never invented at all; others are too much occupied in rolling and selling thousands of tons per week, to have time to think who it was that enabled them to do so. Some men of high honour and known liberality of sentiment, feel, as is natural, the claims of private friendship a stronger tie than abstract points of justice, and fear to move in the latter lest censure might be implied in the former. And I find a feeling which it is obvious we might expect, an aversion to *move first* in a matter which has been so long suppressed.

It is a proper and a commendable feeling which dislikes coming prominently forward without some special individual call for doing so, averse to incur an imputation of assumption, or to impute an appearance of past neglect on those he seeks to lead. Only last week it was admitted to me to be a "very bad case, but that it would happen daily if there were as many Corts as days." I trust this is not a fair estimate of our national character, but in the midst of all these ignorances, hesitations, and uncertainties, it has struck me that the most efficacious course for success will be to *begin at the other end.* To convince Government that the pension of £200 a year granted to Mr. Cort, and from which, with a wise economy, £75 was struck off at his decease, the better to comfort his widow for her loss, and enable her to eaucate and provide for a family of orphans, was *not* a full, munificent, and noble recompense in discharge of injury, may prove difficult. To convince the present generation of ironmasters that the £1000 subscribed by their predecessors to that widow, through the manly efforts of Mr. Robert Thompson, was not an ample share of millions of profit then and since derived by the trade, might likewise involve some difficulty. To convince the House of Commons that the Committee of 1812 came to a decision so monstrously opposed to the evidence, as Mr. Cort's review demonstrates, overthrowing the testimony and resolutions of the whole trade throughout the kingdom, to accept the random or inexperienced assertions of two individuals, may likewise involve time and difficulty, and when life is ebbing there is not much time for debate. So also it may need time and powerful arguments to convince the Treasury that the pensions of £19 a year granted to Mr. Cort's two daughters on the demise of their mother, as an appropriate further fragmentary diminution of the widow's mite, is not already an intolerable and ample burden for the crippled resources of this country to bear for so plebian a service as the creation of the iron trade. These three, the Treasury, the Iron Trade, and the Legislature, have already been appealed to, and they have each done something. Whether they are proud of the measure of their gratitude, and are prepared to say, we have done what we could to annoint this inventor to his burying, no one can deny that they have done a little. What, then, occurs to me is that there is yet a fourth estate, which has not been given the opportunity of emulating in this race of gratitude, namely, those to whom Mr. Cort has given neither riches nor poverty, as in the case of the others and himself, but who, through him, feed on their *daily bread.* The working iron-makers have not those difficulties in the way of a natural emotion which beset the

"—— Atlantean shoulders fit to bear
The weight of mightiest monarchies."

They need offend no authorities, censure no friend, by showing that they are grateful. I am mistaken if there is not a spirit amongst them which would feel proud to set the example, even by a penny subscription, of what humble men can do in a public cause. They evinced far more zeal and honourable sense than their superiors of the benefactions of Mr. Cort, when the trials at the dockyards of the puddled and rolled iron declared the independence of Great Britain from that moment of a supply of foreign iron; with a rude impulse, which it would be well if our statesmen were more prone to emulate, they showed their sense of the magnitude of the fact, by carrying the successful discoverer in a procession of triumph. What would these men have then felt to be told that the reward of his triumph was to be the crushing their benefactor by the officials of the nation he had served, and a starving allowance doled out, as if in mockery, to his children. Truly, they would say, Lazarus was not the only beggar who had sat at the rich man's door—a position here infinitely aggravated by the fact of the rich man's wealth being the outcast's gift—that he owed his pomp to the poor man at his gate. Were I to say that a million mouths in this country are daily fed by the deceased Mr. Cort, I should be vastly under the mark. 10,000 tons of iron per day are now produced in Great Britain; not less than 30 men daily are engaged upon each ton of iron in the direct processes of manufacture and in raising minerals, and the collateral and subsequent employment afforded is enormous. None can so well appreciate as the working men employed in the rolling of bar iron what Mr. Cort has done for them. Ask the men who made the vast specimens of rails in the Paris Exhibition when, and in what figure, they would have reached their destination, had there been no other means but forging them with a hammer. The very commonest rails could not have been exhibited even as *tours de force.* Tell these workmen that 70 years since their familiar rolls had no existence, and that it required the same labour and time to tediously forge ten tons of iron into comparatively useless shapes of comparatively worthless quality, which now turns out over 200 tons of rails and other forms that else would have been altogether impracticable. Tell them the author of this benefaction was pillaged by dominant authority, and left to die of a broken heart, under the withering destruction of great and honourable prospects, and that his children, for aught such authorities care, might be left to die in that common receptacle where all distinctions in life are levelled, as a kind preparation for the last levelling in the grave. Rely upon it that strong arms have hearts strong enough not to be terrified at contributing a penny each towards the preliminary expenses that must be incurred in bringing this matter publicly before the nation's representatives. The children of the pillaged cannot afford to do it; they have already had to pay the bootless costs of one such application, for though the Committee engaged they should be paid, a broken faith never permitted it to be done. The honour of the first contributions will lie with the children of those men who bore their benefactor in triumph; the offering, however small, will be the offering of *real* gratitude, not, as heretofore, a miserable compromise of overpowering claims. The numerous Institutions in the provinces in correspondence with your parent head will form admirable local committees for advocating the cause and collecting the subscriptions. It would not be the first occasion on which the generous impulses of the masses (for it is natural, "if nothing checks," for men to thank those who serve them) have set an example to waken eminent and frigid apathy. Some preparation will be made at once for the harder task of driving great camels through the needle's eye, and greatly assist the operation. Your valuable Journal, circulated in these Institutions, will teach the worker how inventors, the parents of his craft, who give bread to millions in every region, are suffered like dogs to gather the crumbs which fall from their own table, the rich banquet which Cort spread for all nations, but especially for our own; and how the Treasury, which he has filled, honours itself by according to the daughters of the man who has created more wealth than ten centuries would have accumulated without him, a maintenance which the most niggardly private gentleman would blush to make the provision of a faithful domestic. These things ought not to be. If statesmen are not ashamed to show an ignorance or indifference of the source of the astonishing fiscal resources during the present century of our sea-girt patch of land, it is in the power of the hands of labour which support the state to make them so, and stimulate apathy to a comprehension of the grandest lesson in political economy. Whether the eminence be in *arts* or *arms*, it is alike discreditable to a nation *highly civilised* to suffer to be heard in its streets the ancient cry, *date obol Belisario.*

I am, Sir,

Your obedient servant,

DAVID MUSHET.

October 16, 1855.

## DECIMAL COINAGE.

Sir,—Your correspondent Mr. Good has, in yesterday's *Journal*, noticed what I am sorry to find he still considers, "a grave *philological* objection to the adoption of the tenpenny system, as advocated by Mr. Theodore Rathbone and others." His former letters, and those which he has done me the favour of addressing to myself, and the useful and interesting correspondence to which they led, induced me to hope, not only that he would have seen the futility of this *grave* objection at all events, but that having in many respects adopted such just and well considered views on this subject, he would have now perceived that *there is and can be but one possible scheme* for carrying them into effect, and *that*, fortunately, *far* the simplest and the most efficient and complete, as well as the easiest of execution, that has ever yet been proposed.

Mr. Good, like Mr. Laurie and Mr. Minasi, both originally avowed and able advocates of the mil system, and indeed in common with almost every one who unites to thorough scientific, *practical* knowledge of figures and of business, and who has ever fairly considered the two modes of proceeding, now admits as a fundamental principle—1st. That "*such a proposal as the millesimal division of the pound, as the basis of a new system, must be abandoned*," and this on grounds which have been again and again fully stated, and hitherto found unanswerable; and 2nd, states, "*that the sacrifice of the pound would be attended with enormous inconveniences, for which the advantages of the best possible decimal system would by no means be an adequate compensation*." And your correspondent, Mr. Gurdon, who writes to call attention to *his* having advocated this millesimal division of the pound in 1852, and who, to use his own words, "swears" by the pound, and seems inclined to swear at all those who would retain the penny, very justly observes, that, 3rdly, in effecting the alteration, "*the less change the less prejudice to be overcome, and the more easily would the new system be comprehended, and, when comprehended, if founded in good sense, the sooner approved*."

Now I would put it to the common sense of any one who has at all carefully and impartially considered the subject, whether, such really being the facts, as so generally admitted on both sides, the required result can be so entirely accomplished, or can be accomplished at all, by any system but that which I have advocated, REQUIRING SOLELY AND SIMPLY THE EXCHANGE OF THE TWELVE PENCE FOR THE TENPENCE AS OUR FUTURE MONEY OF ACCOUNT, that pence and tenpence should become our legal, and hence ordinary and usual form of account. Thus at once rendering all accounts of the poorer and less instructed classes, strictly and absolutely decimal, with accounts of *every* description such as would require no coins but the existing wholly unchanged in value and denomination, and entirely and at once freed from the troublesome duodecimal addition of the pence, but with the pound still retained as the recognised established expression of large amounts, and until this new and *only strictly decimal* system of accounts had become universally familiar, in short, for *every useful* purpose it can ever serve? Would Mr. Gurdon's pound and mil scheme, requiring the abandonment of *all* our present moneys of account but the pound itself, and all our lower coinage, (involving, according to the high authority he quotes, the recoinage of 700 millions of pieces, and a period of at least 20 years to substitute the new coinage for one with which it is *incommensurable*, unexchangeable without remainder), at all meet, as my proposal would, *his own conditions?* And if it is feared that with so little of compulsion and interference, this invaluable, because purely decimal, literally *all ten* form of account, would be confined to amounts and calculations below the £, and although required in legal and official accounts, would not be taught by the schoolmaster and introduced generally into calculations, let any one entertaining such doubts compare the working of *any* common calculation or sum on the two systems, and he will be satisfied by the enormous saving of figures and labour, how rapidly, universally, and certainly, the decimal would make its own way.

I will not trouble you with the figures, but if a fair average example is taken, as for instance, 31 ton, 12 cwt. 2 qr. 14 lb., iron rails at £12 12s. per ton, (not of course by any means so forcible an illustration as one into which *pence* are introduced) it will be found that by "rule of three," as *required* in the government offices, 156 figures are required to make the calculation, and by "practice" (counting the fractions as single figures, and employing every possible abbreviation of the work) 56—whilst working by the decimal system I advocate—our present pence and our present pounds avoirdupois alike advancing by tens,—7085.4 lb. at 1.35 pence per 10 lb.,—gives the result, (£398 11s. $\frac{9}{10}$d.,) *with but* 31, or, as if this and many such calculations could be easily worked with *only* 25 figures.

But Mr. Good, whose laborious and patient attention to the subject is deserving of the highest praise, gives up all present hope of a decimal system, and proposes one in which there would not be a single strictly decimal feature, and thinks that the above mentioned *immense* economy of labour and time, in education and in the business of life, could not be realised, from the *philological* objection of requiring people to say, "two tens for twenty, three tens for thirty, two tens and five pence for twenty-five pence, &c." Can he seriously doubt that when the tenpence had taken the place of the twelve pence in our accounts, the expression six and sixpence (6 × 6d.) would as much and as clearly signify six tens and sixpence (*i.e.* 5s. 6d.) as it now does six twelves; and why, in the name of wonder, should people say "two tens, &c.," instead of twenty pence, thirty pence, or half a crown, &c.," *exactly as they do at present?*

With reference to my suggestion of rendering by "negotiation" the silver coinage of those great leading decimal systems, the franc, the florin, and the dollar, *international, and exchangable with our own and the accounts of all*, to this extent *corresponding*, by, in the first place, as we so easily might, rendering the silver representing the English tenpence and the French franc *exactly identical*, I am much gratified to observe a similar proposal *with respect to the dollar of the United States*, in an excellent statement just printed at Paris, "*Sur le Système Métrique*," by Mr. W. W. Mann. Although a warm and able advocate for extending the decimal system of France into his own country without further delay, for which petitions are about to be addressed to the American Government, Mr. Mann wisely deprecates *unnecessary* interference with their existing monetary system, and proposes, as I have in my scheme, *that they should render their dollar an exact five-franc piece*, notwithstanding that *their dollars* would not, like our silver coinage, be mere tokens representing in exchange only a given portion of our legal tender, the pound sterling. "*Heureusement*," he observes, "*on a en France une pièce en argent, la pièce de cinq-francs, de la valeur, à peu près, de notre* dollar. *Prenons la pièce de cinq francs, du poids et de l'alliage actuels*," &c. And is it at such a time that the advocates of the millesimal division of the pound can hope to induce *this country* to condemn itself to the barbarism of utter and universal isolation by abandoning a scheme of decimalisation *practically perfect* "*both at the top and bottom of the scale*," and at the same time admitting at any future day, if found expedient, any of those unessential points as to which there is any difference of opinion amongst the advocates of the tenpenny system—the introduction of a 250d. gold coin, of the Imperial of 100d., or of the entire and absolute abandonment for the tenpence of the pound sterling as a money of account.

Yours, &c.,

THEODORE W. RATHBONE.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette October* 19*th*, 1855.]

*Dated 20th June*, 1855.

1411. G. M. de Martinoi, Valesolis, Tuscany, and J. F. O. De Lara, Spain—Material for paper.

*Dated 18th August*, 1855.

1876. O. J. Henry, Paris—Bookbinding.

*Dated 30th August*, 1855.

1963. W. Gossage, Widnes—Carbonates of ammonia.

*Dated 1st September*, 1855.

1980. W. Smith, 10, Salisbury-street, Adelphi—Smoke-consumi ng furnace. (A communication.)

*Dated 11th September*, 1855.

2055. T. Heaton, Blackburn—Pumps.

*Dated 2nd October*, 1855.

2192. A. Sands, Manchester—Securing rails in railway chairs.
2194. L. M. R. Péan, Paris—Inkstand.
2196. R. Threlfall and W. Knowles, Preston—Looms.
2198. J. Bernard, Club-chambers, Regent-street—Boots and shoes.
2200. F. F. Benvenuti, Paris—Typography.
2202. G. L. Stott, St. George's, Gloucester—Carbonate of soda.

*Dated 3rd October*, 1855.

2204. W. Ramscar, Manchester—Fire arms.
2206. W. Patterson, Batley, and G. Patterson, Sowerby-bridge—Moistening fabrics for finishing.
2208. J. Dickinson, Old Bailey—Paper.
2210. W. E. Newton, 66, Chancery lane—Separating metals from their ores. (A communication.)

*Dated 4th October*, 1855.

2212. H. Oldham, Leeds—Weaving textile fabrics.
2214. J. Lancaster, Deptford—Waterproof material.
2216. T. H. Ryland, Birmingham—Bracelets, &c.
2218. C. Hardy, Carstairs, N.B.—Communicating between guards and drivers of railway trains.
2220. E. Meldrum and J. Young, Glasgow—Salts of sodium and potassium.
2222. H. Over, Cambridge—Gauge knife.

*Dated 5th October*, 1855.

2224. P. A. Halkett, Windham Club, St. James's—Motive power for cultivation of land.
2226. J. D. Pfeiffer, Paris—Knives.
2228. R. H. Hills, Lewes—Jointed backband for gig or brougham harness.
2230. T. Dickins, Middleton—Silk machinery.
2232. F. C. Le Page, Paris—Compositions as a substitute for wood, leather, bone, metal, &c.

*Dated 6th October*, 1855.

2234. A. Coutinho, Oldham—Motive power.
2236. J. Washington, Batley, near Dewsbury—Chimney-sweeping apparatus.
2238. J. H. Johnson, 47, Lincoln's-inn-fields—Consuming smoke of lamps and gas burners. (A communication.)
2240. H. W. Hart, Birmingham—Cannon for gun boats.

*Dated 8th October*, 1855.

2242. J. Hubbard, Albion-road, Hammersmith—Sole for boots and shoes.
2244. J. H. Johnson, 47, Lincoln's-inn-fields—Transmission and conversion of motive-power. (A communication.)
2246. J. H. Henry, Glasgow—Floating vessels.

*Dated 9th October*, 1855.

2248. R. Willan and D. Mills, Blackburn—Looms. (A communication.)
2250. J. G. Martien, Newark, U.S.—Iron and steel.
2254. J. Murdoch, 7, Staple-inn—Extracting colouring matter from lichens. (A communication.)
2256. E. F. Vion, Paris—Tea or coffeepot.
2258. S. Goldner, Wimpole-street—Cooking and preserving animal and vegetable matters.

INVENTION WITH COMPLETE SPECIFICATION FILED.

2271. Jane Ann Herbert, Guilford—Propeller, denominated the Whinfield or conical propeller. (A communication.)

## WEEKLY LIST OF PATENTS SEALED.

*Sealed October 19th*, 1855.

863. Thomas Lees, Birmingham—Improvements in metallic pens.
864. Edward Howes and Walter Howes, Birmingham—Improvements in carriage lamps.
885. Horatio Allen, Novelty Iron Works, New York—Improvements in the valves of steam and other engines.
898. William Winter, Carlton-hill, Nottingham—Improvements in the manufacture of warp looped fabrics.
902. Alexander Balan, Paris—Improvements in transporting passengers and goods.
904. Joseph Wright, 12, Sussex-terrace, Islington, and Edward Brimble, 32, Cheapside—Improvements in the manufacture of stays or corsets, and in the means or method of fastening the same.
930. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—Improvements in the manufacture of seamless garments or other useful articles of felt.
934. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—Improved lock for sliding doors.
944. Peter Armand le Comte de Fontaine Moreau, 39, Rue de l'Echiquier, Paris—Improvements in apparatus for preventing the escape of fluids, which he calls diaphragm obturator.
948. Robert Paul Coignet, Rue du Bac, 42, Paris—Improvements for rendering tissues waterproof.
960. Frank James Wilson Packman, M.D., Puckeridge, Herts—Improvements in projectiles, in projectile instruments, and in the means of charging the same.
974. George Wigzell Knocker, Bushy Ruff, Dover—Improvements in motive power by means of water and air.
982. John Scott Lillie, 4, South-street, Finsbury—Improvements in tents or other moveable habitations.
986. Henry Lee, jun., Lambeth, and John Gilbert, Hackney-road—Machinery for mixing the substances used in the formation of concrete and other like substances.
1008. Henry Gustave Adrien Pecoul, 39, Rue de l'Echiquier, Paris—Mode of generating power in steam engines.
1056. Frederick William Norton, Edinburgh—Improvements in the manufacture or production of figured pile fabrics.
1392. John Jones, Sheffield—Improvements in obtaining motive power.
1612. James Reilly, Essex bridge, Dublin—Improvements in bending or shaping iron hoops for casks.
1804. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in feeding steam boilers.

*Sealed October 23rd*, 1855.

909. Henry Jeremiah Iliffe and James Newman, Birmingham—Improvements in the manufacture of covered buttons.
913. James Hunter and George Hunter, Leysmill—Improvements in stone cutting machinery.
915. Frederick James Utting, Wisbeach—Improvements in land rollers and clod crushers.
919. Henry Cockcroft, Haslingden, Lancaster—A self-registering letter box.
924. Mark Mason, Dukinfield—Improved machinery or apparatus for manufacturing metallic "sole tips" and "heels" for clogs, boots, or other coverings for the feet.
925. John Joseph Victory, Henrietta-street—Apparatus for marking out curved lines upon wood and stones, specially adapted to the marking out of hand railings, together with improved machinery for boring and sawing wood.
929. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—An improved gas regulator.
931. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—Improvements in scales or machines for weighing.
938. Edward Frankland, Owen's College, Manchester—Improvements in the treatment of certain salts, commonly called alums, to obtain products therefrom.
941. John Silvester, Smethwick—Improvements in spring balances, and in their connection and adjustment to steam valves.
952. Emile Muller, Joseph Gilardoni, and Xavier Gilardoni, Paris—A grooving and clamping hooked tile, by means of which the entire covering of a roof is tied together; a machine for the fabrication of such tile, by which it is continuously delivered from the mould, through a peculiar system of delivery, applicable to any matter that may be moulded, and a conterminous succession of furnaces for its burning.
1004. Alexander Brandon, Paris—Improvements in heating and warming apparatus.
1012. Daniel Foxwell, Manchester—Improvements in machinery or apparatus for making wire cards, and in the manufacture thereof.
1064. Joseph Pascall, Chislehurst, and George Fry, Lee—Improvements in blanching, forcing, and propagating garden-pots.
1394. Charles Antoine Hartmann, Paris—Improvements in the preparation or combination of colours for printing stuffs and textile fabrics.
1874. William Sangster, 75, Cheapside—Improvement in the manufacture of umbrellas and parasols.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

*October 1st.*

57. John Joseph Macdonnell, Temple-mead, Bristol—Improvements in the construction of railways.
92. Thomas Lawes, 32, City-road—Improvements in the manufacture of agricultural implements, or an improved agricultural implement.
93. Thomas Lawes, 32, City-road—Improved quilt or coverlid.

*October 5th.*

237. Herm Jager, Ludgate-hill—Improvements in the treatment of cotton and other similar fabrics by the introduction of chemical agents, to supersede the use of dung in the dunging process.

*October 15th.*

392. Joseph Burch, Crag-hall, near Macclesfield—Improvements in baths and bathing.
393. Joseph Burch, Crag-hall, near Macclesfield—Improvements in building ships and vessels, for the purpose of saving lives and property in cases of shipwreck or fire at sea.
417. Pierre Augustin Puis, Paris—Improved chain or cable, and an apparatus employed therewith for certain applications.
507. Felix Lieven Bauwens, Croydon—Improvements in treating fatty matters prior to their being manufactured into candles and mortars, which are also applicable to oils.

Journal of the Society of Arts.

*FRIDAY, NOVEMBER 2, 1855.*

## PARIS EXHIBITION.

### The Silks of Piedmont. Bombyx Cynthia.

(From *Le Commerce Sericole*, 17th Oct.)

In the gallery at the northern end of the great nave are the products of the Sardinian dominions, consisting of furniture, cloths, woollen and cotton fabrics, brushes, lace, clocks, and musical instruments. The Sardinian States, of which Piedmont forms one-half, are very fertile. Their natural productions consist of corn, wine, oil, rice, oranges, figs, and mulberries. Silk is there cultivated in abundance.

Many of the neighbouring towns, such as Turin, Nice, Coni, Alexandria, have sent silks both raw and organzine. The culture of silk forms the staple industry of these places. [The article then proceeds to give a short history of the introduction of silk, tracing its origin to the missionaries, who brought the eggs by stratagem from China, showing its first settlement in the Morea, from whence it travelled to Italy, about the time of the Crusades, the encouragement given by Henry IV. of France to the views of Olivier de Serres in opposition to the great Sully, and the regal ordonnances compelling landowners to plant mulberry trees by the side of all the high roads—their failure everywhere except in Touraine, where the climate permitted the trade to flourish, and its development there under Louis XIII., and its subsequent spread among the northern provinces.] At the present time this industry may be said to be completely naturalized in those parts, and the habits and wants of the insect are so well-known that it may with care be successfully raised in the northern provinces. [The article then proceeds to describe the transformation which the insect undergoes, stating that "every thousand worms consume fifty pounds weight of fresh leaves" from the moment of hatching to their death; and the treatment of the cocoons and chrysalides.]

The silks, both raw and organzine exhibited by the reelers of Piedmont are very fine. They are bright and lustrous, and the twist is strong. The number of exhibitors is considerable, amongst whom may be specially named Messrs. Pelisseri and Maucardia, of Turin; Mosca, Brothers, of Chiavazza; Dinegri, of Novi; Novellis and Bonelli, of Savellani; all of them owners of large establishments for reeling and for rearing the worms. Everything shows that the silk business is carried on to great perfection in the Sardinian states. Many of these establishments exhibit in their cases cocoons of various sorts, arising from different methods of treatment. Among them may be remarked the large cocoons, the produce of eggs from Libau; others originally from Broussa, and the very small cocoons known by the name of *tezzini*, from Florence. These *tezzini* appear to proceed from a cross breed with the larger sorts, and to be more specially cultivated in the Sardinian establishments. Messrs. Bellini (brothers), silk reelers, at Rivoli, exhibit the results of a curious experiment. For some time past, as is well-known, a great deal has been said about the introduction of a new silkworm, known by the name of the *Bombyx Cynthia*, which feeds on the leaves of the castor oil plant, is more hardy than the mulberry worm, and capable of living in the open air in the northern provinces without any care. Its silk is not so beautiful as that of the ordinary silkworm, but it is strong, of good quality, and is fitted, it is said, for a number of useful purposes. The Chinese make their more common garments of this silk; and the inhabitants of the East Indies use it even for making those *foulards* which are sold at so high a price. Messrs. Bellini were desirous of ascertaining how far all that was said of these new comers was true. They procured some of the eggs of the *Bombyx Cynthia*, hatched them, and fed the worms on the plant which forms its natural food. The result did not repay their trouble. They then attempted to improve the produce by a change of food, and they tried the worms, which they were endeavouring to acclimatise, successively with the leaves of the lettuce, the willow, and the chicory. The silk produced was nevertheless neither better, more beautiful, nor more abundant. It was coarse, thick, and of an earthy colour, wanting in elasticity and fineness. These experiments took place this year (1855), and are an additional proof how difficult, if not impossible it is, to effect acclimatisation, and what great changes in the nature of the animal and its products are caused by a change of country and those accompanying circumstances which escape our ordinary apprehension. Messrs. Bellini also exhibit in their case, side by side the produce of the new worm, several moths of this species. They appear to be of a much larger size than the common silkworm; their colour is of a greenish yellow, with many bands of white on the wings, and on the upper wings the spots are well marked. They more nearly resemble the *Paon de nuit*, but they are not so beautiful, and the radial markings are less distinct.

It is now a fitting time to examine whether these splendid silks of Piedmont are superior to those cultivated in France, such as Grenoble, Nimes, Aix, Lyons, Toulouse, and numerous other places in the northern provinces. For a long time this was thought to be so, looking only to the fact that silk and the insect producing it were originally from Asia, and that Sicily and Italy, after the Morea, were the first European states in which it had been successfully acclimatised. Since then, however, we have seen the production of silk extend northward with more or less success. England herself possesses silk-rearing establishments, which she is endeavouring to place in competition with those of Lyons.* This pretension, however, is not warranted. There must be a limit to the conditions of success. We may safely assert that our southern provinces are situated in the most favourable position for silk culture, and that our provincial silks are in no respect inferior to the silks of Piedmont. The art of silk-throwing has also there been brought to a higher degree of perfection. And further, it has been remarked, that worms raised in our climate are generally more vigorous, and less subject to sickness, than worms raised under a higher temperature. In accordance with this observation, many cultivators who at one time thought it necessary to keep their hatching-rooms at a temperature of from 18 to 20 degrees of Reaumur, have now adopted a rule of not heating them beyond 14 or 15 degrees; they have found it very successful.

### Bombyx Cynthia.

*Le Commerce Sericole* of the 23rd of October, quoting from the *Annales de la Colonisation Algeriene*, after speaking of the splendid silks shown in the Algerian department, proceeds to notice the productions of the *Bombyx Cynthia* from this colony, in the following terms:—

"In a corner of the ground-floor may be seen the silk products obtained from the cocoons of the *Bombyx Cynthia*, raised in the central nursery of the colony. These products have been got up by M. Lepoutre-Parent, of Roubaix, who has found it necessary to card the cocoons like waste silk, being unable to wind them off, because the filaments of silk are not continuous, but are broken in the cocoon itself, due to the peculiar action of the insect in spinning it. The thread of the *Bombyx Cynthia* is far from attaining the value of other silk, owing to its colour, which is of a dull grey. It appears even in-

* The writer appears to be in error on this point. Silk cultivation on a large scale has hitherto failed in England.—Ed. Journal of Society of Arts.

ferior to the waste silk, which the manufacturer has placed side by side of it for convenience of comparison. If, notwithstanding this, fabrics of this silk are used among the people of China, it can arise only from the same cause that rye, barley, and oats form the nourishment of ten or twelve millions of French people who are too poor to obtain wheaten bread, a consideration which ought not to be lost sight of when it is proposed to introduce a foreign product on the sole ground that in another country it is in constant use."

## SANITARY APPLICATIONS OF CHARCOAL.

Under this head, in the *Journal* No. 146, p. 695, in a letter signed "Nemo," reference is made to certain observations by Dr. Sutherland, Chief Sanitary Commissioner in the Crimea, in a letter addressed by him to the Earl of Shaftesbury, wherein the doctor throws great doubt on the value of charcoal as a disinfectant, referring to the case of the "Chester." The following remarks, specially referring to this point, are taken from a pamphlet by Mr. James Bird.* After quoting the passages from Dr. Sutherland's letter, as given in the *Journal*, Mr. Bird says:—

"To these remarks of Dr. Sutherland, the following extract from the *Pharmaceutical Journal*, affords, we think, a correct and conclusive explanation:

"'It is certainly a very important question to be determined whether, and in what way, or to what extent, the offensive odour of decomposing organic matter is connected with infection. We agree with Dr. Sutherland, that the terms deodoriser and disinfectant ought not to be commonly used in connexion, as if the one effect necessarily followed the other. In fact, we know very little about infection, its real nature, and the *modus operandi* of those substances which have been found, or supposed to prevent contagion. It is generally considered that the poison of contagion is destroyed by a process of oxidation—a process similar to that by which offensive odours are usually got rid of. Admitting this, however, it does not follow that the two effects should be necessarily simultaneous.

"'Charcoal and lime are two of the best known substances for preventing the escape of offensive odours from decomposing organic bodies; but these two substances do not act in precisely the same way. The action of the charcoal in as far as the charcoal is itself concerned, is mechanical, that is to say, the charcoal does not enter into chemical combination with any of the elements present. On the other hand, the lime combines with some of the products of decomposition. But the sure, most active and efficient agent in destroying offensive odours, and also, as is assumed and generally believed, in destroying contagion, is atmospheric oxygen. Charcoal possesses the property, in a very high degree, of condensing gases upon its surface; and it is thus capable of bringing large quantities of atmospheric oxygen, in an active state, into contact with the noxious products of organic decompositions, and causing their destruction by an oxidising action. The action of sand or gravel would be somewhat similar to that of charcoal, but with this difference, that sand or gravel are deficient in that property which so remarkably distinguishes charcoal, of condensing gases on their surface. The sand or gravel acts simply as a porous mass, the interstices of which are filled with air; and the gaseous products of decomposition on passing through the mass, are minutely divided, and brought into intimate contact with atmospheric oxygen. Dr. Sutherland says, that a stratum of six inches thick of sand, placed over ground filled with decomposing bodies, entirely deodorised the soil. In this case, we have no doubt, the action of the sand was such as we have described.'

"Poisonous influence upon living animals is always proportionate to its degree of concentration; a resident within the limits of the Pontine marshes, would be much more liable to be affected by its malaria, than one whose habitation was some distance removed from them—constitution, temperament, and other conditions being similar in both individuals. A healthy person coming in contact with another individual afflicted with cholera, would be far less likely to imbibe the disease, than he would be if his intercourse extended to one hundred so circumstanced. Again, one patient in typhus fever or small pox, confined to a small ill-ventilated room, with little regard to cleanliness as respects raiment or bedding, would generate by concentration, a poison sufficiently virulent to infect every person who entered his room; while a hundred persons similarly diseased, in a large airy well-ventilated apartment, where cleanliness and other proper sanitary measures were duly attended to, might be visited with absolute impunity. Erisypelas, or gangrene, or fever, breaks out in one of the wards of a hospital, or union, or barrack, and all former experience has demonstrated that unless the case be immediately removed and isolated from other invalids, the disease rapidly extends from bed to bed, until first all the inmates of the ward and afterwards those in the whole building are attacked. Great mortality of course follows, and a disease is engendered by concentration again of so virulent, pestilential, and contagious a character, as to render it a matter of the utmost difficulty to subdue or eradicate it. A minute dose of arsenic may be taken as a tonic with the greatest benefit in neuralgia and ague, but concentrate those minute doses by mixing a dozen doses together, and you produce by such concentration a virulent poison. Hence it is clear, that large dilution in every instance, is the most certain and effectual method of destroying all kinds of contaminating influence, whether existing as animal, vegetable, or mineral poisons, or even in that subtle and insidious gaseous form as it emanates from the decompositions of either of the before-named substances. The dejections of one dysenteric or choleraic person, left to purify in the vicinity of a closely packed community of healthful persons, would be sure to do less mischief, than would result from the dejections of one hundred such invalids; and so would the sanitary condition of such congregated community be best promoted, were all the dejections removed, with as little delay as possible, from the vicinity of the spot upon which they are obliged to dwell. Cotton, wool, sand, ashes, saw dust, earth, gravel, will all absorb the odours consequent upon decaying animal or vegetable matter; but they will retain them unchanged, and become fully saturated thereby; and as the poisons generated by the putrid action of animal and vegetable matter are also self-generating, this saturation becomes sooner or later completed, and emanations more poisonous, because more concentrated than those originally infused into the interstices of the cotton, wool, &c., in the first instance, are evolved again with fatal consequences. Not so with Charcoal; whatever gaseous matter passes within its pores, there it is decomposed by the oxygen distributed in such large quantities over its minutest particles; and it is satisfactory to know, that these noxious gases are never again liberated in a pernicious form, and that except in the one solitary instance, where Charcoal is burnt destructively in a room perfectly closed from all access to the atmosphere, no inconvenience can ever result from its use.

"It must be obvious therefore, that early deodorising and disinfecting, and frequent and complete removal of all feculent matter from densely populated localities, is the primary and fundamental means of promoting health and of arresting the ravages of disease; and that without this, all other precautions are vain and ineffectual."

* The Medicinal and Economic Properties of Vegetable Charcoal, with Practical Remarks on its Use in Chronic Affections of the Stomach and Bowels. By James Bird, M.R.C.S., late Surgeon Royal Glamorganshire Militia.

## DECIMAL COINAGE COMMISSION.

(From the *London Gazette*, October 26, 1855.)

Whitehall, Oct. 25.

The Queen has been pleased to direct letters patent to be passed under the Great Seal, nominating and appointing the Right Honourable Lord Monteagle, of Brandon, the Right Honourable Lord Overstone, and John Gellibrand Hubbard, Esq., to be her Majesty's Commissioners for considering how far it may be practicable and advisable to introduce the principle of decimal division into the coinage of the United Kingdom.

## UNDERGROUND MANURING.

In No. 113 of the *Journal*, 19th January last, p. 148, is an account of a method of underground manuring, advocated by Mr. E. Wilkins. Mr. Wilkins states the result of his experiments at Caversham as follows:—The examination took place about a week since, in the presence of Mr. Elliott, one of the Commissioners of Sewers of the city of London, several members of the Oxford Corporation, several gentlemen of this town, and Mr. Johnson, head gardener at Stratfieldsaye, the seat of the Duke of Wellington. A mangold wurtzel grown on the new system was found to be 26½ inches in circumference, whilst one on the old plan measured only 16½ inches; hops planted on the new system, were very strong in the bine, full of hops, and measured 20 feet high, whilst those on the old plan were only 14 feet high; two plants of grown potatoes, in earth, on the new system yielded 22lbs. 6oz., whilst the same number on the old plan weighed only 14½lbs.; 2 plants of ash-leaf kidneys, grown in one foot of sand from Mr. Collier's sand rock, on the new system yielded 10¾lbs. weight; old system, 5lbs.; one potatoe grown in this garden last year, and planted this year on the new system, produced 101 fine potatoes weighing together 24lbs.; one of these was 1lb. 3oz., and was grown in 8 inches of earth only. The beet root, peas, clover, Italian rye grass, rhubarb, &c., grown on the new system, greatly contrasted with that after the old plan. Mr. Wilkins afterwards exhibited the roots, &c., at the Town-hall, and entered into an explanation of his mode of culture.

# Colonial Correspondence.

## THE COMMERCIAL RESOURCES OF BRITISH HONDURAS.

Belize, British Honduras, Sept. 17, 1855.

Sir,—In my last letter I stated, in reply to the question proposed by Mr. Hancock, whether caoutchouc might be cultivated in Jamaica or the East Indies, that the India rubber tree grew very plentifully in this country. I have since procured a specimen of the caoutchouc extracted from that tree, and I have now great pleasure in forwarding it to you. I do not know whether or not it will be considered to be of a good quality, but to me it appears not to be of so close a texture as that which I have usually seen. This, however, may not be owing so much to the nature of the material itself, as to the mode of extracting and preparing it. Be that as it may, it *is* veritable caoutchouc, and if not applicable to all purposes may be very useful for some. I am told that a good tree will produce at a time from three to four gallons. I have requested a merchant in Belize, who is engaged to a limited extent in mahogany cutting, to endeavour to make up his inevitable losses in that business, by bringing from his mahogany works all the caoutchouc which he can collect from the numerous india-rubber trees with which they are surrounded. He appears to be quite aware of the value of the suggestion, and being an American, he has—to use a nautical phrase,—his weather-eye always open. In fact, he is one of those true sons of Mercury who calculate and guess with considerable certainty where a penny may be turned.

The mahogany labourers commence their operations about six o'clock in the morning. They have a task set them, which they generally accomplish before noon; the rest of the day is their own, which they spend according to their several tastes. One man throws himself into his hammock and falls asleep, "the world forgetting, by the world forgot." This is a favourite pastime. Another man smokes his pipe, looks very meditative, and reflects upon nothing. Another takes his gun, a very fine, single-barrelled fowling-piece, which cost three dollars—twelve shillings sterling. This he loads, first with a double charge of powder, then with an inch of oakum, then with as much shot called BB. as will lie in the palm of his hand, and, lastly, with another inch of oakum, all which is rammed down with no child's arm. Verily miracles have not ceased. These guns never burst. I suppose they are warranted not to burst, and therefore don't. Having performed the operations above described, he next throws over his left shoulder a large canvas bag, the contents of which are various, and somewhat curious. First, there is a large bull's horn with a cork at the small end and a plug made of wood at the other. This contains his powder. Then the shell of a cahoun nut, neatly cut in two, curiously carved, and made to open and shut like a box. This is a snug receptacle for percussion caps. Then a canvas bag, drawing at the mouth with springs, and having printed upon it in large capital letters the word NAILS. This is the Bristol blue department. Then, a deerskin case, which rolls up, and is tied round with a thong, also made of deerskin. In this is deposited a considerable quantity of unmistakeable returns, or negro-head, with a flint and steel. Then, a short, black, venerable-looking pipe, the fragrance of which would have driven good King James out of his senses. Then, the shell of a young cocoa nut, with a hole at one end. This contains tinder, which is used for the purpose of lighting the said pipe. The rest of the articles are a gin-flask, a calabash of the shape and size of a breakfast basin, a roasted plantain, a piece of dried fish, and a case knife. The bag containing this elegant assortment, as I said before, he slings across his left shoulder, girds his waist with a leather strap, from which hangs a machete, holds his Manton with both hands behind his neck, so that he presents the appearance of a cross, and sallies out in quest of deer, peccary, gibbonet, curacou, qualm, armadillo, iguano, squirrel, monkey, or any other edible animal which fortune may throw in his way. Another man, more industriously disposed, shoulders his huge axe, fit to cleave the skull of a Titan, and proceeds into the bush in search of a small mahogany or cedar tree. Having found one suitable for his purpose he will fell it; then he will square it; then he will shape it into the form of a doug or pitpan, and then dub out the inside with an adze. Being finished, he will bring it down to Belize at Christmas, and sell it for fifteen or twenty dollars. Now, if all these men, instead of sleeping, smoking, shooting, &c., were to take all the demijohns, gin-flasks, porter-bottles, calabashes, and every other vessel which they can lay hold of, and fill them with the juice of the India-rubber tree, they would not only be more healthfully, usefully, and profitably employed as regards themselves, but they would contribute to the prosperity of the country and to the wants of the British and other European markets. This I have urged upon the gentleman of whom I have above spoken.

I send you a small quantity of the bark of the *cinchona*. It was brought to me from Omoa, in the state of Honduras, in the neighbourhood of which town it grows. It is considered there to be equal to the Peruvian bark. On this point, however, I can give no opinion, but I am informed that an infusion of it is administered in intermittent fevers, with the same salutary effect as *quinine*. I do not know whether it is to be found in the British settlement, but I am strongly inclined to think that it may be, as it grows so plentifully in a neighbouring state. There is a species of *cinchona* in Jamaica, an account of which was given by Dr. Wright, in a paper which he published in the *Philosophical Transactions*. It was called by him *Cinchona Jamaicensis*. In Jamaica it is called the "sea-side beech." It also grows in the island of St. Lucia. This was treated on by Dr. Kentish, and called by him St. Lucia bark. [See Ency. Brit., ed. 1797.]

I have always thought that tobacco might be cultivated in Honduras with great success. In every part of this country the wild tobacco is as abundant as thistles in England—or even in Scotland. In an old edition of the *Encyclopædia Britannica*, I find under the title *Nicotiana* the following statement:—

"There are seven species, of which the most remarkable is the *tabaccum*, or common tobacco plant. This was first discovered in America by the Spaniards, about the year 1560, and by them imported into Europe. It had been used by the inhabitants of America long before, and was called by those of the islands *yoli*, and *pœtun* by the inhabitants of the continent. It was sent into Spain from Tabaco [qy: Tabasco], a province of Yucatan, where it was first discovered, and from whence it takes its common name."

That part of British Honduras which lies between the Belize river and the River Hondo, is in the province of Yucatan. Formerly a very extensive trade was carried on between Havanna and Yucatan, the latter supplying that city with logwood, salt, deerskins, a fibre from which ropes and hammocks were and are still made, and likewise tobacco. When the planters in Cuba were able, by careful and skilful cultivation, to produce a better tobacco than that with which they had been originally supplied from Yucatan, that article ceased to be a branch of the trade. The Yucatecos, however, continued to cultivate tobacco for their own use, as well as an article of commerce with other countries. The cigars which are brought from Merida, the capital of Yucatan, are very excellent, and little if at all inferior to those exported from Havanna. In the whole of Yucatan to the north of the Hondo, there is a great scarcity of water, very few large rivers, and hardly any small streams. This want renders cultivation extremely precarious. But in that part of Yucatan which is now British Honduras, magnificent rivers, tributary streams, and broad lagoons abound. The Indians of Yucatan are called Maya Indians, and their language is called the Maya language. Wherever one of these people settles, one of the first things which he begins to cultivate is tobacco—"the narcotic odour of which," it has been said, "equally infatuates the ignorant savage and the intelligent philosopher." He is moved to this by two feelings—a religious sentiment, and a love of the soothing influence produced by the fumes of the burning leaf. Whatever Christianity may have done to humanise and enlighten the race of man by the Divine principles which she teaches—and she has done much—she has not succeeded in altogether rooting out of the minds of many of the savage inhabitants of this part of the world their ancestral superstitions, and a hankering after the false gods of their fathers. The Indian yet looks upon the tobacco plant as a special gift of the Deity, to solace him in trouble, to tranquilise him in prosperity, to teach him calmness of action and soberness of thought, and to fill him with soft, and gentle, and holy feelings. He thinks that when he kindles the dried and folded leaf that he is sacrificing to his god; that every puff of smoke is an incense of adoration; and that the stupor which steals over his senses is that heavenly calm enjoyed by blessed spirits, and which is wafted to him from the gates of Paradise on celestial airs. Until a very recent period, no person attempted to cultivate tobacco in Honduras, either for exportation or personal use. In 1848, the war broke out in Yucatan between the aboriginal Indians and the Spanish inhabitants, who are, in fact, a mixture of the old Spaniards and the Indian. This mixed people have the vices of both races, and the virtues of neither. They are cruel, revengeful, and the slaves of every gross and sensual appetite. They are as degenerate in their persons as in their minds. Very few of them are so much as five feet in stature. They have an oval face, sanguinary-looking lips, round, fleshy, sensual chins, low narrow foreheads, and large, dark, inexpressive eyes, except when under the influence of anger, and then they roll and flash with a demoniac lustre. Their figures are squat and unshapely, and given to obesity. Their hands and feet are remarkably small, and all their bones are fragile and delicate. Such is the Spanish Yucateco in appearance. These people have for many years treated the Indians with great cruelty, making them work like slaves, and putting hem to death on the slightest provocation. One mode of tormenting these poor creatures, and one to which they often resorted, was called the "campaign stock." The Indian was thrown upon his back, his wrists were tied together below his knees, and the barrel of a gun was placed between his arms and his thighs. In the year 1850 it was my duty to try a man called Florencio Vega for inflicting this horrid torture upon a poor Indian labourer, called Juan Nepomucini Torres, in the British settlement. The following is what Torres stated:—"Some time ago, I was residing where Mr. Vega was residing, at New River. It is about three months ago. It was New River in this settlement. The name of the place was San Esteven. I was placed by Mr. Vega for eight hours in a campaign stock. My wrists were tied together and brought over my knees, and a gun-barrel was passed through my arms and under my legs. I was thrown on my back. I was placed in this position by Felipe Vega and Alonzo; This was done by order of Florencio Vega. Florencio Vega stood by, commanding the people to do it. I was released at 8 o'clock at night, by the request of several persons. I was placed in that position about one o'clock in the day. After they released me, they chained my leg to a post in a new house they were building, and I was kept there until the next day at three o'clock."

At last the patience of this most patient race was exhausted, and they rose *en masse* against the tyranny of their oppressors. The Indian is a much finer *animal* than the Spanish Yucateco, although *he* has got nothing to boast of. He is likewise diminutive, possessing small feet and hands, and delicate limbs; but the shape of his face is very singular. His portrait may be seen any day in the Egyptian department of the British Museum. His hair is long, straight, and of a raven black. His face is roundish, and his cheek-bones are very high. His lips are thick and projecting, his chin round and retreating, his nose slightly aquiline, and broad at the nostrils, and his eyes black, large, full, starting, almond-shaped, and almost hidden within the folds of a thick, heavy, sleepy lid. He always walks withhis toes turned inwards, and his feet are clothed with sandals, the antiquity of which is indisputable; the sole of this sandal is generally of wood, but sometimes it is made of thick bull's hide. It is fastened to the foot somewhat in the same manner as skates are, but the foot is naked, and a cord which passes through a hole at the end of the sole goes between the great toe and the one next to it. I have sent you a pair of the sandals, for I think they are rather curious. It is highly probable that they differ very little from those which were worn by the Phenicians and the ancient Egyptians, from whom I have no doubt these Maya Indians are descended.

The Indian, although a docile creature, is not deficient in courage. His Spanish oppressor, on the contrary, like all cruel and vindictive natures, is an arrant coward. When the Indians revolted, the town of Bacalar was the first place which they attacked. Bacalar is a moderate-sized and pretty-looking town, distant about 30 miles from the mouth of the Hondo, and situated on the margin of a beautiful lake, which is sometimes of a deep rich blue, sometimes a light azure, sometimes a bright emerald, and sometimes at sunset and sunrise it shines with alternate streaks of violet and crimson. Commanding this lake and the surrounding country is one of those large, dark, strong, frowning fortresses which the old Spaniards, in Ferdinand and Isabella's time, used to build to secure their conquests. This castle is built upon a high mound, partly natural, partly artificial, and is surrounded by a deep ditch, over which is a drawbridge. In 1847 there were in this stronghold several pieces of ordnance, a considerable quantity of cannon balls, and plenty of gunpowder. There were also at least a thousand muskets, two hundred of which, with percussion locks, were in excellent order, and were arranged in the armoury with great precision. Notwithstanding all this—the frowning turrets of the old Spanish Castle—the ditch, the drawbridge, the bristling cannon, the thousand stand of arms, the Indians, with nothing but old rusty swords, machetes,

hatchets, muskets without locks, slings, and bows and arrows, took the castle by storm, and cut the throat of every Spaniard they could lay hold of. The greatest portion of the inhabitants fled with precipitation, collecting in the hurry of their hasty exodus a few trinkets which they huddled up with their clothes in bundles. They took refuge in Honduras. But the tide of war suddenly changed. Yucatan had previously declared its independence, but now, in the hour of peril, the Yucatecos acknowledged themselves to be subject to Mexico, and demanded assistance from that country. This was vouchsafed, a large armed and disciplined force was dispatched to Yucatan, and the Indians were driven from Bacolar with as much rapidity as they had before scattered their enemies. It was now their turn to fly, and they also chose Honduras as their city of refuge.

I have mentioned these circumstances to show how it came about that the cultivation of tobacco was commenced in this country. Upon the New River there is a large settlement formed by the Indian and Yucatan refugees. These people, living now peaceably together, rear poultry, and cultivate tobacco and Indian corn. I have sent you twenty-three cigars grown and manufactured by them. I abstain from pronouncing any opinion upon them, but I have not the slightest doubt that if care and skill were bestowed upon the cultivation of tobacco in this country, cigars might be exported from Belize, equal in every respect to those which are sent from Havanna. It is a fact not to be overlooked, that it was from Honduras and other parts of Yucatan, that tobacco was first imported into Cuba, and that the far-famed cigars of that island have an Honduras origin. I shall procure some of the leaf tobacco and send it to you, I hope, by the next packet.

By the last packet I sent you a specimen of the fibre of this country and Yucatan. I have now great pleasure in presenting you with an Indian hammock, made of a fibre similar to that which I forwarded to you.

I have the honour to be, Sir,
Your very obedient servant,
R. TEMPLE.

# Home Correspondence.

## DECIMAL COINAGE.—THE TENPENNY SYSTEM.

Sir,—Mr. Rathbone does not disprove my assertion that a *centesimal* ratio is found by experience to be preferable to a *decimal* one between moneys of account, while he assumes, as the *sine quâ non* of a change, "that pence and tenpences should become our legal, and hence ordinary and usual form of account."

Now with reference to his scheme, which he describes as "the simplest and the most efficient and complete, as well as the easiest of execution that has ever yet been proposed," I think it may, on the contrary, with very little difficulty, be demonstrated that it is actually inferior to our old-fashioned £ *s. d.* mode.

Mr. Minasi has shown that the saving in figures by the use of the penny system in any form would not amount to one-half per cent. But a comparison of figures is not the only test that ought to be applied. In taking measures to simplify our currency, we should proceed on the supposition that the masses know nothing of written accounts, and are even unacquainted with the multiplication table. The loss or gain in facility of *mental* computation should accordingly be estimated, before deciding on the merits of any given system. Suppose, then, Mr. Rathbone himself, ignorant of accounts, and having to pay "17 tens and 6 pence," or "9 tens and 7 pence," with shillings and pence—his plan requiring, as he says, "no coins but the existing"—I should be glad to know how he would avoid the "troublesome duodecimal" division of 176 or 97, in order to find the number of coins wanted to make up the sum. I suspect that the increase of mental labour in this "invaluable" form of account, even when "confined to amounts and calculations below the £," would far more than counterbalance the half per cent. saving already mentioned, and that Mr. Rathbone would soon acknowledge the inconvenience of reduction to 14s. 8d. and 8s. 1d., and back again. Moreover, if it were possible to start to-morrow with no coins *but* tenpences and pence, his scheme, in my opinion, would prove impracticable, since, in reality, no advantage would accrue from making *ten* the ratio between moneys of account.

It does not appear to me that the introduction of arithmetical examples of the kind given by Mr. Rathbone is likely to do much, if anything, towards settling the question. Merchants, tradesmen, and others, have peculiar abbreviations in computation, adapted to the weights and measures of the commodities in which they mostly deal, and an expert arithmetician, as a merchant's clerk ought to be, would perceive at a glance that, in such a calculation as 31 tons 12 cwt. 2 qrs. 14 lbs., at £12 12s. per ton, £1 per ton gives a shilling per cwt. and 3d. per qr. He would, therefore, work it, so as to leave no advantage on Mr. Rathbone's side, thus :—

| | Tons. | cwt. | qrs. |
|---|---|---|---|
| | 31 | 12 | $2\frac{1}{2}$ |
| | 1 | 1 | 3 |
| | 31 | 12 | $7\frac{1}{2}$ |
| | | | 12 |
| | 379 | 11 | 6 |
| 10s. = $\frac{1}{2}$— | 15 | 16 | $3\frac{3}{4}$ |
| 2s. = $\frac{1}{5}$— | 3 | 3 | $3\frac{3}{20}$ |
| | £398 | 11 | $0\frac{9}{10}$ |

Mr. Rathbone's Method.

| Tons. cwt. qrs. lbs. | d. |
|---|---|
| 31 12 2 14 | 7085·4 at 13·5. |
| 20 | 13·5 |
| 632 | 354270 |
| 4 | 212562 |
| | 70854 |
| 2530 | |
| 28 | 12) 95652·90 |
| 20254 | 20) 7971·$0\frac{9}{10}$ |
| 5060 | |
| | £398 11s. $0\frac{9}{10}$d. |
| 70854 | |

It would be a fairer comparison, however, for Mr. Rathbone to make his calculation at 302 *tenpences and* 4 *pence per ton*, than at 13·5*d. per* 10 *lb*. In any case, "the enormous saving of figures and labour" is purely imaginary, and had better be left out of the discussion altogether.

I remain, Sir, your obedient servant,
SAMUEL A. GOOD.

H.M. Dockyard, Pembroke Dock,
27th October, 1855.

## SOCIETY'S LIST OF LECTURERS.

Sir,—The Committee of the Pembroke Dock Mechanics' Institute having seen Mr. Charles F. Partington's name and address in the Society's List of Lecturers, where he describes himself as lecturer to the Royal Panopticon, arranged for the delivery of a lecture on receipt of a prospectus bearing the same name and address. The result, as explained in the following notice from the *Pembrokeshire Herald*, was hardly fair towards either the Society of Arts or the Institute.

Yours obediently,
X. Z.

"Lecture at Pembroke-Dock.—The members of the Pembroke-Dock Mechanics' Institute were sadly disap-

pointed on Monday and Tuesday evenings. The person who undertook to lecture on "The Resources of Modern Warfare," turned out *not* to be the Mr. Partington of the Royal Panopticon, who was expected, but his son or nephew, a young gentleman who in appearance is scarcely out of his teens. He occupied the time of the audience on the first evening by reading a dull prosy outline of the history of the Crimea and its invasion by the Allies, up to the fall of Sebastopol. His lecture was by no means enlivened by a stammering indistinct utterance and incorrect pronunciation. On the following evening he attempted to illustrate, with the aid of a few explosive chemicals, the principle of the Russian infernal machines, &c., leaving, however, his audience very little wiser on the subject than they were before. The Institute has unhappily not hitherto been very successful with its *paid* lecturers."—*Pembrokeshire Herald*, Oct. 26, 1855.

## Proceedings of Institutions.

BRADFORD (WILTS).—The Third Annual General Meeting of the Literary Institution was held on the 2nd of October. The report states that the number of subscribing members to the 31st of August, is one hundred and fifty five, paying £74 5s. 0d., of which £10 is from a new life member, £58 7s. 6d. from annual subscribers, and £5 17s. 6d. from half-yearly and quarterly subscribers. The treasurer's report shows a balance in the bank in favour of the society, of £55 2s. 11d. The lectures, as usual, have continued to be a source of great interest, and have been numerously attended. The reading rooms continue to be well frequented. The library has, during the past year, been increased by valuable presents and donations from Mrs. Wade Browne, the Rev. J. H. Bradney, the Rev. W. H. Jones, Mrs. Jay, and other friends. The issue of books during the past year has been 1,916, against 1,777 of the previous year. The meetings of the Mutual Improvement Class have been well attended, and the increased number of its members indicates a growing interest in its proceedings.

BURY ST. EDMUNDS.—A bazaar was held on the mornings of Tuesday, the 2nd, and Wednesday, the 3rd of October, and on the evening of Friday, the 5th, in the lecture-hall of the Athenæum. The ladies who presided at the stalls, &c., were:—Lady Arthur Hervey, Lady Manners, the Hon. Mrs. Pellew, Mrs. Bennet, Mrs. Dennis, Mrs. Greene, Mrs. Ion, Misses Michell, Mrs. Ord, Mrs. Smith, Mrs. Deck (with Messrs. Walsham and Oakes), Miss Ramé, and Mrs. Youngman (with Miss Warren). The whole sum collected was £748 11s. 4d. The expenses amounted to £83 10s. 5d., leaving a balance of £665 0s. 11d. The council have disposed of this sum as follows:—To the library committee, for new books, £100; to the committee of archæology and natural history, £100; to the immediate payment of 45 loans of £10., £450; and the balance of £15 0s. 11d. towards additional lighting of the lecture-hall. In addition to the nine loans of £10 each, payable under the deed of trust, it has been determined that forty-one loans, making a total of £500, be now paid off according to numerical order, unless otherwise desired by the parties entitled to priority, thereby reducing the charge on the Athenæum to £2,200, and that such payments be taken in relief of the annual instalments of the debt as far as may be found necessary, provided that the sum considered as liquidated by this payment shall not exceed £50 in any one year, or £90 in two consecutive years. Besides rendering an account of the sum realised and the mode of its appropriation, the council return their most sincere and grateful thanks to the bazaar committee, to the Lady Arthur Hervey, to the ladies committee, and to the ladies who presided at the several stalls. These were well provided by the liberality of the friends of the Athenæum, as the receipts show, and every stall was entirely cleared of its stock of ladies' work. The reason of the expenses being so small was owing to the tradesmen of the town having generously given their gratuitous services and gratuitous materials for preparing and decorating the hall for the bazaar. The council express the hope that the greatly increased strength of the Institution, arising from such an increase both of friends and of funds, will have the effect of conciliating to it yet further support, and attracting to it the cordial union of those who have hitherto stood aloof.

CHICHESTER.—The annual report of the Literary Society and Mechanics' Institute, the present number of members of which is 415, after speaking of the results of the concert given last winter in the Assembly Rooms, which was attended by about 400 persons, and increased the funds of the Institution by £8 18s. 6d., proceeds to speak of "the crowded audiences in the lecture-room, the numerous visitors to the museum, and the great demand for books from the library." In regard to the museum, the report observes, "that some Roman coins, and other antiquities, lately presented by the dean and chapter, are, in consequence of having been dug up in this city, of particular interest; for although specimens in any of the branches of natural history, or of the productions of human talent and ingenuity, wherever they may be found, are very acceptable, yet such as may contribute to illustrate the topography or history of this interesting locality, should be held in especial estimation by the managers of this Institution. The collection of local objects is already perhaps as extensive as in any provincial museum in Britain." The number of persons who have visited the museum during the past year has been 1344, of whom 220 were members. The success which has attended the Polytechnic Exhibitions at Brighton and Worthing, has led the committee of the Literary Society to suggest that at no distant period one of a similar kind may be held in connexion with that Institution. The donations to the library have scarcely reached the usual average, but the issues have amounted to 5000 volumes. The annual statement of accounts gives the total receipts of the year as £262 0s. 7d., and the current expenditure as £247 4s. 0d., but as at the termination of the preceding year there was a balance due to the treasurer of £25 5s. 4d., the difference in the receipts and expenditure of the present year only in part meet this deficit, the balance still due to the treasurer being £10 8s. 9d. The report states that this extra expenditure was incurred in providing new glass cases for important portions of the museum.

DUMFRIES.—The lecture-session of the Dumfries and Maxwelltown Mechanics' Institute was opened on the evening of October 9th, by Mr. EWART, M.P., in an address on Mechanics' Institutes, and the benefits arising from them and other educating agencies. The chair was taken by Dr. BROWNE, president of the Institute. Mr. EWART, after alluding to the prosperous state of the Institution, said that it was a favourable opportunity of taking a review of such Institutions, as the working classes were rising in intelligence. He quoted the words of Dr. Lyon Playfair as to the Central School of Science in London, stating that the "600 working-men's tickets were eagerly taken. The regular attendance of the working classes, the attention with which they listen, the copious notes which they make, are in all cases remarkable." The hon. gentleman then traced the origin of Mechanics' Institutes from the time of Dr. Birkbeck, the foundation of the Institute of London under Lord Brougham and others, and noticed the objections made to them. It was said they were not the institutes of mechanics, but they were becoming more so every day. The uncertainty of their funds was an objection. They had not been sufficiently self-supporting; this was undoubtedly true. He remembered instances where, in societies for promoting a knowledge of the arts, the arts themselves were put under an execution, the casts were confiscated, and the Apollo Belvidere went to the highest bidder. But

they were now far better managed, and more nearly self-supporting. The want of a system of union had been objected. The hon. gentleman traced the attempts to form unions of such institutions: the Yorkshire Union, the Cheshire Union; lastly, the union proposed by the Society of Arts. That body had also proposed a system of classes and examinations. He feared that great difficulties would attend the latter system. Meanwhile, the government had extended its operations in a similar direction. A parliamentary committee, which he (Mr. Ewart) procured in 1836, had recommended that, for promoting a knowledge of the arts among the working-classes, a normal school of masters should be formed in London, to supply teachers for self-supporting schools of design in the provinces. This system was at length about to be adopted. It would, no doubt, be extended also to schools of science as well as schools of art. His doctrine was, that the government should interpose, but not interfere. The local administration of such institutions should be in the local authorities. On such terms only ought institutions to accept the aid of government, if offered. There was no doubt, however, that, though government ought not to "encumber them with help," it might greatly assist them. He was far from desiring to see adopted the protecting interference of foreign countries. But we might with advantage introduce some of their modes of instruction. He adverted to the advantage derived by the foreign mechanic from such institutions as the *Gewerb. Institut* at Berlin, and the *Conservatoire des Arts and Métiers* at Paris. He also adverted to the advantages given to workmen in the United States, and to the Reports of Messrs. Whitworth and Wallis on the Industrial Exhibition at New York. It was insulting the British mechanic to suppose that he should be brought up a mere machine. He had a right to enjoy larger views. Refinement and education would increase his value, and raise his position. He ought to equal or surpass the foreigner in the cultivation of the intellect, as he did in the energy of labour. The hon. gentleman then alluded to what might be called collateral institutions. Having been requested to advert to free public libraries, he stated that, having procured a committee on public libraries, after a committee on the arts, he had been asked, together with his friend Mr. Brotherton, first to introduce a bill for enabling towns to establish museums, adding to them rooms for science and art. Power was given to raise a rate for the purpose. The power was permissive. But about twelve towns had already adopted it—Manchester, Liverpool, Oxford, Cambridge, Salford, Sheffield, Warrington, Kidderminster, Bolton, and others. At Manchester, whence he had just come, he found that 250 daily readers frequented the noble library established there; and the same proportion at Liverpool, Salford, and other places. Books were also lent out to the resident population in large numbers. At Liverpool they proposed to raise a magnificent building; at Norwich another. Altogether 90,000 volumes had been added to the public use in these libraries. The result was the more satisfactory, as the bill, when introduced in Parliament, met with great opposition. They appeared inclined to accost him there as a well-known character was accosted by Jack Cade and his followers, in the play of Shakspeare: "Thou hast traitorously corrupted the youth of this realm by the foundation of a grammar-school." However, the bill was passed, and its end would, he believed, be satisfactorily attained. The hon. gentleman then adverted to the hopes and fears which attended the introduction of a national system of education, and to the immense benefits conferred by their ancient system of education in Scotland. He was desirous of seeing it enlarged and improved. He also adverted to the advantage given to poor scholars in the Scottish universities. They might all become learners by lodging cheaply and freely in the town. By the less liberal system of England (though it was not so formerly) the student must undergo the costs of being a member of a college in his university. But whatever advantages were given, a man's education in these times lay principally with himself. His own independent pursuit of knowledge was better than a system of drilling, which often narrowed and enfeebled the mind.—Major Scott, of the Dumfriesshire Militia, begged to propose a vote of thanks to Mr. Ewart, which was seconded by the Rev. Mr. Goold. The Chairman, in a few forcible and eloquent observations, conveyed the vote of thanks to Mr. Ewart; which the hon. member briefly acknowledged.

Liverpool.—Two courses of public lectures have lately been delivered at the Collegiate Institution. The first, on "Vegetable Growth in its Connection with Art," by Mr. C. Dresser, of the Department of Science and Art; the second, on "Textile Materials," by Mr. T. C. Archer, who has published some of the botanical diagrams of the same department. The former course of lectures was specially connected with the School of Art lately established at the Collegiate Institution.

Much Wenlock.—The fourteenth annual meeting of the Reading Society was held on Friday, the 19th of October. Mr. M. G. Benson, the president, took the chair. The report commenced by observing that the present rate of subscription to the reading room, considered apart from the lending library, was altogether inadequate. It was therefore proposed to double the subscription, making it 10s. instead of 5s. It was also proposed to revert to the original annual subscription of 6s. to the lending library, the reduction of 1s., made as an experiment, not having been followed by any increase in the number of subscribers. The committee, finding so few names of journeymen, mechanics, day labourers, and domestic servants, on the list of subscribers, suggested that certain publications should be set aside for their use on the payment of 1s. half-yearly, in advance. This, it was stated, was now rendered practicable by the great accession to the library during the last few years. A working-men's reading-room was likewise proposed to be established; the subscription to be fixed at 1s. half-yearly. The report then went on to speak of the great desire of many young persons in the neighbourhood for instruction in drawing, and expressed the hope that the neighbouring institutions of Coalbrookdale, Madeley, Broseley, and Bridgnorth, would unite with Wenlock, so that a salary might be secured sufficient to obtain a master from the Board of Trade (Department of Science and Art), who could visit each institution in succession once a week. The committee congratulated the members on the extension of the corn market, which will give increased facilities for exhibitions of agricultural and horticultural produce, and the erection over such extension of a room to communicate with the present reading-room. This will be useful for a museum of objects of local interest, as well as for drawing, music, and other classes, whilst the reading-room can be used for concerts, lectures, or other public meetings. The Olympic class, instituted for the encouragement of athletic exercises and the reward of intellectual merit in young persons, continues to increase in prosperity. The subscriptions amounted in the year to £22, of which the sum of £11 5s. was distributed in money and book prizes to competitors in public games at the meeting held on the race-course on Wednesday, September 12th; £2 in book prizes for proficiency in writing, reading, arithmetic, recitation, and plain sewing; and £6 15s. in incidental expenses. The Philharmonic class has saved £18 15s., and received promises of donations to the amount of £13, making a total of £31 15s. intended to be applied in the purchase of a piano, as soon as the amount reaches £50. Considerable additions have been made during the year to the society's collection of dried plants, 300 specimens of which, all collected in the neighbourhood of Wenlock, were exhibited on Friday, September 14th; 300 more would have been shown had there been sufficient space. Miss Brookes, of Cressage, has presented to the Society several specimens of rare and interesting native plants, moulded in wax, and has promised

to make additions to this collection next year. In the department of Local Antiquities the committee record a most valuable donation made to the Society by Thomas Mytton, Esq., of Shipton-hall, viz., the Deed of Naturalisation of the Priory of Wenlock, anno 18 of Richard II. 1695. There has also been presented to this department, a small brass bell, found in the north transept of Wenlock Abbey; models of Shropshire public seals, in gutta percha; an engraving of Charles I. (to whom the borough of Wenlock owes its second charter) taking leave of his family; four views of the abbey; Spanish, French, and English coins (one of Cromwell); and six oak trays, in compartments, for the collection of coins. During the year many interesting autographs of distinguished personages have been added to the Society's collection. The financial statement gave the following results: amount of members' subscriptions, £42; amount of expenditure, £50 18s. 3d.; leaving a balance against the society of £8 18s. 3d. The various propositions for altering the rules of the Society, &c., contained in the report were, after some discussion, adopted. M. G. Benson, Esq., was unanimously re-elected president of the society; and the following committee was appointed to see the new building carried out: M. G. Benson, Esq., Sir G. Harnage, Bart., W. P. Brookes, Esq., Rev. R. G. H. More, Rev. N. Heywood, Messrs. Burd, Blakeway, Horton, Phillips, Amphlett, and Hinton. In connection with this part of the proceedings it was stated that it was intended to begin the new building, next spring. The estimated cost of the building is £300, of which sum £160 has been subscribed. Previous to the annual meeting there was held an adjourned meeting of the Olympic class for the purpose of distributing prizes to the boys and girls belonging to Wenlock schools, and others in the neighbourhood, for the greatest proficiency shown in arithmetic, reading, writing, and recitation, and (to girls) for the best plain sewing done in the shortest time. The Rev. N. Heywood presided over the examination, and with him were associated as judges, W. P. Brookes, R. C. Blakeway, and G. Burd, Esqrs., and Mr. James. It appears that this Institution owes its origin to the honorary secretary, Mr. W. P. Brookes, who has for fourteen years been its life and soul, and conducted its operations with energy and earnestness to which its present successful condition is mainly attributed.

Plymouth.—The half-yearly meeting of the members of the Mechanics' Institute was held on Monday evening week, in the Hall of the Institute,—John Edmonds, Esq., presiding. The attendance was very limited; but it would appear from the report of the committee, that the institution is in a flourishing condition,—the names of upwards of 1000 persons being enrolled in the society's books, and a balance of £130 in the treasurer's hands. So favourable, indeed, is its progress, that a very considerable amount, in liquidation of loans on the building, has been set apart by the committee, which will reduce the debt to about £1,600. It was also stated that a valuable addition would shortly be made to the Institution, of the complete series of volumes issued from the Patent Office, London. These works having been offered to the town, on condition of a room being provided for public reference to their contents, a communication was made to the municipal authorities, on the part of the Institute, offering to provide the necessary accommodation. This proposal has been accepted; and the collection will doubtless prove of great value to those interested in mechanical and scientific pursuits. The report, after discussion and a few suggestions from one or two members present, was received and adopted. The election of six members to act on the committee in the room of those who retired by rotation, was then proceeded with; and thanks having been accorded to donors of books and periodicals to the Institution during the past half-year, and to Mr. Edmonds, for his conduct in the chair, the meeting separated.

Romford.—In the month of August last a rural *fête* was held in connexion with the Literary and Mechanics' Institution, whith afforded enjoyment to nearly 2,000 persons, and secured a profit to the institution of £100. Of this £50 has been invested, in the hope that eventually a sum will be raised sufficient to erect a building for the meetings of the Institution. The great success which attended the *fête* has encouraged the committee to appeal to the friends of the Institution for their permanent support, by becoming subscribers to its funds. There is also a strong desire to act upon the suggestion of the Rev. W. Taylor Jones, M.A., viz., to encourage healthy out-door recreation during the summer months, and make it one of the features of the Institution.

## To Correspondents.

The Secretary has received a letter from Dr. J. E. Gray, in reply to one from Mr. Theodore Rathbone, which appeared in the *Journal* of the 12th October. This will appear next week.

## MEETINGS FOR THE ENSUING WEEK.

Mon. Royal Inst., 2. General Monthly Meeting.
Architects, 8. 1. Mr. W. Tite, M.P., "Remarks on the Present Condition and Future Prospects of Architecture in England." 2. Mr. J. W. Papworth, "Considerations upon some of the Objects connected with Architecture in the Exposition des Produits de l'Industrie, at Paris, 1855."

Tues. Syro-Egyptian, 7½. Dr. Benisch, "Hebrew transcript and translation in English, with remarks, of the Phœnician Inscription lately discovered at Sidon, by Rabbi Isidor Kalisch, compared with the original inscription and with other Hebrew transcripts and English and German translations."

Wed. Geological, 8. 1. Mr. Godwin-Austen, "On the Newer Tertiary Deposits of the Sussex Coast." 2. Mr. Poole, "Report on the Coal of the North-western districts of Asia Minor."

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette October 26th*, 1855.]

*Dated 20th June*, 1855.
1405. W. C. Holmes, Huddersfield—Gas.

*Dated 21st July*, 1855.
1650. A. Tooth, 14, Mincing-lane—Curing flesh and hides of animals in an entire state.

*Dated 21st August*, 1855.
1890. G. Lewis, Leicester—Gloves.

*Dated 15th September*, 1855.
2081. P. F. Wohlgemuth, 57, New Bond-street—Bridges.
2083. H. Chandler, Birmingham—Roasting jacks.
2085. D. Hill, Tipton—Material for resisting fire in furnaces, &c.
2087. G. Hamilton, Great Tower-street—Weighing apparatus.
2089. L. D. B. Gordon, Abingdon-street—Electric telegraphs. (A communication.)

*Dated 17th September*, 1855.
2093. U. Scott, Duke-street, Adelphi—Vehicles.
2095. E. Gibbs, Wolverhampton—Picture-frames, vases, busts, &c.
2097. N. Turner, Chorley—Gold wire and gold plate.
2099. G. Copland, Liverpool—Fluid compound for destruction of bugs, &c.
2101. J. H. Destibeaux, Paris—Waterproof fabric.
2103. C. T. and E. B. Bright, Liverpool—Electric telegraphs.

*Dated 18th September*, 1855.
2105. I. J. Halcome, Cambridge—Skeleton maps.
2107. P. G. Barry, Gray Town, France—Obtaining products from bituminous shale, bog-head mineral, &c.
2109. A. V. Newton, 66, Chancery-lane—Paddle-wheel. (A communication.)
2111. J. Willis, Cheapside—Umbrella and parasol furniture.

*Dated 19th September*, 1855.
2113. G. A. Biddell, Ipswich—Railway crossings.
2115. W. R. Lomax, Hammersmith—Steam engines.
2117. J. H. Linsey, 12, Pilgrim-street, Ludgate-hill—Account and other books.

*Dated 20th September*, 1855.
2119. J. Page, Perth, and W. Robertson, Dundee—Moulding or shaping metals.

*Dated 21st September*, 1855.
2121. A. Lees and J. Clegg, Oldham—Looms.
2123. G. S. Parkinson, 14, Devonshire-terrace, Kensington—Railway breaks.

*Dated 22nd September*, 1855.
2125. W. Pollitt, Clayton-le-Dale, and J. Eastwood, Blackburn—Apparatus for churning milk and mixing liquids.

*Dated 24th September, 1855.*

2134. J. Musto, Cambridge road, Mile End, and F. Bear, 43, Northampton-street, Mile End—Tobacco machinery.

*Dated 1st October, 1855.*

2184. W. Kempe, Leeds—Machinery for raising pile on fabrics.

*Dated 10th October, 1855.*

2262. T., W. A., and G. Fairbairn, Manchester—Casting ordnance.
2264. W. E. Newton, 66, Chancery-lane—Flour-dressing machinery. (A communication.)
2266. T. Oddie, and W. and J. Lancaster, Preston—Looms.
2268. D. Hébert, Paris—Heating and arranging ovens. (A communication.)

*Dated 11th October, 1855.*

2270. R. R. Reinagle, 12, King William-street, Strand—Barrows, hand-trucks, &c.
2272. J. Gilpin, Leeds—' Raising gig.'
2274. W. Bayley and J. Quarmby, Stalybridge—Carding machines.
2276. W. B. Adams, 1, Adam-street, Adelphi—Woodworking machinery.
2278. R. A. Tilghman, Philadelphia—Treating fatty and oily substances.

*Dated 12th October, 1855.*

2280. F. Puls, Soho-square—Electro coating metals.
2282. T. Moore, Retford—Corn mill.
2284. C. Ward, 36, Great Titchfield-street—Clarionets.
2286. J. Livingston, Leeds—Permanent way.

*Dated 13th October, 1855.*

2288. J. S. Cockings and F. Potts, Birmingham—Sockets for whips and candles.
2290. G. A. Thibierge, Versailles—Chlorine.
2292. W. G. Eavestaff, Great Russell-street—Pianofortes.
2294. J. Moseley, Birmingham—Machinery for cleansing linen, &c.
2296. G. T. Bousfield, Sussex-place, Brixton—Power looms. (A communication.)
2298. G. T. Bousfield, Sussex-place, Brixton—Looms for weaving wire fabrics. (A communication.)

*Dated 15th October, 1855.*

2300. C. Leftwich, 21, Munster-street, Regent's-park — Water-closets.
2302. T. W. Dodds, Rotherham—Firearms, and ordnance, and projectiles.
2304. R. Benton, Birmingham—Motive power by leverage.
2306. E. A. L. Negretti and J. W. Zambra, Hatton-garden—Mercurial meteorological instruments.

*Dated 16th October, 1855.*

2308.—G. Thompson, Glasgow—Steam engines.
2310. W. Church, Birmingham—Ordnance.
2312. J. Forrest, Dears'-place, Somers-town—Extracting metals from their ores.
2314. T. A. Claeijs, Bruxelles—Corks and bungs.

*Dated 17th October, 1855.*

2316. W. Crossley and S. Beaumont, Hulme, Manchester—Cement.
2318. J. H. Clément, Paris—Railway break.
2322. E. Mackinlay, Glasgow—Reeling apparatus.
2324. W. H. Walton, Glasgow—Carding machine.
2326. I. J. Halcombe, Cambridge—Gates.
2330. T. Taylor, Manchester—Extinguishing fire.
2332. T. R. Harding, Leeds—Combs, gills, and hackles.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2345. W. Basford, Penclawdd, Glamorgan—Purification of coal-gas and obtaining a residuum.—19th October, 1855.
2362. P. A. Leroux and L. R. Martin, Paris—Combining a resinous matter with oils or fatty bodies, in order to obtain various useful products therefrom.—22nd October, 1855.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed October 26th, 1855.*

945. Auguste Edward Loradoux Bellford, 32, Essex-street, Strand—A new combination of slide valves and ports for the induction and eduction of steam or other elastic fluid in steam-engines, or other engines of similar character.
951. Thomas Page, Middle Scotland Yard—Improvements in ordnance.
957. Richard Clark, Strand, and John Thomas Stroud, Suffolk-street, Birmingham—Improvements in lighting, applicable to table, street, signal, and other lamps, as also for the constructing, denoting, and regulating the signals and burners of lighthouses.
959. Daniel Warren, Exmouth—Improvements in obtaining and applying motive power.
976. James Edward Boyd, Hither Green, Lewisham—A 'ship's course indicator' or exhibitor, for the purpose of exhibiting to the helmsman and others in a legible manner the course which a ship is to steer, as well as for certain improvements in ship's compasses.
980. Robert Adcock, Wolverhampton—Improvements in the purifying processes of alcoholic liquids.
988. Marie Amédié Charles Mellier, 47, Rue de Seine, St. Germain, Paris—Improvement in the manufacture of paper.
1002. Robert Midgley, Salterlee Mill, Halifax, and George Collier, Halifax—Improvements in preparing yarns for weaving and other purposes.
1022. James Lewis, Holborn—Improved soap.
1030. John Allin Williams, Baydon, Wilts—Improvements in machinery or apparatus for driving or actuating ploughs and other implements employed in working and cultivating land.
1034. Jules Joseph Imbs, Brumath, France—Improvements in manufacturing cartridges or cases for containing charges for fire-arms.
1054. Matthew Allen, Worship-street—Improved valve, particularly applicable for regulating the supply of air to furnaces and fire-places.
1058. Charles Jared Hunt, The Willows, Mitcham—Improvements in tug and other hooks.
1078. William Dray, Swan-lane—Improvements in the manufacture of frames for all kinds of structures, together with the means of fastening the same when necessary, part of which is applicable to the manufacture of screws and bolts.
1114. Alexandre Maximilien Mennet, Paris—Improvements in ornamenting textile and other fabrics.
1146. John Mahon Murton, 3, Somers-place-west, St. Pancras—Improvements in sister hooks and thimbles for ships and boats' riggings, such improvements or parts thereof being applicable also to other purposes where hooks are required.
1188. John Allen and William Allen, Wallsend, near Newcastle-on-Tyne—Improvement in applying heat to alkaline solutions and to drying and making alkaline salts.
1318. Cromwell Fleetwood Varley, 1, Charles-street, Somers-town—Improvements in electric telegraphs.
1854. Francis May, Tooley-street, Southwark—Improvements in obtaining instantaneous light. (A communication.)
1894. Lucius Paige, Vermont, U.S.—Improvements in brake mechanism for railway carriages.
1910. William Denton, Addingham, Yorkshire—Improvements in drawing wool and other fibrous substances off the combs of combing machines.
1944. Alfred Vincent Newton, 66, Chancery-lane—Improvements in separating substances of different specific gravities.
1946. Benjamin Moore, New York—Improvements in sewing machines.

*Sealed October 30th, 1855.*

965. Edward Acres, Pouldrew Mills, Waterford—Improvements in desiccating and cooling atmospheric air, and the application thereof to useful purposes.
969. Henry Francis, 456, West Strand—Improvements in manufacturing boots and shoes.
973. William Eassie, Gloucester—Improvements in machinery or apparatus for stopping or retarding railway trains.
975. William Hartley, Bury—Improvements in safety valves, and in apparatus connected therewith, applicable also to regulating the flow of steam for other purposes.
985. Samuel William Campain, Deeping Fens, Lincoln—Improved machinery for filling corn and other sacks.
997. Jean Pechgris de Frontin, Agen, France—The use of a new material in the manufacture of paper and pasteboard.
999. John Hamilton, junior, James street, Liverpool—Improvements in the construction of iron girders.
1003. Joseph Beaumont, Elland, York—Improvements in treating wheat meal obtained in the manufacture of flour.
1011. Henri Marquis de Balestrino, Genoa—Improvements in obtaining motive power by the aid of explosive gases.
1019. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in hair and other pins used as dress or ornament fastenings. (A communication.)
1025. Joseph Hughes, White Hall Mills, Chapel-en-le-Frith—Improvements in the manufacture of paper.
1029. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in machinery or apparatus for the manufacture of paper tubes to be employed in connection with spinning machinery. (A communication.)
1031. James Bowron, Tyne and Tees Glass Works, South Shields—Improvement in the manufacture of glass tiles.
1035. Thomas Williams, 14, Red Lion-street, Clerkenwell, and John Hobson Fuller, New Brentford—Improvements in wrenches, pliers, and spanners.
1049. Charles Mertens, Gheel, Belgium—Improvements in breaking and scutching flax, hemp, and other fibrous matters, and in the machinery employed therein.
1059. Joseph Hallam, Sheffield, and John Elce, Manchester—Improvements in the construction of rowels or toothed cylinders for self-acting temples and other purposes.
1065. James Steele, Greenock—Improvements in effecting the drainage of moulded sugar.
1071. John Herdman, Belfast—Improvements in the manufacture of wrought iron plates adapted for ship-building and other purposes, for which strength and lightness are required.
1085. Robert McConnel, Glasgow—Improvements in beams or girders for building or structural purposes.
1105. Charles William Siemens, John-street, Adelphi—Improvements in cooling and in freezing water and other bodies.
1131. Paul Firmin Didot, Paris—An improved process of bleaching paper-pulp, textile fabrics, and other substances or matters.
1173. George Walker Muir, Glasgow, and Matthew Gray, Bonhill, Dumbarton—Improvements in admitting and regulating the admission of air to furnaces.
1181. Edwin Haseler, Wolverhampton—Improvements in frames for pictures, drawings, engravings, and other similar articles.
1183. Alexander Melville, Baker-street, Portman-square—Improvements in breech-loading firearms, and in projectiles used therewith.
1224. Jean Baptiste Acklin, Paris—Improvements in the mode substituting paper for pasteboards in jacquard looms.

1337. William Armitage, Manchester—Improvements in the manufacture of union bags and sail cloth.
1343. Henry William Ford, Gloucester—Improvements in machinery or apparatus for effecting agricultural operations.
1383. William Little, Strand—Improvements in printing machinery.
1455. Thomas Beatt Sharp, Manchester, and Alexander Yorston, Belfast—Improvements in the arrangement and construction of furnaces or fireplaces.
1467. Thomas Swinburne, South-square, Gray's-inn—Improvements in machinery for applying and obtaining motive power, applicable, but not exclusively so, in the propulsion of vessels and railway trains.
1527. Christian Friedrich Werner and Ludovicus Piglhein, Hamburg--Improved manufacture of elastic stuffing for chairs, couches, and other articles requiring the same.
1551. Julius Jeffreys, Kingston-hill—Improvements in sun blinds or solar screens.
1625. John Pretty Clark, Leicester—Improvement in the manufacture of metallic reels.
1653. Edward Myers, Rotherham—Improvements in buffers and other springs for railway and other carriages.
1671. Louis Antoine Ritterbandt, Warwick-street, Regent-street, M.D., and Joseph Bower, Hunslet, near Leeds—Improvement in the manufacture of manure.
1683. Richard Polkinhorn Huthnance, Chipping Norton—Improvements in drying, and in apparatus to be used therein.
1691. William Weallens, 12, Elswick-villas, and George Arthur Crow, Forth-street, Newcastle-on-Tyne—Improvements in steam engines.
1739. Joseph Robert, Liege—Improvements in machinery for manufacturing firearms.
1743. John Clarke, Leicester—Improvements in machinery for making loop fabrics.
1751. Rudolph Bodmer, 2, Thavies-inn, Holborn—Improvements in rotatory steam engines. (A communication.)
1755. Henry Hough Watson, Bolton-le-Moors—Improvements in the manufacture of coke.
1773. Edward Hall, Dartford—Improvements in the manufacture of gunpowder.
1787. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture of india-rubber. (A communication.)
1799. John Sidebottom, Broadbottom, Chester—Improvements in shuttles and in skewers for shuttles and other purposes.
1803. Alonzo Webster, Vermont, U.S.—Improvement in machinery, by which a horse may be suddenly disengaged from a carriage while running away with the same, or whenever required to be detached from it quickly. (Partly a communication.)
1839. Thomas Kempson, Birmingham—Improved steam engine and boiler.
1871. George Collier, Halifax—Improvements in weaving plush by power, parts of which improvements are applicable when weaving other fabrics.
1879. Alphonse René Le Mire de Normandy, 67, Judd-street, Brunswick-square—Improvements in the manufacture of soap.

Patents on which the Stamp Duty of £50 has been Paid.

*October 22nd.*

495. David Crichton, Manchester—Arrangements and apparatus for producing continuous circular motion, giving a series of different velocities obtained from alternate motions, applicable to looms and other machines.
504. George Kennedy Geyelin, Camden-town—Improved machine for grinding pigments or other vegetable or mineral substances.
625. John Cameron, Manchester—Improvements in boilers for generating steam, and in feed-pumps, and in apparatus connected therewith.
646. George Fife, M.D., Newcastle-upon-Tyne—Improvements in steam and water gauges.

*October 23rd.*

579. Alfred Vincent Newton, 66, Chancery-lane—Improvements in machinery for cutting corn and other standing crops. (A communication.)
590. William Petrie, Woolwich—Improvements in the manufacture of sulphuric acid.
592. George Dixon, Dublin—Improvement in bleaching palm oil.
662. Peter Fairbairn, Leeds, and John Hargrave, Kirkstall—Improvements in machinery for opening, combing, and drawing wool, flax, and other fibrous materials.
721. Caleb Bloomer, West Bromwich—Improvements in the manufacture of anchors.
832. John Beale, East Greenwich—Improved arrangement of steam-engine, and an improved packing to be used therein.
1131. John Roberts, Upnor—Improvements in apparatus for preserving animal and vegetable matters, and for cooling wines and other liquids.

*October 24th.*

519. Mathew Fitzpatrick, Upper Cleveland-street, Fitzroy-square—Improvements in machinery or apparatus to be applied to locomotive engines and carriages for the prevention of accidents, and also in the manufacture and application of indestructible and non-rebounding cushions to be applied to the above, and for other similar purposes.
528. Halsey Draper Walcott, Boston—Improved mechanism or contrivance for cutting button-holes or slits in cloth or other material.
589. William Danteo, Liverpool—Improvements in preventing incrustation in steam-boilers.
749. Amory Hawkesworth, Abbey-road, Torquay—Improvements in life-boats.
801. John Trestrail, Southampton—Improvements in raising sunken vessels or other materials from under the water or in the sea, or to prevent them from sinking,
883. William Massingham, Ipswich—Improvements in carriages and apparatus for carrying the dead.

Patents on which the Third Year's Stamp Duty has been Paid.

*October 16th.*

425. William Roberts, Millwall, Poplar—Improvements in machinery for stopping and lowering cables and other chains.
450. George Heyes, Blackburn—Improvements in the manufacture of fancy woven or textile fabrics, and in the machinery or apparatus connected therewith.
465. Joseph Cundy, 21, Victoria-grove, Kensington—Improvements in hot-air stoves.
725. Julien François Belleville, Paris—Improvements in generating steam for producing motive-power or heat.
746. Joseph Cowen, Blaydon-burn, near Newcastle-upon-Tyne, and Thomas Richardson, Newcastle-upon-Tyne—Improvements in the manufacture of sulphuric acid.

*October 17th.*

422. George Randfield Tovell, Mistley, and John Mann, jun., Colchester—Improvements in the construction of ships and other vessels.
515. Robert William Mitcheson, Garford-street—Improvements in anchors.
584. George Thomas Selby, Smethwick Tube Works, Birmingham—Improvements in steam boilers.

*October 18th.*

453. Frederick Richards Robinson, Charlestown, Massachusetts, U.S.—Improvement in the gridiron or instrument for cooking steaks or other articles by broiling.
487. Archibald Slate, Dudley—Improvements in the manufacture and construction of cores and core bars used in the production of hollow castings in iron and other metals.
624. Edward Lord, Todmorden—Improvements in certain machinery to be used in preparing, spinning, and weaving cotton and other fibrous substances.

*October 19th.*

474. William Weild, Manchester—Improvements in looms for weaving certain descriptions of pile fabrics.

*October 20th.*

477. Henry Charles Gover, 9, Prince's-street, Bedford-row—Improvements in the apparatus used in printing with colours.
509. Charles Watson, 31, Rhodes-street, Halifax—Improvements in ventilation.

*October 25th.*

524. Charles Rowley, Birmingham—Improvements in nails.
525. Myer Myers, Maurice Myers, and William Hill, Birmingham—Improvements in pens and penholders.
533. Alfred Charles Hervier, Paris—Improvement in the application of centrifugal force to propelling on water.
582. James Sinclair, Stirling—Improvements in engines to be worked by steam, air, or water, the said improvements being also applicable to pumps.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3770 | October 19. | Combined Expanding Carriage Bow Spring | Wheeler, Kinder, & Robinson | Leicester. |
| 3771 | „ 22. | "The Kaloped," or Self-adjusting Colosh | Adolph Stargardter | 4, Mitre-street, Aldgate. |
| 3772 | „ 22. | Dies of Vices, for holding Tubes or other Circular Articles | Samuel Garside | Ashton-under-Lyne. |
| 3773 | „ 24. | Stirrup | Fairbanks and Lavender | Walsall. |
| 3774 | „ 25. | Billiard Bagatelle Table | Samuel Twist | Birmingham, |
| 3775 | „ 25. | The Perflated Coat | James Fairman | 4, Bishopgate-street Within. |
| 3776 | „ 31. | A Wheel Roller for Clod-Crushers | William Tasker and<br>Charles Haslem | Newbury.<br>Reading. |

Journal of the Society of Arts.

*FRIDAY, NOVEMBER* 9, 1855.

## FREE LIBRARY FOR LONDON REJECTED.

(From the *Morning Post.*)

On Monday a public meeting of the ratepayers of the City, convened by the Lord Mayor, in obedience to a vote of the Court of Common Council, was held in the Egyptian Hall, Mansion House, to decide if they would avail themselves of the benefits of the Public Libraries Act.

His Lordship, on taking the chair, said that there were few subjects on which he could call them together to deliberate with more entire satisfaction to himself than on that of establishing a free library, open to all, in which his fellow-citizens might avail themselves of the intellectual labours of those gifted with genius and learning for their own improvement. To convene a meeting for such a purpose was doubly gratifying to him in his municipal capacity, as it so contrasted with the ordinary duties of officers like himself, a considerable portion of which were devoted to the punishment of crime. His lordship then explained the provisions of Mr. Ewart's Act, and the maximum extent of rating which it sanctioned, and informed the meeting that that rating could not be imposed unless a clear majority of two-thirds of the present meeting agreed to it. He had himself no particular feeling with respect to the matter, but he wished them clearly to understand that the adoption or rejection of the measure would be their own act.

Mr. Sergeant Mereweather having read the clauses of the Act as applicable to the City of London, stated that all the preliminaries of the meeting had been legally complied with.

Mr. Ewart, M.P., in proposing the first resolution, to the effect that the meeting, convinced of the great moral and social advantages of education, hailed with satisfaction the opportunity of establishing in the City of London a free library and museum, open to all classes of the community, stated that there were already two free libraries in Manchester, one for Manchester properly so called, and the other in Salford. In Liverpool, too, the inhabitants had lately raised £12,000 for the purpose of erecting a new building for the accommodation of their free library. In addition to that £12,000, one of the inhabitants of the town (Mr. Wm. Brown, M.P.) had contributed £6,000 towards the purchase of books. The building at present used as the library was formerly a Socialist hall, in which were promulgated doctrines opposed to good order, and in nowise congenial with the interests of learning. He might add that, of the £12,000 originally subscribed for the purchase of the building, as much as £800 had been contributed by working men. It was not, however, in Manchester and Liverpool only that the experiment had been tried with success, for in the small town of Hertford the rateyayers had unanimously resolved to establish a free library. On the Continent, there was scarcely a town of 3,000 inhabitants which had not its free library. Every such institution established in this country, independent of the other advantages which it would afford, would become the nucleus of a mass of topographical knowledge for the use of future Macaulays. In Liverpool and Manchester there were lending libraries in connection with the free libraries, and he found, by the report of the librarians, that out of 110,000 volumes lent out to the people to read, only one volume had been lost. The use of books would teach the people to reverence books, and would raise their intelligence. Indeed, as it was, the people were most careful of the books lent to them, and in taking them from the lending libraries covered them with cloth as a protection. In the free libraries the rich would meet with the poor, the native with the foreigner, and their intercourse would naturally break down those barriers which at present prevented them from fully appreciating each other; it would, too, lessen the rancour of religious discussions, as all would see that they were met on common ground for a common object, the good of the community. In conclusion, he would rest the approval of the act upon the intelligence of the City of London, and should they reject it, he should look upon their doing so with feelings of astonishment.

A person in the meeting desired to know if Mr. Ewart was a ratepayer. (Great confusion.)

The Lord Mayor replied in the negative, but added that as none but ratepayers would be allowed to vote on the motion, it was immaterial who proposed it.

Col. Sykes seconded the proposition, and said he was astonished that the subject had not been taken up before in the City. The expense would be trifling, for although the maximum limit of the rate was a penny in the pound; yet in actual practice it would not amount to the ghost of a farthing in the pound; and he hoped that, for the honour of the City, they would consent to tax themselves to that extent. In Munich they had 17 libraries free to the public; in London there were only 22 volumes available for every 100 of the inhabitants. In Paris, the proportion was 162 to every 100; in Berlin, 182; in Florence, 317—(cries of "It does them much good," and "The Madai into the bargain")—and in Copenhagen, 460. Having thus placed before them the relative accommodation in books which the inhabitants of the principal cities of Europe enjoyed, he would conclude by stating his fullest concurrence in the remarks of Mr. Ewart upon the usefulness of lending libraries.

Mr. Cox wished to know if there were not a free library already existing in the City?

The Lord Mayor—No.

[Here a scene of indescribable confusion took place, seven or eight gentlemen, each of stentorian lungs, attempting simultaneously to address the meeting.]

Mr. Deputy Peacock, on the ground that the present taxation was oppressive, and the consolidated rate in debt to the extent of £90,000, moved, as an amendment, that the resolution be not put for approval.

Mr. Cox seconded the amendment, and explained that he had supported the proposition when brought before the Common Council, because he wished that such a voice should proceed from the present meeting as would show to the corporation the necessity of extending the usefulness of the library in Guildhall.

Mr. Deputy Bowyer supported the amendment, as there were already 35 libraries and 27 museums for the use of the people in the metropolis. He instanced, too, the failure of the London Institution, the Aldersgate Institution, and the Birkbeck Mechanics' Institution, to show that there was not a reading public in London during the evenings, as those employed in the City for the most part slept in the country.

Mr. Abrams, amidst loud cries of "Divide, divide," supported the original resolution.

The Rev. Mr. Mackenzie, for the honour of the City, and for the benefit of the young men employed in it, who, he contended, did not reside in the country, also supported the original motion, and remarked that the institutions referred to by Mr. Deputy Bowyer had failed because they had not been free.

After some observations from Dr. Sparke and Mr. Dodd, which were almost inaudible,

Mr. Tite said that there was no doubt of the motion being rejected, and he considered its introduction ill-timed. He wished it, however, to be understood that the rejection took place on account of the pressure of the times, and not from any opposition to the principle of free libraries. He thought that the required library might be established by private subscription.

Mr. Mechi maintained that the cost of the library would be no burden to the poor, as it would be borne almost entirely by the large wholesale houses.

Alderman Sidney condemned the whole movement, as founded on a spurious liberality, which pretended to provide for the working-classes, who perfectly well knew their own business.

After a few words from Mr. Bennoch in support of the motion,

The Lord Mayor put the amendment to a show of hands, and declared it carried by a large majority.

Loud cheering followed the announcement.

On the motion of Mr. Tite, M.P., seconded by Alderman Finnis, a vote of thanks was passed to his lordship for his conduct in the chair, and the proceedings terminated.

## SALFORD BOROUGH ROYAL MUSEUM AND LIBRARY.

The seventh report of the Executive Committee states that "it is most gratifying to them to find that the demand for useful knowledge by the artisans, mechanics, and other operatives, who have so largely availed themselves of the benefits of the Library and Museum, has, during the six years of its existence, continued steadily to increase, thus proving to demonstration the desirableness of establishing free public libraries, and especially in populous districts.

"The number of volumes issued in the Reference Library in the past year is 73,780, and in the Lending Library, 34,822, making an aggregate of 108,602 volumes delivered to readers, thus showing that nearly one-third part of the books are taken to the dwellings of the applicants for careful reading and study.

"The Executive Committee, finding the usefulness of the Lending Library gradually extending, and the circulation rapidly increasing, have added by purchase during the past year about 1,800 volumes of carefully selected books, and the Lending Library now consists of nearly 5,000 volumes. The Reference Library has likewise been augmented by donations and by purchase to the extent of 1,200 volumes, of which 1,043 volumes have been by donation, making an addition of 3,150 volumes in the year.

"The Committee have again to acknowledge the great liberality of E. R. Langworthy, Esq., by whose contributions the whole of the funds available for purchasing books and specimens during the past year has been supplied."

The report then refers "to the orderly demeanour of the many thousands who have visited the Institution, and the care which is taken by them of the books, especially those in the lending department, which are almost invariably returned without damage or injury."

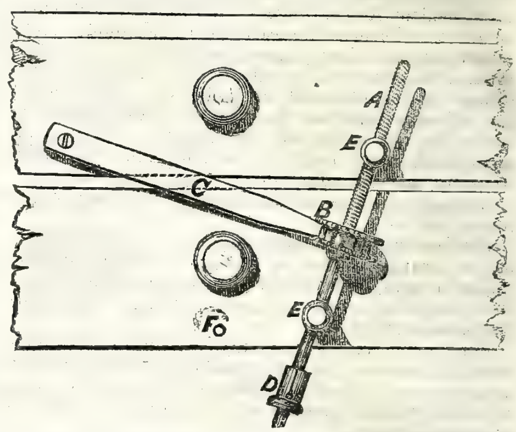
Some very valuable donations have been made to the Library and Museum, including a copy of the Grants and Specifications of the Letters Patent for Inventions, which have been bound, and comprise nearly 300 volumes. Specimens in natural history of considerable value and interest have been this year added to the Museum, and also many mechanical models, presented by Mr. Richard Roberts, C.E.

The statistical returns compiled by Mr. Plant, the curator, show the gradual appreciation by the working classes of the advantages offered to them by the Library; and also "a marked improvement in the class or character of the literature sought after by them; thus establishing the fact, that, as the desire for reading progresses, the reader is led on to seek for works of a more useful and elevating kind; or in other words, that literature of a light or pleasing kind eventually gives place to history, science, and general literature. These returns also show that the Library is used almost exclusively by the operative classes, and especially by young men, the number issued to readers under 21 years of age greatly preponderating over those read by persons of more mature years, a fact which is most encouraging to the promoters of free libraries.'

## A NEW PARALLEL AND RADIAL RULE.

By E. T. Loseby.

The accompanying engraving represents the middle of the rule, containing the improved portions; the ends being of the ordinary construction, they are omitted.




A is a straight steel wire, made into a screw at one end, on which is fixed a nut, B, milled on the edges and divided into ten notched divisions, which admit the end of the steel spring, C, and prevent the screw being accidentally moved; the spring is made to travel with the screw, by its acting in a groove sunk in the nut; D, a clamp, milled on the edge, which is slit to make it move tightly and evenly along the wire; the audible sound which the spring makes in falling into the notches enables them to be counted by ear to relieve the eye; whole turns are counted by a mark placed on the nut, and every tenth turn by a notch in the wire. E E, two studs, screwed into the rule, in one of which the screw works and the other forms a stop, which, limiting the range of the clamp, D, regulates the distance the rule opens; the holes in the studs are a little elongated horizontally, to allow of the wire accommodating itself to the motion of the rule; the wire being placed at the best angle with the joint arms for reducing the motion to the lowest amount.

The screw should be of the proper pitch to open the rule $\frac{1}{100}$ of an inch each revolution, which it would do with 100 turns to the inch if placed at a right angle with the rule, but as the proper angle is rather less, the screw requires to be proportionably coarser, in order that each division on the nut may be equal to $\frac{1}{1000}$ of an inch, each turn to $\frac{1}{100}$, and each notch on the wire to $\frac{1}{10}$.

In setting the rule to open accurately a particular distance, the nut, B, is screwed forward close to the screw-stud, and the clamp, D, pressed along the wire to the stop-stud, so as to keep the rule quite close without it being strained. The marked division on the nut should now be uppermost, and the clamp at the zero notch on the wire; the nut is then unscrewed the requisite number of turns and parts of a turn, to accord with the number of tenths, hundredths, and thousandths of an inch required. For less accurate purposes, the clamp may be set to the proper division on the wire by the eye, without it being screwed home, the object of which is to ensure perfect contact of the bearings.

The rule is converted from a parallel to a radial rule by a point placed at F, and a small hole, not shown in the drawing, drilled in the line of the line of the straight-edge at the end towards the left hand, through which, and the centre of the circle to be divided, a pin is driven into the drawing-board; the rule being then opened and closed in the ordinary way by a finger placed on each of the studs, it is constrained by the points to move round in a circle.

One of the finger-studs is made to serve for the point by screwing it into the hole, F, and the rule being thinner to-

wards the edge, it allows the point to project sufficiently there without projecting when placed in the other hole for drawing parallel lines; the studs are milled on the edge to facilitate their being unscrewed with the fingers.

The different parts should be so proportioned and arranged that when the back point is placed at F, so as to be convenient for the fingers, the two points will remain at the same distance from each other, and simply revolve whilst the rule is being opened and closed, and that ten turns of the screw will be equal to 1°. Both these conditions can be fulfilled if the proper size and position of the following parts are observed, viz.,—the distance between the two points, and the distance of F from the straight-edge; the length of the joint-arms from centre to centre, and the angle they are placed at on the rule.

Amongst the uses of the rule the following may be mentioned:—

For drawing any number of lines at equal distances—as, for example, those in sectional drawing, shading, flights of steps, screw threads, laying on a tint of equal lines similar to engravers' machine-ruling, ruling paper for tables, writing, &c.

For drawing lines at increasing or diminishing distances—as, for instance, giving the position, without individual measurement, of doors, windows, columns, &c., in a range of buildings seen in perspective; the position of wheel-teeth seen edgeways, &c.

For graduating straight scales of divisions either at equal distances, as those of thermometers, &c., or at accumulating distances, as those of hydrometers.

For drawing radial lines round a circle, either at equal distances or at increasing or diminishing distances.

For dividing circular scales into equal or accumulating spaces, laying down angles, &c.

A gauge for short distances, giving micrometer measurements.

It would add to the security of the rule in drawing parallel lines if four pointed screws, similar to the one used at F, were placed at the corners to diminish the risk of its slipping; but for very accurate work, such as engravers', this may be more effectually done by fixing the back of the rule to the drawing-table frame, or board with pins, reversing the clamp, D, and placing it to act on the other side of the stop-stud, and working the front half of the rule by the screw alone. This arrangement will allow a tool to be pressed against the straight-edge with sufficient force for engraving wood blocks or steel plates.

One or two other things remain to be noticed which apply to ordinary rules as well as to those above described. First, they should have discs of thin metal between the joint arms and the rule, to prevent any rubbing at a distance from the rivets. Secondly, the straight-edge should be of steel, hardened and tempered to resist the action of tools drawn along it: the steel which is cheaply prepared for ladies' stays answers very well; it may be fixed by being cemented into a groove in the rule. Thirdly, the rule, instead of being flat on the under side, as they are usually made, should be slightly bevelled towards both edges, so as to divide the width into three equal bearings; this effects two objects, one of which is to make the rule easier to work and less liable to shift accidentally, as when one side is pressed down it raises the other, and keeps it quite free whilst it is being moved; the other object is to enable the same straight-edge to be raised different distances from the paper whilst drawing the lines by pressing down the front, middle, or back, of the rule.

As several years have elapsed since the construction was completed and arranged in the present form, after several others that occurred to me had been tried, and as improvements in mathematical instruments very seldom repay the heavy cost of a patent, the construction is now open for any one to manufacture, but in order to afford further facility for its being properly carried out, I have furnished detailed instructions to the principal mathematical instrument makers, who are making arrangements for supplying the improved rules to the public; having done thus much in the matter and occupied several months with the rule at different times, it must rest with them whether it is perfectly manufactured or not.

## TANNING SAILS.

Fishermen *tan* their sails to render them more durable; but does the benefit of this practice arise from the preservative quality of gallic acid, or from some other cause? This being a question of much importance, the late Sir Samuel Bentham determined to investigate the matter. He procured a piece of linen, had it thoroughly washed, to free it from the starch used in weaving, then had it made into half-a-dozen pair of drawers. The *right* legs of half of them were *tanned* and the *left* legs of the other three pair, the other legs being left in their original state. All the drawers were worn till ragged, and no difference could be discerned between the tanned and untanned halves.

The results of this very simple experiment were important. Sir Samuel had all along conceived that the beneficial practice of tanning sails depended, not on the impregnating them with gallic acid, but on the paste being by this process either decomposed, or washed out; therefore in the year 1803, during a visit to many of our principal manufacturing establishments, he endeavoured to find master weavers of sail-cloth who would furnish Government with sail-cloth woven *without* starch, but failed till he arrived at Castle Eden. It was contrary to the interest of weavers to so weave sail-cloth, for besides the additional trouble of weaving without it, "five or six pounds of starch making a difference of 10 per cent.," is much cheaper weight for weight than yarn, and two or three pounds of starch or often more remained in a piece of sail cloth. At length, at Castle Eden, it appeared that by that company's peculiar mode of placing the yarn in the loom, namely, in a contrary direction to that in which it was spun, there was little difficulty in beating up the weft. Mr. Scarth, the acting manager of the company, undertook to furnish some pieces of sail-cloth woven entirely *without starch*, and on the 13th of April, 1804, the General proposed that a trial should be made of the Castle Eden sail-cloth thus woven. Whether sail-cloth be now woven with or without starch is not known. I have been told that of late sail-cloth is boiled; if a sufficiency of water be used, the starch will be got rid of, but a single boiling can scarcely suffice, especially when the quantity of water is not very abundant.

Much has been said and written about the adulteration of food, whilst that of manufactures is scarcely noticed; for instance, excepting in Sir Samuel's papers, it does not seem that the substitution of cheap starch to high-priced flax has been brought to notice.

There is another common practice that deteriorates sail-cloth, namely, that of using lime for bleaching it, instead of pearl-ash or soda, and the mischief is so much the greater that it cannot be discovered when the article is fabricated. M. S. Bentham.

# Home Correspondence.

## DECIMAL COINAGE.

Sir,—Having been absent from London during the greater part of the last month, I did not see Mr. Theodore Rathbone's letter, inserted in your number of the 12th instant, until this morning. It would be too tedious, and would only serve to weary your readers, to go through a detailed comparison of the letter with his original communication, on the subject of a decimal coinage, in the *Athenæum* of the 3rd of September, 1853. Although it

would be easy to show how widely they differ in many respects, this exposition would, however, be much more simply and completely effected by a reprint of Mr. Theodore Rathbone's communication in the *Athenæum*, which would fully justify all I have said in relation to it. I would ask for no better proof of all that I have advanced, and I therefore earnestly request that you will afford your readers the opportunity of judging for themselves which of us has correctly or incorrectly represented its contents. If you should think proper to comply with this request, I will gladly forego all comments upon the letter, leaving it to tell its own tale.

I am, Sir, your obedient servant,
JOHN EDW. GRAY.

British Museum, 30th October, 1855.

"DECIMAL COINAGE.

"Everyone who has reflected on the subject must have observed with unmixed feelings of satisfaction the general conclusions of the Committee of the House of Commons appointed to take in consideration and report on the practicability and advantages, or otherwise, of adopting the Decimal system of coinage in this country—the unanimous, unequivocal opinions of almost all the various witnesses examined, and the general urgent demand for some prompt and decisive action. Before it is too late, I would, however, beg to be allowed to call attention through your columns to one most important view and mode of proceeding which has not yet I think been sufficiently taken into consideration; although we might thus, with very slight modification of the propositions of the Committee and no practical sacrifice whatever of their advantages, but on the contrary with much less disturbance of existing arrangements, secure the almost inestimable *additional* advantage of a clear, intelligible, *universal monetary system*,—already sufficiently in existence for the purpose in a great portion of the civilized world, and certain, if taken up by this country, to extend itself universally.

"I quite agree with the Committee, that this country has kept accounts too long in and is too widely bound up with *pounds sterling*, represented by the sovereign, to allow of its being either reasonable or practicable to give up this great denomination in our accounts and our coinage. On the other hand, France has now extended over the Continent far too widely to be ever abandoned that beautifully simple, admirable system of francs and Napoleons,—the delight of every Continental traveller, and equally the source of his grief and regret when passing on into the varieties and perplexities of absurd coins and accounts, changing (literally with railway speed) from hour to hour, which still disgrace some parts of Europe. *Instead, then, of the entirely new coinage and designation of mils and their multiples, up to the thousand making a sovereign*, proposed by the Committee,—would it not be wiser to sacrifice a little of theoretic nominal perfection for the far more simply and easily obtained, and surely greatest of all possible practical advantages arising out of the following plan of proceeding! Let it be assumed that *the European franc will ultimately become the universal unit in all accounts, and let all coins whatever be multiples or definite portions of the franc, with the exact number and proportion which they represent distinctly expressed upon them in all cases;* and for the present let the amounts of the various coins in use, and to be kept in circulation in different countries, and the exact mode of keeping accounts, be left, *subject to this one condition*, to be settled in each of them as circumstances shall determine. In this country, for instance, in place of the half-dozen new mil coins, wholly without correspondence with anything now in existence, proposed by the Committee, and the banishment of all the old figures but the pound sterling from our accounts, we should have little to do but to substitute an issue of francs for our shillings, to stamp our sovereigns with the number 25, our crowns as 6, and our half-crowns as 3-franc pieces,—and we might still keep our accounts in pounds, *francs* and pence (or double sous), instead of our present pounds, *shillings*, and pence. If a foreigner hears of £1000 sterling he then is at once aware that 25,000 francs is the sum indicated, and if he enters England laden with his rouleaus of 5-franc pieces he knows at once that five of them make up the current gold coin of the country. When the alarming amounts of francs with which an Englishman is sometimes perplexed are named, a division by 25 at once turns the milliards into pounds sterling; and when he leaves his own country there can be equally little difficulty or question as to the exact standard exchangeable value everywhere of his native sovereign with its indicative number 25. All that would be necessary to render this simple, self-evidently useful plan general and comprehensive, would be, for England and France by negotiation to induce other countries, as widely and generally as possible, to enact that *their* coinage and accounts should hereafter be *some* multiple of the franc,—*the tenpenny, or twenty-sou piece*,—and that *no coin* should hereafter circulate without the exact multiple or decimal part of the franc which it represented being distinctly impressed upon its surface. If the United States of America, for instance, still chose to have their accounts kept in dollars and cents,—to bring even them into the arrangement it would be only necessary that they should make their future dollar an exact 4 or 5-franc piece, and their cent a sou:—involving a scarcely perceptible change in their present monetary system. How long, in short, *could* any but a land of savages, cut off from all intercourse with the civilised world, resist the overwhelming social and commercial advantages to be secured on terms such as these!

"I must not occupy more of your valuable space with details; and indeed, it is sufficiently obvious to render them unnecessary, that the plan now proposed would work far better in practice—be far less injurious and repulsive, particularly to the poorer and less educated classes, besides its other still more important public and national advantages—than that proposed by the Committee of the House of Commons. The penny postage, tolls of every kind, and all cases in which pennies and halfpennies are concerned, are admitted by the Committee to offer serious and very embarrassing difficulties in the carrying out of their plan,—as these important denominations and coins would no longer exist, and would be replaced by nothing at all corresponding with them. In the first case, for instance, that of postage, the proposed new 5-mil coin would add, it appears, 20 *per cent.* to our rate of postage,—to which Mr. Rowland Hill, on the part of the public, naturally entertains a most decided objection;—whilst the next denomination in the new proposed coinage (the mil coin) would cause a loss of £100,000 a year to the revenue,—which the Chancellor of the Exchequer would, no doubt, equally dislike. Not only would the double sou, or English penny, meet all these difficulties,—but the poor bewildered rustic, instead of all these new mil coins, would still find in the single and double sou pieces his old familiar pence and half-pence. The only necessary practical change of any moment in this country would, in short, be that from shillings to pence; and here the broad, clear, distinction *between twelve pence and ten pence* would put every one on his guard;—and the fact that three francs would constitute the well-known English half-crown, must render this change intelligible to the most limited mental capacity that ever existed. We should pass from our present state of isolation and admitted barbarism in accounts and currency to a universal and universally intelligible circulating medium and standard of comparison in every description of statement—commercial and statistical:—and this *not* by means of the proposed half-dozen of altogether new unheard-of mil coins, still without correspondence with those of any other country,—but by means of the alteration of little more than a single one of our existing forms of money, and scarcely any in the present form of our accounts.

"P.S.—Since writing the above, a number of able letters and comments on the plan of decimal coinage proposed by the Committee of the House of Commons have appeared in the newspapers,—all, almost without an exception so far as I know, warm in their approbation of the Decimal system, but objecting to the form in which the Committee propose to carry it out in practice. The injustice, injurious consequences, and almost absolute impracticability of this plan are in particular pointed out with great ability and knowledge of the subject in a long letter, signed J. E. G., in the *Times* of Tuesday last. As this letter contains the only approach to a suggestion of any other and more practicable scheme than that of the Committee, I would just observe that the great conclusions at which this writer arrives—viz., 'that no decimal system of coinage will be just and practicable which does not retain the penny as one of its essential elements'—is entirely in harmony with the scheme which I have proposed. Both in our coinage *and as a denomination in our accounts*, the penny, or two sou piece, the tenth of the franc or livre (*the unit in far the most widely extended and perfect decimal system in existence*), would retain the position claimed for it, on grounds, it appears to me, altogether irresistible. "T. W. R."

## EDUCATION AND PHYSICAL TRAINING OF WOMEN.

1, Adam-street, Adelphi, Oct. 29, 1855.

Sir,—That the English race generally has not deteriorated, seems tolerably clear from the war in the Crimea. The nation of least civilisation, Russia, has succumbed in corporeal contest to the most civilised, England and France. So far, therefore, civilisation has not deteriorated corporeal humanity in our fighting men.

Nor has there been any sign of want of courage among the higher classes composing the officers of the English army, so far as regards stroke and flash, in the ranks of battle. But if reports may be relied on, there has been less of that courage which enables men to bear hardships and privation. Those who could dare " the imminent deadly breach," might be found faltering in the imminent deadly trenches. It would be a useful piece of statistics to know who they were who sought leave of absence—not their names—but the physical class of men, whether they were men distinguished as boaters, cricketers, shooters, hunters, yachters, swimmers, and general practisers of what are called " manly sports," or whether they were sybarites, men about town, living in luxuries, and with damaged constitutions, having the mere courage to stand and be shot at, without the physical energy requisite to bear hardships; or whether they were men suffering for the sins of their progenitors, badly born, unmasculine, nerveless and not nervous, diseased from birth, etiolated, and prepared for paralysis from lack of a healthy current of life in the channels of their blood?

Probably no finer specimens of the human creature exist than are to be found in the ranks of our aristocracy. Why should it be otherwise? Without care or anxiety, fed on wholesome food, trained to gymnastic exercises, provided with teachers of all accomplishments, with mental cultivation for all their aptitudes, with a stimulating climate second to none in the world, and power of locomotion to all kinds of natural beauty and scenery,—if they happen only to be well born, *i.e.* born of a man, and more especially of a woman, in the full sense of the term, viz., the combination of physical and mental excellence, and with all deteriorating circumstances removed, there is no reason why the Greek Apollo and the Greek Minerva should not exist in England in living perfection, and with the Christian spirit superadded. From time to time we see close approximations to this in what we call the aristocracy, and in such cases, really and truly the aristocracy; and in the children of the poor we also see at intervals faces and forms such as Murillo loved to paint, but which we know will be shorn of their due development by the pressure of painful circumstances.

Those who have watched the people of England as a collection of human beings, have become painfully aware that during the present century there has been growing up amongst us a large and increasing class, remarkable for intellectual acuteness and physical debility. They are not confined to one race or class, but are found in all, —noble, middle-class, and poor. In some portions of the nobility inbreeding, marrying cousins, and the debauchery of past years, have increased the debility more than the intellect. In the poorer classes, an unhealthy mill system —unhealthy from ignorance—has etiolated their vitality, and quickened uncultivated intellect into cunning. But it is in the middle classes that the acutest intellect is developed in unhealthy frames. Men live in anxiety and over-work, under the pressure of ostentation, to die of premature exhaustion. Such of them as are forced by their business into the open air, live longer, but it is a life growing more and more like the feverish state of existence that marks the American character, a life that lessens laughter, and increases—not thought—but cunning. Such a man's family, whether in England or the States, are less his connections than his property, to be managed by others, like an outlying farm. He goes to his business in the morning after a solitary breakfast without appetite; returns to a stimulating dinner, sleeps, or drinks wine and takes coffee in company, and goes to bed, to follow the same routine next day. His children he hardly knows, save by their names, and what he is told of them by the mother, who gets her information from the governess or tutor, or the boarding school. Nor is the condition of the mother better. She is married, not mated; she has a life apart, in languid inability, taking an airing in a carriage, and going through a daily routine, according to fashion, without regard to the aptitude of any faculty she may possess. Even the coarser nature of Queen Elizabeth's steak-and-ale breakfasting and 5 a.m. stag-hunting maids of honour, was better than this. *Men* could grow out of them with at least physical stamina, like children of Boadicea.

Whatever be the cause, there is a strong resemblance between the wealthy young women of England and the young women of New England. Tall, slender, and with exquisitely chiselled faces, alive with intellect and trembling with nervous emotion, but not nervous energy, narrow-chested and hooped up in stays—to supply by mechanism what nature has denied them; long taper fingers, growing as it were into twigs, like a mythological transformation; feet like anything but those with which " swift Camilla scoured the plain;" not women in the perfect sense of the term, but animated works of art; the ornaments of drawing-rooms, but not the companions of men—it is not marvellous that energetic men should sometimes say in their coarser moments—

" I will take some savage woman;
*She* shall run my dusky race."

It is only when the high moral purpose is united to the clear and active intellect, that a loving nature of strong energies can sympathise with inherited feebleness of constitution, whether man or woman.

Why this plague spot has grown amongst us, and by what processes it may be removed, are things worth enquiring into. That it is not a necessity is evinced by many examples to the contrary. The stately figure of the Duchess of Sutherland might be taken by a painter to give verisimilitude to the car of Boadicea, or as the helpmate and partner of a Northman Chieftain in the rule of a warrior tribe, or as the Scottish heroine making a bolt of her arm to close the door on entering ruffianry. It is not all physical force that we want, but so much of it as will give a fitting residence to the noble soul; so much of it as will serve the generous purposes of an emotional heart, and not be an impediment to it. So much of it as will constitute woman man's mutual help-

mate and not man's impediment; so much of it as will promote the growth of strong sympathies and not of weak selfishness. It is vigorous and perfect health that gives the charm to life, that brings forth into full relief all the higher and nobler qualities; and for the earnest duties of modern life, it is as much needed as it was in the elder time by a spear-wielding Britomart, or Thalestris, or Penthesilea.

We may assume that all disease arises from misusage of the body, and there is no doubt that in modern times the body is in many ways better used than it formerly was, but there is one prominent distinction. Amongst barbarous tribes, the weakly-born died off or were abandoned to die; in modern times, art preserves the lives of the weakly, and they live to swell the population and multiply the population who formerly would have died. Thus a race of weakly people is kept up.

The same, or similar processes that save them from dying—care and study—could improve their constitutions. The thorough exercise of all the muscles of the body by physical exertion, and the ample inhalation of pure air, are the essentials of health without which digestion and assimilation cannot go on. Without pure air, scrofula will prevail externally or internally, and, if the latter, will probably be fatal. Without exercise the digestion becomes sluggish, the circulation becomes slow, the feculent matter is absorbed by the blood, and acts on the brain, inducing paralysis.

Ennui and vapours were the disorders of fashionable women in the last generations. In this generation they have widely extended to other classes, under the name of nervous disorders. The household duties which, as Cobbett said, "made the signs of labour glisten on their brows," have disappeared; machinery, domestic service, and diminished drudgery, the tradesman baker, the tradeswoman laundress, and the chemist substituted for the still-room, the cooks trained by books, have eaten up the employments that formerly gave healthy appetite. That the employments have gone is not a matter for regret, albeit there be men who think women born for no nobler end than to make "puddings and pies." But it is a matter of great regret that other employments and exercises have not been substituted for them.

Till women understand this generally we can have no hope. Without sensible as well as amiable mothers, we cannot have manly or womanly children. Till families shall become domestic, and put away the ostentatious for the natural, we can have little amendment. While boys and girls are sent to school to be out of the way of their fathers, mothers, and elders, the affections which should shield them from vices cannot grow up. Till mothers shall feel a pleasure in being surrounded by their offsprings, and making themselves a part of their pursuits, cultivating the moral feelings that are not fashionable accomplishments, and form at present little part of what is called education, really happy society cannot exist. But unless all this can be made pleasureable, mere exhortation can have no effect.

Society is the thing most people aim at. Desire of society, even more than intellectual or sensuous gratification, attracts them to morning and evening concerts, to dinners, to theatres, and to operas. The question, then, is how to combine this society-seeking with healthy exercise. There is no other way but by making exercise an enjoyment. Women and children can only be made robust by exercise, not taken with elegant languor in a carriage, not a walk, which exercises only the lower limbs, at a slow pace, inducing fever, but thorough vigorous movement of the whole muscles,

"With laughter holding both his sides,"

inducing perspiration and the subsequent use of the bath.

There is no difference, save in degree, between men, women or children in the matter of exercise, and there is nothing indelicate in woman practising all the exercises of men. There is no reason why they should not row in boats as well as Grace Darling or Scott's Lady of the Lake, for a proper construction of oar would obviate the hardening of the hands. There is no reason why they should not swim, why they should not ride elsewhere than in the parks, why they should not play cricket, or fives, or tennis, as well as use the shuttlecock and the hoop—two of the healthiest as well as the simplest of games, expanding the chest, improving the breathing, and bringing all the muscles into action. At schools girls are taught music and callisthenics, which they leave off, and practice no more when they leave school, and most married women would think themselves eternally disgraced if found playing with a hoop, even though the hoop were a substitute for swallowing daily drugs.

Society, then,—society in which mothers could lead forth their children to healthy physical sports, as a substitute for boarding schools—society in which the animal spirits could have full scope—is one of the things that are needed; sports in which young and old might join to the full extent of their capacities, "and no men make them afraid."

This cannot well exist as dwellings are at present constructed, but there seems no practical reason why there should not exist clubs for families as well as for the fathers of families. Not the expensive erections of Pall Mall, and St. James's-street, but buildings of large area, with glass roofs capable of being thrown open to the air, cheaply erected, and capable of extension to any size, as the demand might grow. With such places of meeting the barriers of form would break down, natural forms of dress would replace artificial, health would grow, and simple food would be eaten with healthy appetite, the craving for night parties would lessen, and refreshing sleep would be induced at wholesome hours. Improper people could be kept out as they are at other clubs, and the freedom which prevails in seaside life could be kept up for the whole year without the disadvantages.

In Eastern countries women and children meet at the bath, which is their club, their *conversazione*, their refuge from the intense weariness of their in-door life. A gymnic club, a reproduction, in another form, of the groves of Academus, suited to our varying climate, would be much more than an Eastern bath to them. And this is one of the purposes to which the Crystal Palace might have been turned had it been within reach, had it been constructed at a moderate cost. For such a purpose we need height, but not enormous height; we need space and cover on the natural surface of the ground; we desire the greenhouse, but not the hothouse; we desire objects of beauty, but not the recondite articles of the museum. We desire swimming-baths, with abundant water, moderate warmth, and abundant ventilation; we desire every kind of sport, and game, and exercise that may best aid in developing the wonderful powers of the human body; we desire libraries in such a place, to add to the pleasure of after repose.

There is no doubt that thus, at a comparatively small cost, English wives and children might obtain healthy social recreation that would appease the craving for mere excitement, and strengthen the system instead of weakening it. The "Sister of Charity" system embodied in Miss Nightingale, is evidence of the craving of wealthy women for better things.

Paris is a place of resort because it has a great number of open-air days throughout the year. With a glass cover to open and close at pleasure, London might be more than an equivalent to Paris. It is not the garden of Epicurus in the gross sense that we need, but the kind of building that will put us on a level with what are called fine climates, and allow us at home to indulge in healthy social intercourse the year round.

It is possible by such a system to carry forward the work of saving weakly infant life to the further stage of making the after life an enjoying one. It is possible to bring up a race—to be the mothers of another generation

—that shall put into the shade the present, that shall make the physician the preventer rather than the curer of disease.

We have had many gymnastic establishments for men pursued with ardour for a time, and then abandoned. There are two reasons for this. The weather closes them one half the year; and they are pursued rather as hygeic business than as a recreation amongst their friends. Women and children in this country have leisure, and could pass the entire day together had they only a fitting meeting place. And professors and classes for education would follow as a natural consequence. Such places would become the schools for women—women, such as those high poets dream of—women with heroic souls, with acute intellect, beaming faces, symmetric forms, and strong healthy frames; women fitted to bring forth a race of heroes, and bring them up to manhood's best attributes.

Many will scoff, and call this dreaming; yet it is but applying obvious means to obvious ends. Other things being equal, those reared in strength will be strong, and those reared in weakness, weak. The ruffian comes forth from the abodes of squalor, the rat from the drain, the sybarite from slothful luxury, the heroine from good birth and wise training.

The possessors of the funds of the Great Exhibition have purchased a large plot of land, whereon they purpose to erect galleries and museums, as means of public instruction. Are they willing to go yet further, and set apart a piece of the land whereon to erect an Academy and Gymnasium? a building perfect in its kind, and filled with all appliances for training a sample band of the future mothers of the community, under the auspices of a Maurice and a Kingsley,—a college for women in the best sense of the word, in order to test experimentally whether the Jane Greys, and the Russells, and the Nightingales, may not become the staple as well as the examples of English womanhood.

Quite as worthy a thing is it to do this as to found a College for Working Men.

I am, Sir, yours faithfully,
W. BRIDGES ADAMS.

## MIDDLE-CLASS EDUCATION.

Bruton-street, Nov. 5, 1855.

My Dear Sir,—I beg to enclose a copy of the Memorandum which I read at the October meeting of the Council of the Bath and West of England Society for the Encouragement of Agriculture, Arts, Manufactures, and Commerce.

The paper, as you will see by the extract from the Minutes, was most courteously received by a numerous meeting of the Council, comprising, I am happy to say, a very good proportion of tenant farmers; and five of the Council at once most handsomely formed themselves into a committee to assist in carrying out the scheme, of which the Memorandum had described to them the leading features.

Before referring you, however, to that Memorandum, I may be permitted to say, that I address you publicly on this present occasion, not only as being the Chairman of the Council of the Society of Arts, and thus, so to speak, to form one person officially representing the unanimous feeling of the whole Society and all its affiliated branches, in favour of education, but also as having long been yourself individually a zealous and effective labourer in the cause of education, and not only a strenuous promoter of educational improvement generally,—but also, and more especially as a most thoughtful and earnest promoter of an improved middle-class education,—as having taken a principal part in framing the "Report on Industrial Education" of 1853, and since in organising a Trade School in your parish of Wandsworth; I have, therefore, the best grounds for my conviction that neither officially nor as a private individual, will you regard with indifference our humble efforts in Devonshire for the encouragement of education and self-culture among farmers' sons.

The object seems to be one deserving of more attention than it has yet received; and without repeating what I have before said upon it in the pages of the *Journal*, I would now again earnestly commend it to the consideration and sympathy of every member of the Society, and of all its affiliated branches, whether in town or country. For these are not times in which England can afford to have class jealousies entertained, or exclusive class interests pursued by her children.

I remain, my dear Sir, with great truth, yours sincerely,
EBRINGTON.

The Rev. Dr. Booth,
Chairman of the Council of the Society of Arts.

*Memorandum on Middle Class Education, by Lord Ebrington, in reference to his prize of £20 for the Sons and Relatives of Devonshire Farmers.*

Having already repeatedly made public, both in writing* and by word of mouth, my impression as to the extent and causes of the relative deficiency of the means of education for the middle classes in general and for the farmers in particular, I need not here go into the whole question again. Nor need I repeat how sincerely anxious I feel that farmers and farming should keep pace with the progress of other classes and other arts. I will observe, however, that if things go on as they do now, I augur more favourably for some time to come of the professional than of the social prospects of the farmers. And for this reason. Though, on the one hand, I am convinced, from the decided advance which agriculture, like all other arts, has latterly been making, that a combination of science with practice, and an acquaintance with the experience of a wide circle of agriculturists, attainable only by the well-educated, will become gradually more and more indispensable to profitable farming; yet, on the other hand, the more I see of farming and farmers, the more sensible I become of the very great amount of valuable practical knowledge they, for the most part, have of their particular business. And though highly-educated gentlemen, on the strength of the really fuller knowledge they have derived on certain agricultural points from their wider range of reading, reflection, and travels, sometimes flatter themselves they can give regular farmers general lessons in their trade; yet the more I am able to learn of the comparative pecuniary results of professional and of amateur farming in general, the more highly I am inclined to rate the regular farmer's superiority in whole branches —and those among the most important—of that business. This, however, makes me only regret the more that, for want of some additional education, so many good farmers and sensible men should, to so great an extent, be restrained from advancing agriculture by the freer communication of their knowledge to others, and from more usefully serving the public in various capacities; and should thus be prevented from doing more justice to themselves in the eyes of the community.

My object in offering the present prize is not merely to give young farmers an incentive to exertion, but also to endeavour to ascertain (with a view to its amendment, if necessary) the means of education at present practically available for that class in Devonshire. I mean of general education, as distinguished from business training. I cannot believe that in the present day any ascertained deficiency will long be allowed to continue in this country without some effort being made to supply it, more especially if the class affected be one so powerful and so capable of manfully overcoming difficulties as the agricultural body has recently shown itself to be. In the present

* See my letter to Mr. Chester of June 28th, 1854, in the *Journal of the Society of Arts*; my speeches at the Conference of the Society of Arts in July, 1854, at the Tiverton dinner last June, and again at the North Molton and Castle Hill dinners this month, &c.

instance this accurate knowledge is the more essential, because we have some reason to believe, not only that more has latterly been done for improving the education of the classes both above and below the farmers than for them; but also that the present generation of farmers find, with regard to the education of their children, some disadvantages which their predecessors did not before the days of Government grants, when such local schools as existed were, for the most part, self-supporting. As it is to the masters of the surviving schools of this class that we shall be mainly indebted for the preparation of the candidates that may present themselves, so it is to them also that we must chiefly look for information on this subject. In this investigation none can be more interested than these teachers. And I would put it to all able and earnest masters of middle class schools whether they have not experienced the want of some impartial and recognised standard in their too often unequal competition with unscrupulous pretenders to the honourable office and title of preceptors. I would ask them to consider whether the institution of some public test of their pupils' proficiency would not, while encouraging those pupils to increased exertions and longer stay at school, at the same time supply to their establishments an evidence of due qualification or certificate of excellence such as the examinations for University degrees and honours have long furnished to the schools of the higher classes—and have furnished, I will venture to say, with great advantage to them all; but more especially to those which, though some of them simply grammar-schools by their foundation, have, thanks very much to these examinations, won a world-wide distinction as the Public Schools of England.

The establishment of special examinations to test qualifications with a view to the selection of the right men for the right places, is becoming one of the questions of the day. Witness the examinations recently set on foot for the Indian service by the Indian Government; for the Engineers and Artillery service by the War Department; for lawyers by the Inns of Court; and last, not least, those projected for our civil service by the late Government. But it is to be observed, that as yet the more general character of University education does not appear by the results to have at all unfitted University men for distinguishing themselves in these more technical and special examinations; nor does the value of academical distinctions appear to have been at all depreciated by the lucrative prizes held out at these newly-instituted contests.

It has yet to be proved whether the establishment of something like a standard of middle-class education, by means of some examinations analagous to those of our Universities, would not prepare the way for, instead of obstructing, and be assisted, instead of obscured by, any subsequent trials of more technical or professional qualifications. I believe this to be a desideratum much wanted. Whether it can be supplied remains to be seen. The Society of Arts, by the examinations it has lately instituted, has made a vigorous effort to do so. As I stated in my letter to Mr. Chester, the Society's comprehensive character, its more than centenary existence, its ties of affiliation with almost every town in England, and the countenance of its Royal President and distinguished Vice-Presidents, afford it great advantages for this work. We shall see by the result of next year's examinations whether the Society has hold enough upon the nation at large to succeed in its object. I hope it has. I fear, however, it certainly has not upon the rural part of the population; and it is in them I, as a country gentleman, must feel the deepest interest.

I have heard it indeed suggested that the Universities might at once strengthen their hold upon the country and render great public service by undertaking this task, but they are at present, and must continue for some time, too much engaged in the work of internal reform to admit of our reasonably expecting this of them. Whether Government examinations, and the certificates to be obtained at them, could ever supply the desideratum, is a question, even supposing Government patronage to be distributed among the successful competitors at examinations for different kinds of Government employment, instead of, as heretofore, almost entirely among political partisans. But one disadvantage would attach to the Government's being regarded as the chief, if not the sole source of educational distinction for the middle classes. I mean the encouragement liable to be thus given, unless great care be taken, to the growth of a body of highly-educated place-expectants; unhappy and unquiet, because looking exclusively to general literary attainments, instead of to special qualifications, as their claim for employment, and still continuing to do so after reaching the age when men, as a rule, should be branching off, if I may so speak, from the general highway of youth into the different byways leading to the several fields of their respective adult employments.

It was under these impressions that, before making trial of the Society of Arts, I was led to think of the plan of county honours and county degrees mentioned in my letter to Mr. Chester. As this obviously, however, could not be carried into effect without larger and more influential co-operation than I had any right to expect for any project of mine, I determined to take the step which the Council were so kind as to honour with a vote of approval when I mentioned it to them at Tiverton. Having said thus much to put the Council fully in possession of my views, and to secure those views, as far as may be, from misconception, I will proceed to the details of my scheme.

(1.) With regard to the candidates for the prize, my own idea is that they should be young men *bona fide* engaged in agriculture, the sons or relatives of Devonshire farmers (whether freeholders or tenants), mainly depending for their incomes upon the pursuit of agriculture.

If occasion should arise for a more stringent definition in this respect, the £50 franchise would perhaps the more fairly indicate the minimum for renting farmers, because it is with their educational qualifications for their position as Englishmen of the middle class, and for their duties as citizens of a free country, that we are here concerned, rather than with their technical or professional knowledge as persons engaged in the business of farming. The standard adopted for tenant-farmers would furnish a sufficient basis for determining the limitations in the cases of freeholders or copyholders. It seems unnecessary to fix a maximum; as the Committee would practically, I believe, find no difficulty in deciding whether or not any one offering himself as a candidate was or was not, from present position in society, or from past advantages of first rate school or college education, so far above the standard of the class I seek to benefit as to be an unfair competitor for the others to have to encounter.

(2.) The object of limiting the age of candidates to 18 and 23 inclusive, is simply to insure their having all fairly committed themselves to the pursuit of agriculture, and being so far removed from boyhood as not to repel from competition those just arrived at manhood, and already entering upon the business of life. But as I have announced my intention of offering the same prize for three years in succession, those who are yet rather too young to come forward as candidates, may look to doing so hereafter, and begin forthwith to prepare themselves accordingly.

(3.) I will refer to my often cited letter to Mr. Chester for the reasons which lead me to require from the candidates certificates of competent Scriptural knowledge as a necessary part of an Englishman's acquirements, on grounds not religious only, with reference to a future world, but also purely secular, with reference to the world that now is, to society as at present constituted in England, to our English laws and English institutions.

(4.) With regard to the subjects of examination, they have this year been purposely limited to three, viz., the English Language, the History and Geography of the British Empire, and Practical Mathematics—some acquaintance with all of which is undeniably required by

every Englishman of the middle class who can be considered educated up to the standard of his position.

(5.) With regard to the points chiefly to be aimed at in examining upon these subjects, I have conferred with the three gentlemen who have so kindly undertaken the laborious duty of conducting the examinations, and I am happy to find a general concurrence between their views and mine.

(*a*.) The knowledge of the English language I seek to test and elicit relates not so much to correct grammar, though that of course is implied, as to some acquaintance with the force and value of words, and the power of faithfully representing thoughts and things in language; that is, of expressing what is meant, so as to convey within a reasonable compass neither more nor less than the sense intended to be conveyed. Mere grammar, the dry bones, so to speak, of the language, cannot of itself perform this higher, and, as it were, vital function. Indeed, if there must be a deficiency in either one or the other, it had far better be in grammar than in expression.

No one who has not the command of a vocabulary sufficiently full and appropriate upon any given subject can without undue prolixity make himself thoroughly understood about it; or speak or write effectively, even if he can himself think accurately, upon it, which, since words are thoughts, is in many cases far from easy. On the other hand the employment of exaggerated language in the attempt at oratory or fine writing, while it is far more repugnant to good taste than the want of point and precision, resulting from a defective vocabulary, for the same reason tends to convey impressions at least equally inaccurate. But every one must have heard and read much that was more or less incorrect in grammar, and yet perfectly intelligible and to the point, often very graphic and sometimes even eloquent. This classical scholars well know from occasional examples in the best authors. Still, even were it otherwise, the practical character of the classes here in question require that their education should deal with substance in preference to form.

(*b*.) The History and Geography of the British Empire may, I think, be well taken together, as they happen in the case of our particular country to be so closely connected with each other.

What I should especially seek here in the candidates would be a fair acquaintance with the outline of the History of the Empire, of its principal events, particularly of its wars and conquests, or discoveries, and, in connexion with these, of the course of its colonization. To this, as of not less importance, especially for men engaged in the business of raising food for the population, I should add a good general idea of the character, products, and resources of the United Kingdom, and of those numerous colonies and dependencies which together make up the British Empire.

The consideration of the History and Geography of that mighty Empire in this point of view seems to me better calculated to kindle sentiments of pure and undivided patriotism in Englishmen, than would be the study, to an equal extent, of the History of the English people, of the growth and development of our social organization and political institutions; because such a study necessarily brings men into contact with party and controversial questions still debated at the present day. Moreover, the study without which a real knowledge of our history viewed in the latter aspect is not to be acquired, must be far deeper and more systematic, and demands powers of philosophical reflection hardly to be attained without longer and severer mental training than it is reasonable to pre-suppose in the candidates to whom I offer my prize.

(*c*.) With regard to the third subject, viz., Practical Mathematics, what ought to be required would seem to be a thorough knowledge of the earlier rules of arithmetic, and of the first principles of the mechanical powers, of bookkeeping, and of mensuration. I say of the principles, because it is far more important to have a thorough understanding of principles than a familiarity with those convenient formularies which, though invaluable in the daily business of life, cannot of themselves enable any man to deal with new and unexpected cases; and, if merely learnt by rote, give none of the valuable mental training furnished by the process of thoroughly mastering any subject.

In conclusion I will only add how anxious I am that the three examiners* should be relieved from all trouble about this matter not inherent in the nature of their duty; and, indeed, it would seem on every account desirable that a Committee should take off their hands any questions that may arise as to the admission of persons proposing to present themselves as candidates, &c. I would therefore venture to ask the Council to designate some Devonshire members of the Bath and West of England Society,† whose assistance I might solicit for this purpose with the high sanction of the Council.

*Extract from the Minutes of the October Meeting of the Council of the Bath and West of England Society for the Encouragement of Agriculture, Arts, Manufactures, and Commerce. Established* 1777.

After some remarks upon the above statement of his Lordship, it was proposed by Mr. T. D. Acland, and seconded by Mr. A. H. D. Troyte:—

"That the Council beg to thank Lord Ebrington for communicating to them the arrangements which he proposes to make for awarding the prize which he has offered to the sons and relatives of farmers in Devonshire, and to assure him that whatever tends to promote so desirable an object cannot fail to be a matter of interest to them."

It was proposed by Mr. Acland, and seconded by Mr. Dymond:—

"That the Council understanding that his Lordship does not propose to make the Society responsible for the details of the proposed examinations, are happy to learn that there is reason to believe that some active members of this Society are prepared to co-operate with his Lordship in carrying out the proposed plan."

Both resolutions were carried *nem. con.*

## Proceedings of Institutions.

CARLISLE.—A *soirée* in connection with the Church of England Religious and General Literary Association was given on the evening of the 30th ult. The Assembly Room of the Athenæum was gaily decorated for the occasion. After tea, during which the band of the Royal Anglesey Militia and the Choir of the Cathedral, played and sang, the Very Rev. the DEAN of CARLISLE rose to address the meeting. After remarking on the double title of the Institution, and explaining by that means its object and character, he proceeded to observe that these Institutions held with regard to the mass of the community at large, the same position which was held by the universities with regard to the members of the learned professions. A boy might learn a great deal more himself after he left school by cultivating his taste for reading than the schoolmaster taught him. And an institution of that kind would enable him to carry on his education till he arrived at the maturity of life. He thought it would fare very ill with the members of the manufacturing community if their whole education were to terminate when they left school. And here he would say in all

* Sir Stafford Northcote, Bart., M.P.; the Rev. Chancellor Martin; R. Dymond, Esq., C.E., who most kindly undertook, at my request, to conduct the first examination next Easter.

† The following members of the Council: Mr. Sillifant, of Coombe; Mr. Thomas Hussey, of Waybrooke; Mr. Farrant, of Growing; Mr. Fry, of Culmstock; and Mr. Widdicombe, of Nyborough; most kindly undertook to act as a Committee in compliance with this request.

seriousness—for it was a melancholy fact, seeing that there was so much talk on the subject of education, seeing that they had an inspector, seeing that no session of Parliament passed without many debates on the subject, and seeing that the word was in every man's mouth—that there was such a vast multitude of persons who did nothing whatever for the cause of education. He did not think that they should have a school-rate by authority—and for the present, at least, it had been put aside—but one among themselves, rendering it unnecessary for the Imperial Parliament to lay a rate upon them. The Rev. W. M. Schniebben then addressed the meeting at considerable length on "The Advantages to be derived from Lectures." While he admitted that the same amount of information was not to be obtained from listening to popular lectures as from study, he contended that every man was not disposed, after leaving his hard day's toil, to take up a book and go into a severe study. Under these circumstances the lecturer would be willingly listened to with advantage for an hour or so, and a rational evening's amusement might thus be obtained. The Rev. G. R. Moncrieff, Her Majesty's Inspector of Schools in the Northern District, next spoke upon the subject of education. He pointed out the advantage of sound elementary education, and said he had no doubt that ere long the whole of the different branches of education and the duties of self-improvement would be converted into an admirable and gigantic system. Mr. James Barnes, the secretary to the Association, then gave some information in reference to its working. At the end of the first year there were only 170 members, but at the end of the fourth they had 225 members. In 1852 their income was £88 16s. 6d.; and in 1855 it was £103 3s. 0d. Although the subscriptions had increased, it must likewise be borne in mind that the liabilities had increased, so much so indeed, that for the last three years they had had their balance, he felt sorry to say, on the wrong side of the sheet.

Croydon.—It is gratifying to state that the Literary and Scientific Institution is at present in a more flourishing condition than it has been for many years past, and that the debt, which had so long paralyzed the efforts of the committee, is almost cleared off. This is, in a great measure, to be attributed to the judicious course adopted by the management, in enlarging the society's sphere of usefulness by means of lectures, and various important improvements to the library and reading-room. It should be observed that during the past year none but lecturers of acknowledged talent have been engaged, and although this has not been accomplished without great expense, yet, in the end, the society's finances have much improved, and a far higher character has been given to the Institution itself. A numerous party of members visited the Paris Exhibition lately, and the gentlemen forming it, have presented the secretary with a very chaste and elegant silver inkstand, bearing the following inscription:—"Presented to S. L. Rymer, Esq., by the gentlemen who visited the Paris Exhibition with him in September, 1855, in remembrance of his courtesy and kindness to them on that occasion." The winter course of lectures has just been inaugurated with success, by an entertainment on the Patriotic Songs of England, given by Mr. Henry Phillips. It is to be hoped that the present state of things will not only continue but improve, and that ere long the permanent stability of the Institution may be fully established.

Portsea.—On Wednesday week the annual re-union of the members of the Watt Institute took place in the Reading Room, and a tea meeting was held on that occasion in aid of the fund to increase the library. There was a very full meeting. Mr. Maxwell, treasurer, was in the chair, and, in addressing the meeting, stated that the affairs of the Institute were in a favourable position, being unincumbered, and signs of an increase of members. The library contained upwards of 750 volumes, and the circulation had been very large during the past year. The pupils of the Elocution Class next proceeded to show the progress they had made in their studies; many select and pleasing recitations were given, interspersed with a variety of glees, sung by Messrs. Fuller and Stapleton, who kindly volunteered their services for the occasion. Mr. Williams, teacher of the flutina, performed several airs on that instrument, with great credit; and a band also added to the evening's amusement.

Preston.—The twenty-seventh annual meeting of the Institution for the Diffusion of Knowledge was held in the theatre of the Institution on Tuesday, the 2nd of October, Thomas Walmsley, Esq., president, in the chair. From the report it appears that there has been an increase among the quarterly members, but a decrease in the number of annual subscribers. The latter class were last year 236, this year 221. The quarterly were last year 335, this year 346. The total number in each year being 571 and 567. The report then proceeds to observe that, "the negotiations so long pending with the Department of Science and Art of Her Majesty's Privy Council for Trade—in reference to the establishment of a School of Design in the Institution—have been terminated without arriving at the successful result so earnestly hoped for," as it was found "that a school established under the auspices of the Board of Trade, would not only require a very considerable sum to be drawn from, or charged to, the funds of the Institution for outfit, and also the entire and exclusive use of the Exhibition Gallery; but that it must be to all intents, and in all its purposes, a public school, in which the members of the Institution would scarcely, if at all, have any priority of privilege." By the proceeds of the Exhibition of Works of Art, 1854, and the results of a subscription set on foot at the last annual meeting, the building has been freed from debt—though some portions of it are still incomplete. From the improved state of the funds, however, the committee have felt justified in entering into contracts for its completion. To Mr. Birchall, the president of 1850, and of 1853-54, the gratitude of the members is due for providing means to render the building at first habitable, and for his various subsequent sacrifices. 257 books have been added to the library during the year, 222 by purchase and 35 by donation. The library now contains 5,795 volumes. Thirteen lectures were delivered, all gratuitously, during the session. The members' Class Committee, referred to as under trial in the report of the last annual meeting, have continued their operations, and educationally, it is hoped, with some degree of success. "The largest average attendance appears to have been in the Vocal Music Class, namely, 18, by last report, 13; in the French Male and Female Classes, each 18, by last report, Female only, 10; in the Architectural Drawing Class, 13, by last report, 6; in the Mathematical Class, 11, by last repert, 10; in the Phonetic Short Hand Class, 9, by last report, 6; in the Literary and Elocution Class, last report (not previously mentioned) 8; in the Botanical Class, last report, 8. No other class is reported to have numbered more than six." The News Room has experienced a diminution of members during the last two quarters of the year. The *soirée* held in November last, produced a sum of £16 19s. 11½d., besides adding considerably to the permenent stock of the Institution.

Stamford.—The seventeenth annual meeting of the Institution was held on the 16th ult., J. T. English, Esq., president, in the chair. The one subject of regret to the committee is, that, owing to the purchase of philosophical apparatus (under circumstances eventually beneficial to the Institution), and to unpaid bills neglected to be sent in prior to the close of last year, they are again compelled to postpone the payment of interest upon the building debt. Their causes of satisfaction are, the large increase in the number of members, both annual and quarterly, now amounting to nearly 300; the greatly increased number of books in circulation, being nearly threefold, or 2,020 volumes issued, against 740 in the previous year; and the uniform good condition in which

the books have been returned, which completely justifies the additional privileges of the quarterly members, to whom the news room has also been thrown open, without the additional subscription of 10s. previously made. The museum has been enriched by the addition, among other things, of a very valuable mineralogical and local geological collections, brought together with much labour and expense by Mr. J. F. Bentley, the late secretary, who has in consequence been made a life member. It is believed that the specimens in this and the Natural History Department, will bear comparison in number and excellence with those of any local museum in the kingdom. The philosophical apparatus, before referred to, has been purchased of the late secretary, by whom it had been chiefly obtained and used as a means of instruction at the Class and Juvenile Lectures given by him during the period of his office. Eight lectures and readings, five paid and three gratuitous, were delivered during the past year, to all of which the members had free admission, and, frequently, tickets for the admission of one or two friends.

## Miscellanea.

Adoption of the Public Libraries Act in Hertford.—On Wednesday evening a meeting of the burgesses of Hertford was held at the Shire Hall, for the purpose of determining whether the Public Libraries Act of 1855 should be adopted in the borough. The chair was taken by the Mayor, and amongst those present were, the Right Hon. William Cowper, M.P., most of the town councillors, and a large number of the leading residents of the district. The result of the proceedings was a resolution, unanimously passed, for the adoption of the act.—*Hertford Mercury.*

## MEETINGS FOR THE ENSUING WEEK.

Mon. Geographical, 8½. 1. Sir Roderick I. Murchison, "Report upon the completion and erection of the Bellot Monument on the quay of Greenwich Hospital." 2. Dr. Frederick Muller, "Account of a journey to the Australian Alps; with note from Captain Sturt, F.R.G.S., announcing the departure of the North Australian Expedition under Mr. Gregory." 3. Letters from Dr. Livingston, in Africa, accompanied by a new Map of the Interior.
Tues. Civil Engineers, 8. Mr. G. Herbert, "On the Construction of Stationary Floating Bodies."
Med. and Chirurg., 8½.
Zoological, 9.
Wed. Literary Fund, 3.
Royal Soc. Literature, 4½.
Ethnological, 8½.
Thurs. Antiquaries, 8.
Sat. Medical, 8.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette November 2nd*, 1855.]

*Dated 26th July*, 1855.
1693. C. Schiele, Oldham—Motive power.

*Dated 31st July*, 1855.
1737. G. J. Dalman, Alfred-villas, Kingsland—Earthenware glazes. (A communication.)

*Dated 23rd August*, 1855.
1911. W. L. Thomas, Chapel-place—Projectiles.

*Dated 25th August*, 1855.
1931. H. Le Franscois, Vauxhall—Cleaning stewpans, &c.

*Dated 24th September*, 1855.
2127. D. Chalmers, Manchester—Cutting pile of woven fabrics.
2129. J. Beattie, 11, Lawn-place, South Lambeth—Furnaces.
2131. H. J. Harcourt, Birmingham—Bell cranks and furniture.
2133. G. R. Hudson, 120, London-wall—Coffee pot. (A communication.)
2135. A. V. Newton, 66, Chancery-lane—Casting solid and hollow articles in metal. (A communication.)

*Dated 25th September*, 1855.
2137. J. L. Gardner, Providence-street, Walworth—Buttons.
2139. J. C. Clive, Birmingham—Photography.
2141. E. Laport, Paris—Candles.
2143. J. Roberts, Upnor, near Rochester—Cements.

*Dated 26th September*, 1855.
2145. R. Crankshaw, Blackburn—Preparing warps for weaving.
2147. F. Bouchet, Paris—Moving submerged bodies.
2149. M. W. Hilles, Percy-street, Bedford-square—Rack for window-blinds.

*Dated 27th September*, 1855.
2151. H. Hughes, Loughborough—Compensating for wear of machinery subject to rectilinear motion.
2153. A. E. Guilbert and C. L. Guillemère, Paris—Bridle
2155. F. X. Poignaud, Paris—Wedges and keys. (A communication.)
2157. C. F. Théry, London—New preparation of coffee.

*Dated 28th September*, 1855.
2159. T. Dyke, Long Newton, near Darlington—Grass cutting machines.
2161. W. D. Gray, 1, Clifton-road, Old Kent-road—Instrument for showing the course or direction and distance run by a ship at sea.
2163. R. L. Johnson, Dublin—Gas from peat, &c.
2167. E. D. Thomson, Duke-street, St. James's—Steam boiler furnaces.

*Dated 29th September*, 1855.
2169. G. Adamson, Edinburgh—Travelling crane.
2171. J. Mitchell, Sheffield—Railway buffers and draw springs.
2173. D. Chadwick, Salford, and H. Frost, G. Hanson, and J. Chadwick, Manchester—Water and gas meters, and motive power engine.
2175. J. Beattie, 11, Lawn-place, South Lambeth—Railway wheels and axles.

*Dated 1st October*, 1855.
2177. J. Gedge, 4, Wellington-street-south, Strand—Gas meters. (A communication.)
2179. W. Illingworth, Manchester—Printing ceramic manufactures.
2180. C. Radcliffe, Sowerby-bridge—Damping textile fabrics for finishing.
2181. A. E. L. Bellford, 32, Essex-street, Strand—Ventilating hats. (A communication.)
2183. J. Mitchell, Dunning's-alley, Bishopsgate-street-without—Apparatus for washing ores, &c.
2185. J. H. Denning, New York—Projectiles. (A commmunication.)
2187. G. Baker, 149, High-street, and C. Miller, Flying Horse-yard, Southwark—Register stoves.
2189. Capt. F. Uchatius, Vienna—Manufacturing cast steel.
2191. J. R., R., and J. Musgrave, Belfast—Stoves.

*Dated 2nd October*, 1855.
2193. J. Chadwick, Charlesworth, near Glossop—Carding machinery.
2195. G. Rennie, Holland-street, Blackfriars—Boilers of marine engines.
2199. W. E. Newton, 66, Chancery-lane—Elastic bed-bottoms. (A communication.)
2201. G. T. Bousfield, Sussex-place, Loughborough-road—Locks for firearms. (A communication.)
2203. R. Peyton, Birmingham—Wrought-iron fences and gates.

*Dated 3rd October*, 1855.
2205. T. Greaves, Manchester—Motive power.
2207. R. A. Brooman, 166, Fleet-street—Indicating and regulating height of water in boilers. (A communication.)
2209. R. Wilkinson, Staley-bridge—Carding machinery.

*Dated 4th October*, 1855.
2211. R. A. Crosse, Bartholomew's-lane—Founding printers' type.
2213. G. F. Gruet, Bordeaux—Lamps.
2215. H. Cornforth, Birmingham—Hooks and eyes.
2217. F. G. and T. R. Sanders, Poole—Pottery, earthenware, &c.
2219. W. Hamilton, St. Helen's-lodge, Hants—Tables, chairs, sofas, &c.
2221. H. Brierly, Chorley—Self-acting mules for spinning.
2223. F. M. Demait, Paris—Preservation of animal and vegetable substances.

*Dated 5th October*, 1855.
2225. T. Grahame, Lichfield—Floating batteries.
2227. W. Spence, 50, Chancery-lane—Cards for carding cotton, &c. (A communication.)
2229. J. B. Howell, Sheffield—Steel castings.
2231. E. C. Wren, Tottenham-court-road—Child's cot.

*Dated 6th October*, 1855.
2233. W. J. Roffe, Upper Holloway—Stoves.
2235. B. Hoyle, Pilkington—Dyeing.
2237. J. T. Hester, Oxford—Invalid and children's chairs.
2239. W. Rogers, New-road, Whitechapel-road—Firearms.

*Dated 8th October*, 1855.
2241. J. Denner, 11, Albion-grove west, Islington—Furnaces.
2243. W. Rothera, Hollins, Lancaster—Bolt, screw, blank, and rivet machinery.
2245. J. H. Johnson, 47, Lincoln's-inn-fields—Rolling iron. (A communication.)
2247. W. E. Newton, 66, Chancery-lane—Condensers. (A communication.)

*Dated 9th October*, 1855.
2249. P. M. Parsons, Duke-street, Adelphi—Joints of pipes and tubes.
2251. W. C. Jay, Regent-street—Collapsible hat or bonnet. (A communication.)
2253. J. Murdoch, 7, Staple-inn—Extracting colouring matter from lichens. (A communication.)

2255. J. F. Belleville, Paris—Smoke-consuming apparatus.
2257. W. H. Lancaster, 24, Hatfield-street, and J. Smith, Sefton-street, Liverpool—Consuming smoke.

*Dated 10th October*, 1855.

2260. J. Onions, 44, Wellington-place, Blackfriars—Utilising smoke, heated air, and gases from furnace fires.
2261. J. Gedge, 4, Wellington-street-south, Strand—Card drawings used in manufactories. (A communication.)
2263. R. W. Pyne, Southwark, and W. Malam, London-road—Gas.
2265. J. Parry, Lower Broughton, and S. Ivers, Salford—Looms.
2267. J. A. W., and H. Thornton, Nottingham—Machinery for knitted fabrics.
2269. W. C. Taylor, 11, Devonshire-road, Greenwich—Marine engines.

*Dated 17th October*, 1855.

2328. F. Ayckbourn, 30, Palace New-road, Lambeth—Apparatus for brushing and cleaning boots, shoes, and trowsers.

*Dated 18th October*, 1855.

2334. J. Wakefield Birmingham—Machinery for screw blanks, nails, pins, rivets, &c.
2338. J. Graham, Aughton, Lancaster—Cleaning and dressing grain.
2340. J. D. M. Stirling, The Larches, near Birmingham—Coating metals.

*Dated 19th October*, 1855.

2344. W. Smith, 10, Salisbury-street, Adelphi—Sewing machines. (A communication.)
2346. J. Elce, Manchester—Self-acting mules.
2348. N. Smith, Thrapston—Mills.

*Dated 20th October*, 1855.

2350. T. Craven and M. Pickles, York—Weaving.
2352. P. A. H. Parant, Limoges—Millstones.
2354. T. Valentine and D. Foster, and G. Haworth, Belfast—Power looms.
2356. H. Gaudibert, Paris—Guard for preventing surreptitious removal of watches, &c., from the person.

## WEEKLY LIST OF PATENTS SEALED.

*Sealed November 3rd*, 1855.

991. William Rowett, Liverpool—Improvements in fitting, handing, and reefing vessels' sails.
992. John Platt, Oldham, and James Taylor, Hollinwood, near Oldham—Improvements in looms for weaving.
994. Fielding Fletcher, Birmingham—Improvements in water-closets.
996. Rodolphe Thiers, Lyons—A machine for manufacturing stretchers of umbrellas and parasols.
998. Joseph Lacassagne and Rodolphe Thiers, Lyons—An electro-metric regulator for electric telegraphing, lighting, and electro-motive purposes.
1000. Daniel Dalton, Chester—Improvements in furnaces for the smelting iron ore and iron stone, and other stones and ores.
1006. Matthew Butcher and Thomas Henry Newey, Birmingham—Improvements in forge hammers.
1024. Charles Claude Etienne Minié, Paris—Improvements in muskets or portable fire-arms.
1026. Daniel Foxwell, Manchester—Improvements in sewing machines.
1070. George Robinson, Manchester—Improved invalid's bed.
1102. Thomas Richardson, Leeds—Improvement in dyeing cloth.
1110. John Knowles and Edward Taylor Bellhouse, Manchester—Improvements in the manufacture or working of marble, stone, glass, and similar materials.
1113. Thomas Dawson, King's-Arm's-yard—Improvements in cases for containing pen, ink, and stamps.
1154. Homer Holland, Westfield, Hampden, U.S.—Improvements in the method of treating metalliferous sulphurets.
1201. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand—A new apparatus for regulating the speed of steam-engines.
1209. Joseph Bennett Howell, Sheffield—A new or improved mode or modes of consuming more effectually the gas and gaseous products evolved during the combustion of fuel.
1214. Auguste Edouard Loradoux Bellford, 32, Essex street, Strand—Improvements in ordnance and in cartridges therefor. (A communication.)
1468. Denis Daniel Buhler, Paris—Improvements in the construction of fencings.
1880. André Dubrulle, Lille (Nord)—Improvements in safety lamps.
1904. Thomas Eyre Wyche, Camberwell—Improvements in propelling vessels.
2028. Louis Dameron, Paris—Improvements in the construction of carriages.

*Sealed November 6th*, 1855.

1023. William Burtt Wilton, Lowestoft—Improvements in furnaces for steam engines.
1027. Thomas Taylor Lingard, Manchester—Improvements in presses, which improvements are also applicable to raising heavy bodies.
1074. George Whyatt, Openshaw—Improvements in machinery or apparatus for cutting piled goods or fabrics.
1112. Wharton Rye, Miles Platting, near Manchester—Improved railway wheel, which may also be employed for other similar purposes.
1410. Robert Walker and Alexander McKenzie, Glasgow—Improvements in electric telegraphs.
1714. George Woods, 61, Crown street, Finsbury-square—Improvements in pack saddles.
1918. Thomas De la Rue, Bunhill-row—Improvement in printing inks.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

*October 26th.*

547. James Henry Smith, Connaught-terrace—Improvements in corsets.
552. George Hattersley, Sheffield—A radiating hearth-plate.
780. James Potter, Manchester—Improvements in machinery for spinning cotton and other fibrous substances.

*October 27th.*

541. Thomas Wilks Lord, Leeds—Improvements in safety and other lamps.
556. Charles Arthur Redl, 27A, Davis-street, Berkeley-square—Improvements in telegraphing or communicating signals at sea and otherwise.
595. Joseph John William Watson, Old Kent-road, and Thomas Slater, St. Pancras—Improvements in galvanic batteries, and in the application of electric currents to the production of electrical illumination and of heat, and in the production of chemical products by the aforesaid improvements in galvanic batteries.

*October 29th.*

572. Henry Brinsmead, St. Giles in the Wood, Devon—For shaking straw to be attached to thrashing-machines.
881. Henry Bollmann Condy, Battersea—Improvements in the manufacture of acetic acid and acetates.
1000. James Lawrence, Westminster—Improvements in the manufacture of projectiles.
1045. Henry Clayton, Atlas Works, Upper Park-place, Dorset-square—Improvements in the manufacture of bricks.

*November 1st.*

856. Richard Dudgeon, New York—Raising heavy weights by means of a portable hydraulic press.
877. Thomas Ainsley Cook, Wallsend—Improvements in bleaching.

*November 2nd.*

640. Marc Klotz, 77, Rue Rambuteau, Paris—An improved process and apparatus to be employed in ornamenting fabrics, leather, paper, and other surfaces.
649. Andrew Lawson Knox, Glasgow—Improvements in the manufacture or production of ornamental fabrics.
650. James Wotherspoon, Glasgow—Improvements in the manufacture or production of confectionary, and in the machinery, apparatus, or means employed therein.
665. Robert Booty Cousens, 50, Halliford-street—Improvements in machinery for cutting cork.
683. Jean Jacques Ziegler, Guebwiller, Haut Rhin, France—Improvements in machinery for preparing to be spun, cotton, wool, silk, silk-waste, flax, tow, and other fibrous substances.
831. William Edward Newton, 66, Chancery-lane—Improvements in the construction of, and method of applying, brakes to railroad carriages, engines, and tenders, for the purpose of preventing collisions. (A communication.)
1032. Timothy Morris, Birmingham, and William Johnson, Washwood Heath, near Birmingham—Improvements in depositing alloys of metal.
2225. William Edward Newton, 66, Chancery-lane—Improved machinery for cutting metal or other substances. (A communication.)

*November 3rd.*

656. Admiral the Earl of Dundonald, Belgrave-road—Improving bituminous substances, thereby rendering them available for purposes to which they never heretofore have been successfully applied.
664. John Arthur Philiips, 8, Upper Stamford-street, Blackfriars—Improvements in purifying tin.
771. John Thomas Way, Hollis-street, Cavendish-square, and John Manwaring Paine, Farnham—Improvements in the manufacture of burned and fire ware.
955. William Keates, Liverpool—Improvements in fire-boxes for locomotive and other steam-boilers.
1123. Warren De la Rue, Bunhill-row—Improvements in preparing the surface of paper and cardboard.

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3777 | November 6. | Finlayson's Mechanical Plough Guide ... | James Finlayson ............ | Pendreich, Bridge of Allan. |
| 3778 | ,, 6. | Horizontal Regulating Throttle Valve ... | Alexander Hibbs and William Acton ......... | Sheffield. |
| 3779 | ,, 7. | Portable Nursery Swing ..................... | Charles Burton ............ | 487, Oxford-street. |

Journal of the Society of Arts.

*FRIDAY, NOVEMBER* 16, 1855.

## NOTICE TO MEMBERS.

The first meeting of the Session will take place on Wednesday evening, the 21st instant, when Dr. Booth, F.R.S., the Chairman of Council, will deliver the Opening Address. At this meeting the medals voted at the close of last Session will be distributed.

Members are particularly requested to bear in mind that they can admit to the Evening Meetings *two friends only*, and that the servants have strict orders to adhere to this regulation, and they have no power whatever to deviate from it.

## MEETING OF COUNCIL.

WEDNESDAY, NOVEMBER 14, 1855.

The following Institutions have been taken into Union since the last announcement:—

400. London, Young Men's Societies Union in connection with the Presbyterian Church in England.
401. Wigan, Mechanics' Institution.
402. Witham, Literary Institution.

## PARIS EXHIBITION.

ECONOMIC MUSEUM.

Last week, the Emperor and Empress of the French visited this department of the Exhibition, and minutely examined its contents. They expressed themselves as greatly interested in it and its future success as a permanent Exhibition likely to be of service to the working classes. During the visit, Mr. T. Twining, jun., V. P. of the Society of Arts, had the honour of being presented to their Majesties by H.I.S. Prince Napoleon. The Emperor congratulated Mr. Twining on the success which had attended his endeavours to form this collection, and the Empress said: "Cette Exposition est très intéressante; c'est une bonne et utile création; j'espère qu'elle deviendra permanente; je le désire beaucoup."

## Home Correspondence.

### MR. LOSEBY'S PARALLEL RULE.

SIR,—The parallel rule described in your last number will be very useful for certain purposes, but will fail to fulfil all the conditions stated by Mr. Loseby. The instrument cannot be perfect until he devise some method of keeping the wire always at a right angle, or at any fixed angle, with the rule. By his present arrangement, equal divisions of the wire will give unequal parallel distances, varying with the angle the wire makes with the rule.

I am, Sir,
Your obedient servant,
R. WEBSTER.

74, Cornhill.

### DECIMAL COINAGE.

Allerton Priory, Nov. 3, 1855.

SIR,—Mr. Good observes in his letter in yesterday's *Journal*, that I have not disproved his assertion that a *centesimal* ratio between moneys of account is preferable to a *decimal*. I have neither done, nor have I *attempted*, anything of the sort. First, because all that can be said on this subject has been said long since, the *unanimity* of opinion in favour of the strictest possible *decimal* system with the least possible disturbance and alteration of our existing moneys of account and circulation, having been fully established in my "Examination of the Report and Evidence of the Decimal Coinage Committee," published in 1853, and the common object I contend that I have secured, and the want of the decime, or penny, *as a money of account*, having been shown to have been the real cause of the failure of the French, both to secure a perfect and universal decimal system, and to banish altogether, even by penalties, the troublesome old sou from their decimal accounts; and, secondly, because if a centesimal ratio *is* ever found preferable, it is at once obtained at any moment, *on the scheme I propose*, and solely by the change of position of the decimal point between the figures. If pence and tenpence are, as proposed, our moneys of account, the next figures above and below these will of course be 100 pence and 10ths of the penny (the cents Mr. Laurie has shown to be so useful and important a feature in calculation on my scheme), and accounts can, of course, if desired, be kept at any time, either in 100d. (Imperials) and pence, *or* in 10d. and cents, the legal form, and at length *thus* rendered the general usage in France.

The really important question is whether the simple change of *one* money of account, the twelve for the ten, and rendering our pence and tenpence, and, in like manner, lbs. &c., advancing by tens, our legal and official forms,—a principle equally applicable to ALL our calculations,—would not offer such enormous advantages in calculations and economy of time and labour, as would, without further compulsion, secure the speedy and universal adoption of such a system in this country; and, its singularly fortunate correspondence with foreign decimal systems, particularly the French,—a world-wide universality, the importance of which cannot be over estimated. *This* really is a simple question of *facts* and *figures*, and as to both Mr. Good falls into errors I should scarcely have expected, when anyone who can count may see that the accuracy of what I have stated cannot be fairly questioned. In the first place, Mr. Minasi's useful and striking calculation only demonstrates the number of figures required to represent (*or write in figures*) as they would have to be expressed in mercantile and banking books, on *the present, the mil*, and *the penny*, schemes, all sums from 1d. to £1,000,000; *and* whilst it establishes, *even in this point of view*, the advantage on *any* of the *penny* systems over *the present*, but *still more over the mil*,—it has no reference whatever TO CALCULATIONS. There are no two ways of doing a rule-of-three sum, and I must not, therefore, ask to occupy your space with the figures required, in the peculiarly favourably example for the present system on which Mr. Good comments,—*thus* to make the calculation of 31 tons 12 cwt. 2 qrs. 14 lbs. at £12 12s. per ton, *on the present system*. It will be found to require *exactly* as I have stated, 156 *figures*, and as this is the mode of making the calculation imperatively required in the Government Offices, the Customs, Admiralty, &c., as well as the method of working employed in ordinary elementary works, and by Professor De Morgan, Sir C. Pasley, Mears, Miller, and others, in their comparative examples, *the difference between* 156 *figures and* 31 *figures*, as shewn below on my scheme, determines *beyond the possibility of question or dispute the truly enormous saving of time and labour* we should at once secure on this plan *in all* SUCH *cases*. But the reduction in this number of figures accomplished by "practice," and by mental arithmetic, with those who are

sufficiently educated, ought fairly, though not as by Mr. Good exclusively, to be brought into the comparison, *giving my system the same advantages.* Mr. Good has added the figures required *to bring back the sum into the discontinued form* of account—which can have nothing to do with the question. The price and amount of the iron is per 10 lbs., *but not a figure of the calculation would be altered, and only the position of the decimal points*, if the price were per lb., ·135 ($1\frac{35}{100}$d.); per 10 lbs., 1·35 ($13\frac{1}{2}$d.); per 100 lbs., 13·5 (11s. 3d.); or, per 1000 lbs., 135· (£5 12s. 6d.)

In each of these cases the figures would be:—

| | |
|---|---|
| 7085·4 | or 7085·4 |
| 1·35 | $1·3\frac{1}{2}$ |
| 354270 | 921102 |
| 212562 | 35427 |
| 70854 | |
| 9565·29—31 figures | 9565·29—would be 25 figures only |

Mr. Good, by a more abbreviated mode of working than that which I am assured on good authority is a fair example of the usual mode of working such a sum *by "practice,"* brings down the figures to 45, as against 25 on my plan. I can well afford to give him the difference, but those who are practically familiar with such calculations can decide which of the two methods most fairly represents that which would be *usually* adopted by clerks, shopmen, &c., of ordinary education.

My Example.

| | £ | s. | d. |
|---|---|---|---|
| 10cwt. = $\frac{1}{2}$ | 42 | 12 | 0 |
| 2cwt. = $\frac{1}{5}$ | 6 | 6 | 0 |
| 2qrs. = $\frac{1}{4}$ | 1 | 5 | $2\frac{2}{5}$ |
| 14lbs. = $\frac{1}{4}$ | 0 | 6 | $3\frac{3}{5}$ |
| | 0 | 1 | $6\frac{9}{10}$ |

| | | | |
|---|---|---|---|
| 10s. = $\frac{1}{2}$ | 31 tons. | | |
| | 12 | | |
| | 372 | | |
| 2s. = $\frac{1}{5}$ | 15 | 10 | |
| | 3 | 2 | |
| | 7 | 19 | $0\frac{9}{10}$ |
| | £398 | 11 | $0\frac{9}{10}$ |

*55 figures, counting fractions as single figures.*

On Mr. Good's Method.

| | Tons. | cwt. | qrs. |
|---|---|---|---|
| | 31 | 12 | $2\frac{1}{2}$ |
| | 1 | 1 | 3 |
| | 31 | 12 | $7\frac{1}{2}$ |
| | | | 12 |
| | 379 | 11 | 6 |
| 10s. = $\frac{1}{2}$— | 15 | 16 | $8\frac{3}{4}$ |
| 2s. = $\frac{1}{5}$— | 3 | 3 | $3\frac{3}{20}$ |
| | £398 | 11 | $0\frac{9}{10}$ |

45 *figures, as above, against* 25 !

And if anyone will take the trouble of working a few calculations, *taken at hazard, and bringing in pence, &c.*, he will find that even this important decisive saving of figures and labour by no means represents that which could often be accomplished, as compared with the shortest possible method on the present system. The cost of 50 tons 6cwt. 3qrs. 21lb. at £18 13s. 4d. per ton, for instance, will be found to require 65 figures by ordinary "Practice," and 49 as worked by Mr. Good, whilst BUT THIRTEEN figures are required on the proposed decimal scheme.

The difficulties anticipated by Mr. Good, in the accomplishment of such results as these appear to me purely imaginary. Suppose, he says, having to pay "17 tens and 6 pence" (17X. 6d., or 14s. 8d., that is 176d.), or 9 tens and 7 pence" (9X. 7d., that is, 97d., or 8s. 1d.), "with no coins but the existing,"—tenpennies not yet issued. He must bear in mind that one of *my* suggestions has always been that until the old coinage be worn out, and my proposed decimal substituted, the existing coins should as generally, and as soon as possible, be stamped with the figures indicating the pence and tenpence they represent, *the same identical figures of course giving, as pointed out, the decimal value*,—10s., 12·0d.; 2s. 6d., 3·0d.; 1s., 1·2d., &c. But *without this*, where *could* be the difficulty of paying 17X. 6d., or 17·6d., with 10s. (12·0d)., 4s. (4·8d.), and 8 pennies; or 9X. 7d. (9·7d.) with 5s. (6·0d.), 2s. 6d. (3·0d.), sixpence (·6d.), and one penny (1d.)?

Yours faithfully,

THEODORE W. RATHBONE.

November 10th.

P.S.—I have to thank you for your altogether unexpected re-publication yesterday of my letter of 19th August, 1853, as in *my* opinion there can be no better proof of the accuracy of the description of its contents given in your list (the point in dispute) to any, if such there are, who feel the slightest interest in such a question. The highly important and useful practical decimalisation of our own accounts and ordinary calculations, and foundation of international decimal accounts and coinage, by substituting the *tenpence*, as there stated, for the shilling, and rendering the franc or tenpence identical, and shewing by decimal figures the exact decimal relation of all coins and accounts in Europe and America as extensively as possible to this future universal coin, are views there I think most intelligibly indicated, as it was most certainly intended that they should be, and as it has been admitted without question that they clearly were, *immediately afterwards*, in my communication to the British Association, and first pamphlet. The letter certainly was very hastily written, some hours after midnight, and having to leave home early the next morning, after reading the report of the Decimal Coinage Committee, and finding to my great regret that this simple course of proceeding had then actually never occurred to any one of the members or numerous witnesses examined, and unless at once brought before the public, must encounter, as has happened, the serious prejudice of another scheme, given to the public on such high authority and warrant, *as the only one to obtain the object.* It appears with every one of the obvious errors of the press and expression I at once admitted and pointed out, and I should have thought your space would have been *more usefully* occupied by my latest and most carefully worded, instead of my first and most hastily written publication, but I do not complain, but the contrary, of your having thus exactly met the wishes, on whatever ground, of your correspondent.

## SOCIETY'S LIST OF LECTURERS.

Sir,—The "Pembroke Dock" is not the only Institute which has experienced disappointment with regard to the lectures of Mr. Partington. He has just delivered his lecture on "War and its Appliances," to the members of this Institute, the result of which, was, I believe, universal *dissatisfaction.*

I think the Society of Arts will do very wrong if they again publish his name as an acceptable lecturer.

I am, Sir, yours obediently,

A. B.

Bilston Institute, 5th Nov. 1855.

## STRENGTH OF MATERIALS.

Sir,—Sir W. C. Trevelyan's letter, inserted in the *Journal* of the 5th ult., not having been responded to by a more able correspondent, I venture to remark that the experiments he suggests would be easily made, and with little cost in any instance where iron is exposed to frequent jars, as in axles of carriages, especially those used on railroads. The superiority of a made mast over one consisting of a single stick scarcely appears to be a case in point in regard to metals, they being nearly of a homogeneous quality, however large the mass, whereas wood is less

strong at some parts than at others; and for this reason Sir S. Bentham, in his specification of patent No. 1951, descanted on the advantages of laminated work where wood is the material. Many circumstances seem to indicate that a laminated composition would, as Sir W. Trevelyan suggests, be advantageous for metals also; for instance, the crystalline form of the molecules of iron given by hammering anchors; vibration being produced by hammering, as it is by the jars to which iron axles are exposed. It was expressly to prevent vibration of iron, that Sir Samuel, in a design, furnished early in this century, for a metropolitan bridge, proposed the filling in of the iron parts of the structure, as may be seen in the reports of the Commission, at whose request he gave his ideas on the improvement of the Thames, together with drawings of his steam-dredging apparatus.

In experiments of laminated iron for axles, it might not be safe to begin with a small thickness of this material, or to make the trial on passenger trains, but in the conveyance of coals, for example; the metal might be diminished by degrees, should experience show that a lesser quantity sufficed in laminæ than in a single mass.

In corroboration of Sir W. Trevelyan's idea, it may be remarked that carriage springs are formed of different folds of metal, to ensure strength, combined with lightness.

I am, Sir, truly yours,

M. S. BENTHAM.

November 2nd, 1855.

## MEETINGS FOR THE ENSUING WEEK.

Mon. Architects, 8. An abridgement of M. Lance's Essay "On a Diploma in Architecture," with remarks and suggestions by Mr. John W. Papworth.
Statistical, 8. Mr. Leone Levi, "On the Meeting of the Statistical Congress at Paris, in September, 1855."

Tues. Horticultural, 2.
Linnæan, 8.
Civil Engineers, 8. Mr. J. Baillie, "On the application of Volute Springs to the Safety Valves of Locomotive Boilers."

Wed. Society of Arts, 8. Rev. Dr. Booth, F.R.S. (Chairman of Council), Introductory Address, on opening of One Hundred and Second Session.
Geological, 8. 1. Mr. J. Prestwich, jun., "Notice of the Artesian Well at Kentish Town." 2. Sir Roderick Murchison, "Notice of the Upper Silurian Rocks at Lesmahago, in the South of Scotland, in which Mr. Slimond has discovered fossil Crustaceans." 3. Mr. J. W. Salter, "Description of some fossil Crustaceans from Lesmahago, in the South of Scotland."

Thurs. Numismatic, 7.
Antiquaries, 8.

Fri. Philological, 8.

Sat. Royal Botanical, 3¾.
Medical, 8.

## PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette November 9th*, 1855.]

*Dated 22nd October*, 1855.

2358. W. Teall, Wakefield—Extracting fatty or oily substances.
2360. A. McGlashan and E. Field, Coal-yard, Drury-lane—Printing presses.

*Dated 23rd October*, 1855.

2366. A. Gregory, 21, Church-street, and J. Jillings, 6, Temple-street, Whitefriars—Cleansing pan of water-closets.
2638. G. Collier, W. Bailey, and R. Horsfall, Halifax—Drying wool.
2370. T. Roberts and J. Dale, Manchester—Treating amylecious substances for stiffening purposes.
2372. W. Shears, Bankside—Gunpowder magazines.
2374. A. V. Newton, 66, Chancery-lane—Rope machinery. (A communication.)

*Dated 24th October*, 1855.

2376. J. Bevan, 2, High-street, Deptford—Projectiles.
2378. J. Healey, J. Foster, and J. Lowe, Bolton-le-Moors—Drawing, moulding, forming, and forging machinery.
2380. J. H. Johnson, 47, Lincoln's-inn-fields—Dies and matrices. (A communication.)
2382. E. Butterworth, Rochdale—Spinning machinery.
2384. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Churns. (A communication.)

*Dated 25th October*, 1855.

2386. A. Ardouin, 5, Woodland-street, East Greenwich—Corking and capsuling machine.
2388. E. D. Johnson, Wilmington-square—Apparatus for tuning stringed instruments.
2390. J. Robinson, Aldersgate-street—Winding clocks.

*Dated 26th October*, 1855.

2392. S. B. Sharp and R. Furnival, Manchester—Drilling, grooving, and slotting machinery.
2394. F. C. Calvert, Manchester—Treatment of copper slags to obtain iron.

*Dated 27th October*, 1855.

2396. Baron de Kleinsorgen, 3, Sidmouth-street—Azimuth compass.
2400. J. D. M. Stirling, Blackgrange, Clackmannan—Cast steel tubes and cylinders.
2402. G. Geyelin, Melville-terrace, Camden-town—Perambulator.
2404. J. Hands, Duke-street, Grosvenor-square—Preserving animal and vegetable substances for food.
2406. I. J. Speed, jun., Detroit, Michigan, U.S.—Car and carriage springs.

*Dated 29th October*, 1855.

2408. G. Riley, 12, Portland-place-north, Clapham-road—Roller mill for grinding malt.
2410. J. Whitworth, Manchester—Artillery and firearms.
2412. L. Roudière, Paris—Cavalry boots.
2414. W. Heartley, Bury—Safety valves.

*Dated 30th October*, 1855.

2418. W. C. Holmes, Huddersfield—Steam boilers.
2420. J. Barrans, Deptford—Steam boiler furnaces.
2422. J. I. B. S. M. de Lignac, Paris—Preserving animal substances.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2442. A. E. L. Bellford, 32, Essex-street, Strand—Sewing machines. (A communication.)
2454. J. Lewis and J. Edwards, Dawley, Salop—Malt crushers.
2479. W. H. Walenn, 46, Regent-street—Flattening cylinder glass. (A communication.)

## WEEKLY LIST OF PATENTS SEALED.

*Sealed November 9th*, 1855.

1043. Richard Shiers Markindale, Salford—Improved method of removing wool from sheepskins and other peltry.
1053. Alfred Vincent Newton, 66, Chancery-lane—Improved mode of preparing colours for printing and staining fabrics.
1063. Constantine Henderson, Tufnel-park—Improvements in the construction and arrangement of locks.
1069. Frederick George Sanders, Poole—Improvements in brick, pipe, and tile machines.
1076. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in machinery for boring or perforating stone and other materials.
1086. Robert Morrison, Newcastle-upon-Tyne—Improvements in steam-engines.
1130. Benjamin Nicholls, East-street, Old Kent-road—Improvements in the manufacture of buttons.
1170. James Park, Bury—Improvements in machinery for manufacturing paper pulp.
1186. Edward Aldridge, Boston—Improvements in meters for measuring the flow of liquids and fluids, which can also be employed for obtaining motive power, and in taps for regulating the flow of liquids.
1196. John Aspinall, Fenchurch-street—Improvements in machinery for extracting moisture from substances, and for separating liquid from solid bodies, applicable to the refining of sugar, drying of goods, and to purposes for which centrifugal machines are employed.
1198. Jean Ciancaleone Ricu and Carlo Bartocci, Fuligno, Papal States—A new beverage.
1218. Joseph Leese, jun., Manchester—Improvements for obtaining colouring matter.
1231. William Arthur Henry, Bridge-street, Sheffield—Improvements in vices, and in the mode of securing the same to work-benches.
1243. Charles Tennant Dunlop, Glasgow—Improvements in the manufacture of chlorine.
1248. Robert Ashworth and Samuel Stott, Rochdale—Improvements in machinery for preparing, spinning, doubling, twisting, and winding fibrous substances.
1263. Henry Cartwright, Dean, Broseley—Improved steam-cock.
1272. William Eley, 38, Bread-street, Golden-square—Improvement in the manufacture of detonating caps for fire-arms.
1478. Robert Besley, Fann-street, Aldersgate-street—Improved manufacture of metallic alloy applicable to the casting of type and other articles.
1563. Edward Simons, Birmingham—Improved instrument or apparatus to be used for condensing and absorbing the smoke and products of combustion arising from gas and other flames, and increasing the illuminating power of the said flames.
1867. William Emerson Baker, Cannon-street-west—Improvements in sewing machines.
1976. Alexander Isaac Austen, Belmont, Vauxhall—Improvement in the manufacture of candles and night lights.

*Sealed November 13th*, 1855.

1084. James Pettigrue, Drumcree, Westmeath—Improvements in propelling vessels.
1089. John Mason, Samuel Thornton, and Leonard Kaberry, Rochdale—Improvements in machinery or apparatus for preparing cotton and other fibrous substances for spinning yarns of threads, and for finishing or polishing such yarns or threads.

1093. Levi Lewis Hill, Westhill, New York—Improvements in silvering glass.
1096. Peter Christie, Greenock—Improved tent or hut for soldiers in the field, emigrants, tourists, and other persons requiring a portable dwelling.
1097. Robert Jobson, Holly Hall Works, near Dudley, and John Jobson, Litchurch Works, near Derby—Improvements in the manufacture of moulds for casting metals.
1101. Wilfrid Latham, Liverpool—Improvements in cutting the terry or pile of certain textile fabrics used for saddle covers.
1115. Jean Guillaume Butt and Jean Alfred Martin, Paris—A new system of rotary steam engines.
1117. Frederick Delacourt Blyth, Birmingham—Improvements in the manufacture of tea-trays, picture frames, and other similar articles from papier mache.
1121. Charles Claude Etienne Minié, Paris—Improvements in breech-loading fire-arms.
1133. Frederick William Mowbray, Shipley, near Leeds—Improvements in looms for weaving carpets and other pile fabrics.
1185. Joseph Hippolyte Poullain, Paris—Improved penholder.
1187. Henry Henson Henson, Parliament-street—Improvement ni the manufacture of fabrics suitable for goods-wrappers, and other purposes for which canvas has been or may be employed.
1249. Thomas Worsdell, Birmingham—Improvements in lifting jacks.
1250. Richard Archibald Brooman, 166, Fleet-street—Improvements in dyeing cotton, threads, yarns, and twists. (A communication.)
1363. James Timmins Chance, Birmingham—Improvements in glass flattening furnaces.
1757. Auguste Edouard Loradoux Bellford, 32, Essex-street, Strand —Improvements in grinding mills.
1763. Henry John Betjemann, 449, New Oxford-street—Improvements in extending tables.
1913. Thomas Bartlett, C.E., Chambery, Savoy—Improvements in machinery for drilling or boring into stone.
1975. Frederick Crace Calvert, Manchester—Improvements in the treatment of heating, puddling, and refinery iron slags or cinders.
2037. James Bird, Seymour-street-west—Improvement in the manufacture of biscuits.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

*November 5th.*

659. John, Edward, and Charles Gosnell, 12, Three King Court, Lombard-street—Improvements in brushes.
709. George Lucas, 42, Kennedy-street, Manchester—A composition for filling engraved cast or sunk letters, devices, or ornaments, on or in brass, zinc, or other metallic plates.

*November 6th.*

722. George Kendall, Providence, Rhode Island—Improvements in apparatus to facilitate the manufacturing of mould candles.
750. John Mirand, Paris—Improvements in the construction of electric apparatus for transmitting intelligence.

*November 7th.*

672. Stephen Carey, Great Guildford-street—Improvements in the construction of viaducts, arches, bridges, and other buildings, upon a non-expansion principle.
685. Robert Knowles, Chorlton-upon-Medlock—Improvements in boilers and apparatus for generating steam.
714. Henry Huart, Cambrai, France—Improvements in the storing and preservation of grain.
727. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in measuring and registering the flow of fluids. (A communication.)
742. Hugh Greaves, Salford, near Manchester—Improvements in the permanent way of railways.

*November 8th.*

712. Christian Sharps, Hartford, U.S.—Improvements in breech-loading fire-arms.
1121. Commander George Beadon, R.N., Creechbarrow, near Taunton—Improvements in constructing and propelling ships and vessels.

*November 10th.*

713. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in machinery or apparatus for sewing and stitching. (A communication.)
757. Thomas Taylor, Patent Saw Mills, Manchester—Improvements in apparatus for measuring water and other fluids, which apparatus is also applicable to the purpose of obtaining motive power.
837. Augustus Turk Forder, Leamington Priors, Warwick—Improvements in tenders for railway-carriages.
955. Richard Archibald Brooman, 166, Fleet-street—Improvements in the manufacture of sugar. (A communication.)

## WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

| No. in the Register. | Date of Registration. | Title. | Proprietors' Name. | Address. |
|---|---|---|---|---|
| 3780 | November 8. | The Corbillard, or Improved Hearse ... | William Garstin ........... | 82, Baker-street. |
| 3781 | „ 9. | The Carlton Bottle Holder ................. | Thomas Challinor ......... | 4, Bolt-court. |
| 3782 | „ 10. | Parts of a Lock ................................ | W. Kennard.................. | 32, Little Queen-street, Holborn. |
| 3783 | „ 12. | Improved Wire Heald ........................ | John Shaw and Co. ...... | Sowood Hill, Stainland |
| 3784 | „ „ | Cutting Tool to be used in Machines for Slotting or Grooving ............ | Thomas B. Sharp and W. Fothergill Batho......... | Manchester. |
| 3785 | „ 13. | Improved Portable Alcoholic Camp Kitchens or Lamp and Stand for Pic-nic and General Cooking purposes ........................................ | Andrew Love ............... | Liverpool. |

# INDEX TO VOLUME III.

# ERRATA.

Page 29, col. 1, line 4,—article on the Ventilation of Apartments and Hospitals, for "50 to 75 cubic centimetres," read "·50 to ·75 cubic metres."
„ col. 2, line 7,—For "consumes," read "produces."
„ „ line 8,—For "absorbed," read "generated."
Page 30, col. 1, line 45,—For "2,550," read "2,250."
„ „ line 48,—For "1,982," read "1,928."
Page 33, col. 1, line 26,—For "Tartons," Charles, read "Sartoris," Charles.
Page 123, col. 1, line 33,—For "smoker," read "worker."
„ col. 2, line 31,—For "fine parts," read "fore parts."
„ Bottom and top of next page,—For "pinkers," "pinker," and "pinked," read "prickers," "pricker," and "pricked."
Page 178, col. 2, line 43, *et seq.*,—For "an abstraction from the basin of some 500,000,000 or 600,000,000 millions of gallons a year, and it moreover showed the continuous lowering of the water under London," read "if the *daily* abstraction of only 5,000,000 to 6,000,000 gallons of water had caused so serious a depression of the springs under London, as evidenced by the diagram presented by me (Mr. John Braithwaite), what would have been the depression if 50,000,000 to 60,000,000 gallons of water (the minimum daily supply to the metropolis) had been abstracted?"
Page 271, 8th line of figures from bottom,—For "48·10" read "45·62;" for "3·083," read "2·737;" for "·556," read "·581;" for "·410," read "·456."
„ last line of figures,—For "·157," read "·057."
Page 324, col. 2, line 34,—For "At Nottingham," read "At Tottenham, Middlesex."
Page 325, col. 2, line 51,—For "efficient for *soil*," read "efficient for *evil*."
Page 390, col. 2, lines 32 and 33,—For "coin piece" read "4 coin-piece."
Page 391, col. 1, line 8,—For "This *expression*," read "This *arrangement*."
Page 407, col. 1,—A portion of Col. Sykes's speech on Public Works for India, omitted at this place, will be found at page 429.
Page 412, col. 1, line 27,—For "making," read "many."
„ col. 2, line 3,—For "our," read "an."
Page 413, col. 1, line 18,—For "representation," read "representative."
„ „ line 21,—"For "our charge," read "overcharge."
Page 438, col. 2, lines 18, 19, 20, and 21,—For "and insufficient to carry steamboats of large burthen—he meant in the peninsula of India. He could understand that it might be so in a hilly country; where we caught, &c.," read "and insufficient to carry steamboats of large burthen. In the peninsula of India, in a hilly country, where we caught, &c."
Page 481, col. 1, line 50,—For "160 ounces," read "16 ounces."
Page 525, col. 1, last line, and col. 2, first line,—For "certainly more sinned against," read "certainly *not* more sinned against."
Page 578, col. 1, at bottom,—The declaration here printed is incorrect; it should be as given in page 591, col. 1.
Page 608, col. 1, line 12,—For "three tons," read "thirty."
„ col. 2, line 21,—For "pounds," read "tons."
„ „ line 43,—For "1754," read "1854."
„ „ line 47,—For "Herwisen," read "Herwain."
Page 609, col. 1, line 13,—For "Treve," read "Frere."
Page 741, col. 2, line 2,—For "decimal *florin*," read "decimal *form*."
Page 773, col. 2, line 8, for "XII," read "XIII."

# SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES AND COMMERCE,

ADELPHI, LONDON.

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101ST SESSION, 1854-55.

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# CATALOGUE

OF THE

# SEVENTH EXHIBITION OF INVENTIONS.

BEING A COLLECTION OF ARTICLES RECENTLY INVENTED, PATENTED, OR REGISTERED, EXHIBITED AT THE SOCIETY'S HOUSE DURING THE MONTH OF APRIL, 1855.

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# CATALOGUE

OF THE

# SEVENTH EXHIBITION OF INVENTIONS.

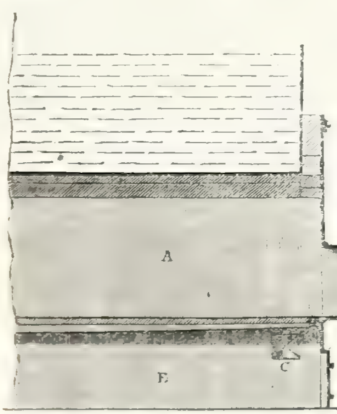
*N.B.—The Council wish it to be particularly understood that they are not responsible for any of the statements contained in this Catalogue. They have to thank several of the Exhibitors for the loan of the wood blocks used to illustrate it. Where an asterisk (*) is prefixed to a number, it denotes that the article exhibited is a drawing.*

## MOTIVE MACHINES, INCLUDING RAILWAY MECHANISM.

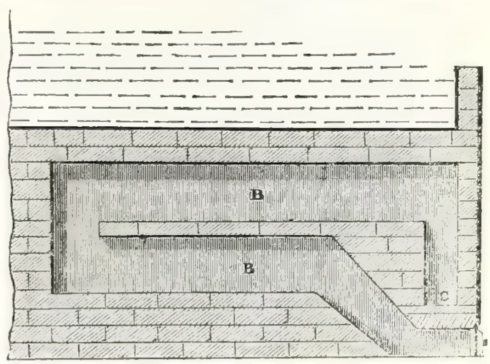
*1. Patent Smokeless Furnace and Stove; G. R. Booth.

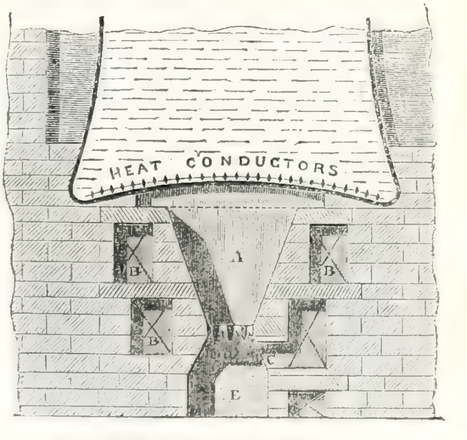
This invention consists of three chambers: the first of which is the fireplace or furnace; the second receives the smoke, gases, and products of combustion from the first, and in it they are mixed with such a quantity of air as to cause them to become inflamed; the resulting products of this chamber are then passed into the third, where a further mixing takes place.

*2. Patent Method of Economising Fuel and Preventing Smoke; Rev. W. R. Bowditch.




A mouth-piece, similar to that used for gas-retorts, is fixed outside the furnace, forming a continuation of it outwards. Each charge of coal is placed in this, and becomes dried and heated before it is placed upon the fire. Fuligirous matter given off here is consumed by passing through the burning fuel behind; steam either escaping up the chimney as such, or possibly being in some measure decomposed and burnt. Hot coal deprived of its 10 per cent. of water will not give off smoke when placed upon a fire. Its




gaseous constituents inflame almost instantly, and are given off more slowly. Side flues heat the air for combustion, and by delivering it, as shown, close to the ash-pit door (which is kept shut), a most vivid combustion is kept up at the point where the smoky matter, &c., given off by the drying fuel meets the fire. Two experi-

ments have been tried with this apparatus, and the results obtained were as follows:—In the first instance, the work done was the same—viz., the distillation of gas. The existing furnace burnt per hour—Coal, 16lbs.; coke, 16lbs.: the improved, only—Coal, 9¼lbs.; coke, 8lbs. The second experiment was in the heating of water. The fuel was the same in both cases, but whereas the old furnace only raised the temperature from 40° Fahr. to 130° Fahr. = 90° Fahr., the improved furnace raised it from 30° Fahr. to 165° Fahr., = 135° Fahr. The heat conductors shown in the boiler are a series of connected pieces of metal, pointed at both ends, designed to save fuel by a more rapid abstraction of heat from the bottom of the boiler than can be effected by water. These are employed on the principle that heat and electricity are subjected to the same laws (which cannot, of course, be discussed here), and have shown a saving of from 16 to 18 per cent. when the heated surface was perfectly clean. They will probably act even more efficiently where furring takes place, and are about to be tested in a boiler occupied in pumping 20 hours per day.

3. Patent Smoke Consumer; — Simpson; and Patent Reciprocating and Moveable Fire-bars; Chanter, Day, and Co.

This invention consists of an inverted bridge, or stop, inserted in the fireplace at a certain distance from the bars, causing the smoke, as it is evolved from the coals, to descend and pass through that part of the fire where there is the most heat, thereby effecting a perfect combustion of the smoke, and a saving of fuel. The further improvements consist in the simple use of toothed or serrated bars with rockers, supported by brackets in tubular, and by boxes under round, waggon, and other shaped boilers, pans, &c. On the rockers, moving serrated bars are placed, so as to work alternately between fixed serrated bars. By the use of a hand-lever, the stoker easily effects a movement of the reciprocating bars, and at once cleans the entire surface of the fire-grate of dust and small cinders, thereby preventing the formation of clinkers to a great extent, and the burning away of the bars, while fresh air passes more freely between the bars, causing a more perfect and brisk combustion of the fuel, and consequently rendering it possible to have a better fire with a less depth of fuel, and to generate steam much quicker.

*4. Improved Furnace for the Consumption of Smoke and Generation of Steam; Joe Cliffe.

Two transverse copper boxes are connected with each side of the flues, and open into the boiler, to which are also connected hollow copper fire-bars, through all of which the water continually circulates, thereby preventing their destruction by the heat of the furnace, as well as generating a greater amount of steam. A partition wall (to which is affixed an iron door, to remove the ashes) is built from the bottom of the flue to the underside of the copper fire-bars, about midway in the length of the ashpit, and in conjunction with the copper fire-boxes at the back of the fire, which completely closes that part of the flue above the bars, thereby compelling the products of the fuel to descend through that portion of the fire on the bars behind this partition, thus consuming the fuliginous products of the fuel. A bridge is built, of the ordinary height, inside the flue, thereby concentrating the flame to the upper portion of the flue. An iron cistern, with a perforated bottom, is placed on the top of the flue, beyond the boiler. This cistern is continuously supplied with a chemical liquid, which, passing through the perforated bottom, completely absorbs the whole of the carbonic and other injurious gases, which are then discharged into a cesspool. A fan, to assist the draught, which might be impeded by the dropping of the liquid from the cistern, is placed just beyond it in the flue.

5. Patent for Admitting Air to Furnaces where Tubular Boilers are employed; R. Galloway.

6. Patents for Consuming the Smoke of Furnaces under the Boiler, and also for consuming the Effluvium arising from the Melting of Fat and Stuff, and in the boiling of Whalebone, Flesh, Bones, Oil, &c.; J. Gilbertson.

The first plan, patented by the inventor for consuming smoke, was in 1828; and consists essentially of hollow bars, and an air chamber under the bridge; the air passes through the bars into the chamber, and escaping thence by small orifices, mixes with the gases, causing them to inflame. The second plan, patented in 1854, is the application of a perforated tube, which carries air to all parts of the furnace, supplying it over the fuel equally. The consumption of the smoke commences with the first lighting of the fire, and from 20 to 25 per cent. of fuel is saved. The consumption of the effluvium is effected by the application of an ash pit door, a dome over the copper or pan, and a shaft from the dome to the ash pit. All access to the fire being stopped by the ash pit door, the draught must necessarily go down the shaft from under the dome, carrying the steam and noxious effluvium with the fresh air requisite to supply the fire.

7. Patent Smoke Consuming Furnace; W. Hazeldine.

The fire bars are here placed across the furnace, and form an inclined plane towards the bridge. A reciprocating action is communicated to the bars, by which the coals are gradually driven forward, and the accumulation of clinker is prevented. The fuel is regularly supplied by means of a hopper, in front of the furnace.

8. Patent Smoke Consuming Furnace; J. Juckes.

The fire bars are formed into an endless chain passing over two drums, one at the front and the other at the back of the furnace. They are moved forward either by hand or by a strap from the steam engine; the power required is less than 1-20th part of a horse; and they travel at about the rate of six feet per hour. The coals pass into the furnace under the door, which lifts up

instead of opening on hinges, and thereby forms a gauge for the fuel, so that the fire is level from one end to the other. With this invention, either large or small coals may be burnt advantageously, the latter admirably suiting the purpose. The air is constantly passing to the fuel through the fire bars, and in this manner perfect combustion is obtained. As the fuel is carried in under the fire door, so the scoria or clinker is carried out under the stop at the back of the furnace, and falls into an iron box or carriage on wheels. The burning away of the fire bars is prevented by their constant motion, being partially covered with unconsumed fuel, and getting cool before they re-enter the fire. The whole of the apparatus can be removed from under the boiler in case of need or repair, as it runs on rails. The entire consumption of the smoke is effected, with a considerable saving of fuel. (See *Journal of the Society of Arts*, vol. ii., page 33.

*9. Improvements in Boilers and other furnaces for the Prevention of Smoke; C. Hargrove.

This invention consists in making the fire bars of steam boiler and other furnaces hollow, and introducing air heated by passing through the said hollow bars, at the bridge or other suitable part of the furnace. The air heated by passing through the said hollow bars effects the prevention of smoke without the lowering of temperature which occurs when cold air is introduced for that purpose.

10. Patent Furnace Flues for the Consumption of Smoke and Saving of Fuel; B. Price and Co.

The principle consists of the admission of atmospheric air at the back of the ash-pit, or any other convenient place, the aperture being fitted with a door or valve, to which is attached a rod that comes to the mouth of the ash-pit, by this means the admission of the air may be regulated to any degree. Opposite the aperture is placed a tube which goes through the circulating chamber behind the bridge, to nearly the end of the boiler. It then branches off each way into two tubes, which return back to the bridge and deliver the heated air into a chamber, the top or outlet of which is made much smaller than the bottom. From this aperture there is a continual supply of heated oxygen brought in contact with the hydro-carbon (or black smoke) produced from the combustion of the coals in the furnace, and escaping unconsumed, for the want of more oxygen, into the flues, and thence to the top of the chimney. The tubes are placed in an elevated position, so as to cause the air to pass through them more rapidly into the small chamber (the receptacle of the heated air). There is also a large circulating chamber, where the different gases meet and get thoroughly mixed; this chamber is so constructed as to retard the velocity of the currents, which causes a more perfect combustion, and produces a more uniform heat round the boiler; the evaporation is much quicker, and the saving of fuel very considerable. In large boilers, there are two, and sometimes three of these circulating chambers.

11. Smoke Consuming Furnace; C. J. Redpath.

The idea of this furnace was partly derived from Mr. C. W. Williams's Argand Furnace. The air is introduced through the outer plate of the furnace door, which is perforated for the purpose, and it then passes upwards into an air-box above the fire, from which it descends in a heated state into the fire, causing the most perfect combustion of the fuel. Opposite the air-box before alluded to there is a valve, which can be opened and shut at pleasure, to admit air directly to the fire without passing between the plates of the furnace-door. When fresh coal is added to the fire, and a large quantity of air is required, this valve is opened; as soon as the charge has become ignited, the valve is closed. The cold air continually impinging on the inner plate of the furnace door, keeps both it and the ash-pit cool, which is a great consideration on board steam-vessels. It also prevents the rapid deterioration of the door. The furnace-bars are not more than three-quarters of an inch thick by six inches deep, and are placed half an inch apart; they are grooved on the top, thus making the set corrugated, offering a broken surface to the fuel, and thereby less inclination to clinker.

12. Patent Smoke-preventing Furnace, with moveable Chill Fire Bars; S. O. Regan.

The object of this invention is to give a regulated supply of rarefied air to the gases of combustion. Air is admitted through a chamber attached to the furnace door, as well as through the dead plate, which has slots in it for the purpose. The fire bars are of two kinds, waved on the upper surface, and grooved or plain, alternately; the former are moved longitudinally by means of a joggle shaft, and the latter transversely. This prevents the accumulation of clinkers and their adhesion to the bars, and keeps the air-way free, so necessary for the protection of the bars and the combustion of the gases. A slide or clinker plate, admitting the air in front of the bridge, is placed at the back of the furnace, between the bars and the hollow cast iron bridge. The bridge is protected by a casing of brickwork above the level of the fire-bars. In its front side, in the ash pit, there is a valve, and the back plate of the bridge is perforated.

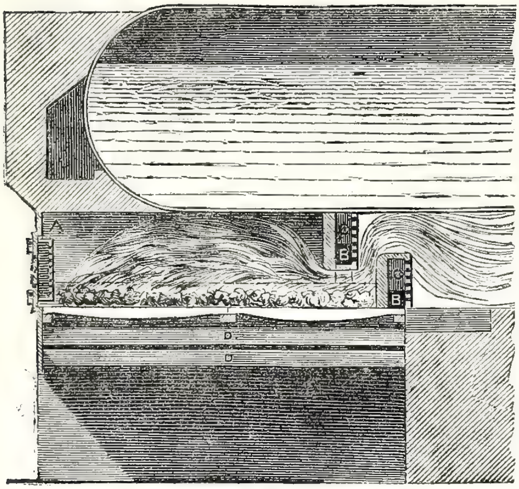
13. Patent Furnaces, for avoiding Smoke from Boilers, Coppers, Ovens, &c.; W. Sorrell.

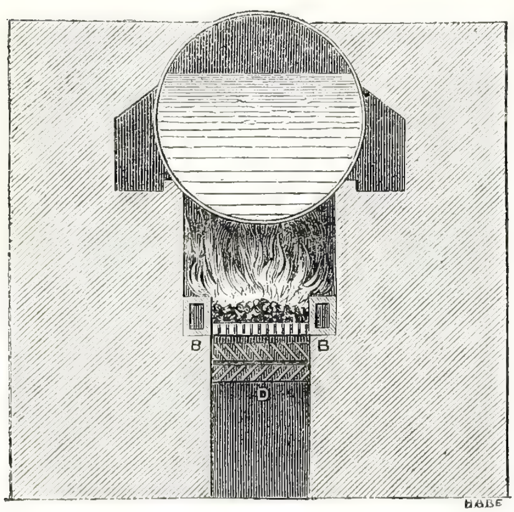
14. Patent Argand Furnace, for the Prevention of Smoke; C. Wye Williams.

The peculiarity of this invention consists, as is now generally well known, in the introduction of a proper quantity of atmospheric air to the bridges and flame beds of the furnaces, through a great number of small orifices, connected with a common pipe or canal, whose area can be increased or diminished, according as the circumstances of complete combustion may require, by means of an external valve. The operation of air thus entering in small jets into the half-burned carburetted gases over the fire and in

the first flue is their perfect oxygenation, the development of all the heat which that can produce, and the entire prevention of smoke. (See C. W. Williams on "The Combustion of Coal, and the Prevention of Smoke;" 8vo, 2nd edition, London, 1854.)

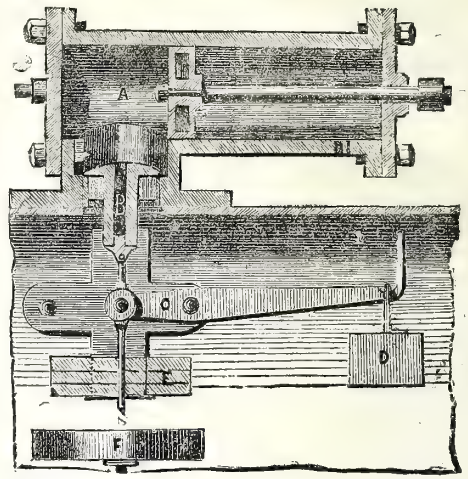
*15. Patent Improvements in the Combustion of Fuel, and in the Construction of Furnaces; W. Woodcock.




By the inventor's first patent heated air is supplied by pipes or flues, placed within the furnace, to the neighbourhood of the ordinary bridge, and, passing through numerous orifices into one common passage, with the gases given off by the fuel on the fire bars, is compelled by the peculiar position of an inverted bridge, to meet and combine with, and thus complete, the combustion of those gases. The hot-air flues, having their external opening at a greater distance from the shaft than the fire bars are, do not injure the draft to the latter, and require no valve or regulator, naturally supplying only the quantity of air required by the gases in the different stages of their combustion. His second patent consists of a series of flat bars immediately beneath the fire bars, somewhat after the manner of Venetian blinds. By their aid the usual waste of heat passing into the ash pit is prevented, and the ash pit kept as cool as the external air; consequently the draught is materially increased, cool instead of hot air being supplied to the fire bars. Thus a more perfect combustion of the fuel is secured, and the fire bars are much protected. (See *Minutes of Proceedings of the Institution of Civil Engineers; Session* 1854-55.)

16. Patent Steam Fire Door and Damper Apparatus; S. J. Healey.




This invention consists essentially of a species of duplex valve, forming a means of communication between the interior of the boiler and a small cylinder and piston arranged to act upon fire doors or dampers, so as to diminish the action of the fire when necessary. A small steam cylinder, A, is fitted upon the top of the boiler, being connected to it by a short pipe cast upon it at one end. In this pipe is formed a seating for a valve, B, which opens upwards towards the cylinder, A. The valve B, has a tubular spindle passing down into the boiler, and to lateral pins on the lower end of this spindle, is hung a frame to receive the weights, E, which are adjusted to the area of the valve according to the highest pressure to which it is deemed advisable to raise the steam. Should the steam pressure increase beyond this amount, the valve B, is of course, raised, and the steam entering the cylinder, A, impels the piston towards its opposite end, thereby opening the fire door, or damper; the piston-rod being connected to one or the other as the case may be. The tubular opening in the valve, B, is fitted with a small valve at its lower end opening downwards, and this secondary valve is connected by a short link to a lever, C, carried by the frame hung upon the valve, B. The lever C, is weighted to D, to counterbalance a float F, connected to the inner end of the lever. It is intended to set this float not at the highest water level, but at a point below which it would be dangerous for the water level to be, so that if

the supply of water, from any cause, fails to maintain the water level at the safety point, the float F, will descend and open the smaller valve, admitting the steam through the tubular passage in the valve, B, to the cylinder A, when it can act upon the piston, and through it upon the fire door or damper. There is an aperture in the cylinder near the end furthest from the valve B, and when the steam pressure is excessive, the piston passes beyond this aperture, and allows the steam to escape. The escape of steam as well as the movements of the details connected with the piston will attract the fireman's attention, and the apparatus will thus be an indicator of danger, as well as a self-acting safety appliance. (See the *Practical Mechanics' Journal*, February, 1855.)

*16*a*. Patent Steam Boiler; J. Warhurst.

Instead of the usual mode of producing steam by the direct action of fire upon water, it is proposed to economise the heat produced by fire in the first instance by confining the steam and passing it through pipes or tubes surrounded by water, causing the tubes so heated by the steam to cause the water to evaporate or produce more steam, thus economising the fuel.

*17*a*. Twin Dredger of 30 horses power; J. W. Hoby and Co. Exhibited by W. and J. H. Johnson.

A deviation from the ordinary system of construction was adopted in this dredger, to meet certain peculiarities in the locality for which it was built. The hull is of plate iron, and is 90 feet long, 30 feet wide, and 8 feet 6 inches deep. A pair of oscillating cylinders, each 25 inches in diameter, form the actuating power for the bucket chains. These cylinders are placed below the main driving shaft, which is at the upper end of the bucket ladders. The steam supply is derived from two boilers, one on each side of the central well of the hull. The motion is primarily communicated to a transverse horizontal shaft, directly over the steam cylinders. This shaft carries two very heavy fly-wheels, and it has, besides, bevil pinions upon its overhanging ends, attached by stiff friction, so as to be capable of yielding to any inordinate strain. These end pinions gear with bevil wheels keyed on vertical shafts, which again carry bevil pinions on their upper ends, in gear with large bevil wheels on the main driving shafts. Connections are also provided for enabling the engines to drive the several winches for lifting the lower ends of the bucket-ladders, and for warping the vessel into position. The machine has discharged at the rate of 1,840 tons per day of 10 hours.

*17*b*. Duplex Steam Boiler; J. H. Robinson. Exhibited by W. and J. H. Johnson.

This boiler is an attempt at the combination of narrow-diameter, and consequently safe boilers, with the greatest possible area of effective heating surface. It is composed of two separate cylindrical generators, disposed side by side, at a short distance apart. The fireplace is between, and partly beneath, these two chambers, and the draught currents, after passing between, and along the outside of the boilers, return by a central flue, or through a set of tubes, in each boiler. The two ends of the internal flue open laterally into an outside flue, which runs back to the chimney. The furnace may be large, so as to hold a great body of fire, which, besides demanding less attention than a small one, insures more perfect combustion, as the draught need be but weak.

17*c*. Small Diameter Steam Boiler; Holcroft and Hoyle. Exhibited by W. and J. H. Johnson.

This is a triple chambered boiler, the three sections being disposed in a triangle. The large space thus enclosed forms the furnace, the direct heat from which is made to act upon large areas of the sides of two external cylinders, and the bottom of the central one. The fire current passes first right beneath the boiler, at the rear of which it is separated into two portions, passing to the after ends of the two side boilers. The flue tubes in these boilers form the return ways and so bring the currents to the front, from which part vertical flues take them down to a single central flue, underground, in communication with the chimney. The gain from the use of small diameters is shown in the fact, that a boiler, 4 feet in diameter, and made of $\frac{5}{16}$ plates, working at a pressure of 75 pounds, is subjected to no greater strain than a boiler 7 feet in diameter, made of $\frac{7}{16}$ plates, and working at 60 pounds. The new plan is also economical in space, a 60 horse boiler only requiring an area of 12 feet by 13 feet 6 inches.

*17*d*. Smokeless Steam Boiler Furnace; J. B. Jackson and W. Bowler. Exhibited by W. and J. H. Johnson.

Messrs. Jackson and Bowler's boiler furnace is arranged to work with intermittent supplies, both of fuel and air; and it is contrived for the prevention of smoke without waste of fuel. An air current is supplied behind the fire, just at the point where the furnace flame would languish. The effect of this supply is, that the flame is supported and carried on until the whole of the inflammable gas is consumed. A weighted air valve is fitted to the front end of the furnace seat, down in the ash-pit; and it is so set that it has a constant tendency to remain open for the admission of cold air. The air passes beneath an inclined heating plate, by which it is warmed, and it joins the furnace flame by emerging at a space between the primary and secondary bridges. This air supply produces complete combustion of the gaseous matters, but as the gaseous production varies with the fuel supply, it is necessary to adjust the air supply correspondingly. This is done by a "cataract" arrangement, set up in front of the boilers. When the attendant fires, he draws down one of the pendant rods of the cataract, thus opening the air valve to its full extent and putting the cataract cylinder into the proper position for retaining the valve open, and afterwards gradually closing it. It is found that the fire burns clear, in from 4 to 6 minutes, and the cataract is therefore set to close the air valve in that time. This plan provides a supply of air in exact accordance with the wants of the burning fuel.

*18. Apparatus for Preventing Incrustation in Steam Boilers; — Riggenbach. Exhibited by R. and L. R. Bodmer.

In this apparatus partitions, or elbow-pipes, are introduced into the boiler, so that, on the water being heated, a current is created which will

prevent any extraneous matter from settling down and adhering to the boiler plates. The apparatus has been applied to compound boilers in France.

*19. Designs for Steam Engines; W. L. Baker.

20. A Steam-Engine with Vibrating Cylinder without Friction; R. Waygood.

*21*a*. Direct-Acting Screw-Propeller Marine Engines, of 400 horse power; H. W. Harman, C.E. Exhibited by W. and J. H. Johnson.

Each cylinder has four piston rods, passing across the screw shaft line, and thence through the condensers on the port side of the ship, guide tubes being cast in the condensers as piston rod guides. From the cross heads on the piston rod ends, long connecting rods pass back to the cranks on the screw shaft, trunks being cast in the condensers for the play of the rods. The air pumps are disposed horizontally in the condensers, and their pistons are worked directly from the piston cross heads. The pumps are open at both ends, their surrounding chambers being valved for a double action. The slide valve motion is of the double eccentric link kind, the entire arrangement being under the control of a central hand gear wheel. The steam cylinders and condensers balance each other on the two sides of the keel line, and the whole of the parts are low down, and well out of the way of shot if arranged for war purposes.

*21*b*. Continuous-action Screw Purchase for Slips and Docks; J. Scott. Exhibited by W. and J. H. Johnson.

By this contrivance ships may be drawn out of the water, and again let down therein, by an easy continuous movement. The essential feature of the traction apparatus, is a large compound, or right and left threaded screw, disposed in the line of ship carriage traverse. Each section of the screw has a massive nut crosshead, capable of traversing in parallel guides, in obedience to the revolution of the screw. From these nuts, rods pass down to traction hooks, which are capable of engaging and disengaging with the shoulders of the hauling chain links. A steam engine connected with the gearing at the head of the slip, affords the necessary actuating power, reversing apparatus being provided for giving the back and forward turns to the screw, as the nuts approach the ends of their traverse. This intermittent action of the screw, causes the two nuts to approach to, and recede from each other, alternately, and hence, each hauling hook alternately hauls and works free upon the carriage chain. The ship carriage is thus drawn steadily up the incline. The hauling chain is preserved in an unbroken condition by being wound upon a hexagonal drum, or rotatory holding frame. Each side of this drum corresponds to the length of a chain link, so that the chain points always exactly hit the angles of the drum, and in winding, the bends of the chain take place with great ease. The boss of the drum is formed with a nut to fit the screw threads on the stationary drum shaft, the pitch of the screw threads being made to agree with the space required for the chain coils. In this way, the chain always coils and uncoils upon the drum, in a uniform spiral. A slip, on this plan, has been made for an Australian harbour, by Messrs. Lawson and King, of Camlachie, Glasgow.

*21*c*. Duplex Screw Steering-Gear; Scott, Sinclair and Co. Exhibited by W. and J. H. Johnson.

This double-screw arrangement has been contrived for communicating the motion of the steering wheel to the rudder, in such a manner as to secure a steady and effective action—whilst all "back-lash" or counterstrain upon the steersman is avoided. The after end of the steering wheel spindle carries a spur wheel gearing, with two pinions on the respective ends of a pair of parallel screw spindles. These screw spindles are respectively right and left threaded—and each has a traversing nut fitted upon it—from which connecting rods pass to the two opposite ends of a double lever on the rudder spindle.

*21*d*. Screws for Marine Propulsion; Scott, Sinclair and Co. Exhibited by W. and J. H. Johnson.

Figs. 1 and 2, side and back elevation of a steam ship, with a two-bladed screw of the new form in position. Figs. 3 and 4 similar views, showing a screw as arranged for auxiliary purposes. Figs. 5 and 6 show a three-bladed screw in two stern views. Figs. 7 and 8 are detailed views of a similar screw to that represented in figs. 1 and 2; but composed of two sections, one of which can be shifted behind the other. In fig. 7 the screw is spread out to its propelling position, the two sections being brought so as to form continuations of each other. In fig. 8 the screw is supposed to be inert. Figs. 9 and 10 are views of a modified form of auxiliary propeller, in two different positions. Fig. 11 is a back elevation of another form of propeller for auxiliary purposes. The two pairs of blades assume positions at right angles with each other, being brought into a line with each other, when not propelling, as shown in side and back elevation, figs. 12 and 13. Messrs. Scott, Sinclair and Co. have fitted a three-bladed propeller of this form, to the *Ignez de Castro*, belonging to the Glasgow and Lisbon Screw Steam Packet Co.; and since that time it has been applied in several other instances.

*21*e*. Steam Hammer; R. Morrison. Exhibited by W. and J. H. Johnson.

The essential improvement is the substitution for the hammer block piston and piston rod of the ordinary hammer, of a cylindrical wrought iron bar to form the acting hammer. The steam piston is forged upon the hammer bar, which projects out at the top of the cylinder, and has a T head to act as a guide for the bars traverse in the upper part of the framing. The steam cylinder over-hangs the standards, so as to leave the hammer quite clear for work, giving the workman very great facilities for operating upon his masses of iron.

22. Patent Screw Propellers; E. Hunt.

These screws are designed to obviate the defects arising from centrifugal action in the common screw. The outer and more effective portions of their blades are thrown considerably in advance, so as to act on more *solid* water in advance of that disturbed by the centrifugal action of the central part of the blades. The acting surface of the propeller, marked A, is a portion of a true helical or screw surface, precisely similar to that of a common screw, but instead of the blades being cut from the circumference

straight down to the shaft on their leading and back edges, as in the common screw, these edges are gradually sloped backwards towards the shaft. The propellers, marked B and C, have the same peculiarity as the propeller A, but their acting surfaces have, in addition, a *backward* curve, so as to have a greater hold on the water: they are, however, true screws, and the two, B and C, merely differ as far as regards the curves of backward inclination of their acting surfaces. All the three propellers are of the same pitch and diameter.

23. Patent Screw Propeller; the Phœnix Foundry Company, Lancaster.

The blade of this screw commences at a tangent to the boss, and is bent back spirally until it reaches about three-quarters of the entire radius; the curve then returns and terminates at right angles to the radius. This construction reduces the lateral resistance at the non-effective part of the blade, and gives great axial power at the effective or outermost part. It will carry an unusually large pitch with superior effect.

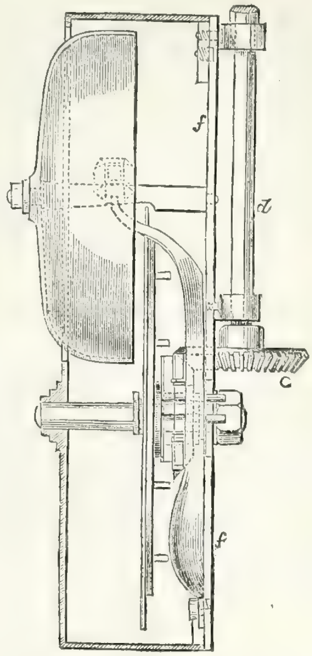
24. Improvements in Propelling Vessels; H. Walduck.

In screw propellers of the ordinary kind a considerable amount of power is wasted by the water being thrown off, partly by the impact of the blades spreading out the water laterally, and partly by centrifugal force. The invention is calculated to remedy this defect by making propellers with grooves on their propelling face, passing from the forward to the back edge of the blades, by which the water is prevented from escaping in a lateral direction, and the screw passes quietly through the water without creating any lateral commotion. These grooves vanish into an even cutting edge, which divides the water, while the back or hindermost edge is chamfered off into the plane of rotation. Three forms of blades are shown in the drawings annexed to the specification. 1st, a screw of the common shape, with the addition of the grooves; 2nd, a screw of a form somewhat like the letter S, which presents sharp entering points to the water; and 3rd, a screw of a conical form. In the first the grooves are of a semi-circular form, if viewed in section. In the last two forms the grooves form a series of curved steps, rising one above the other.

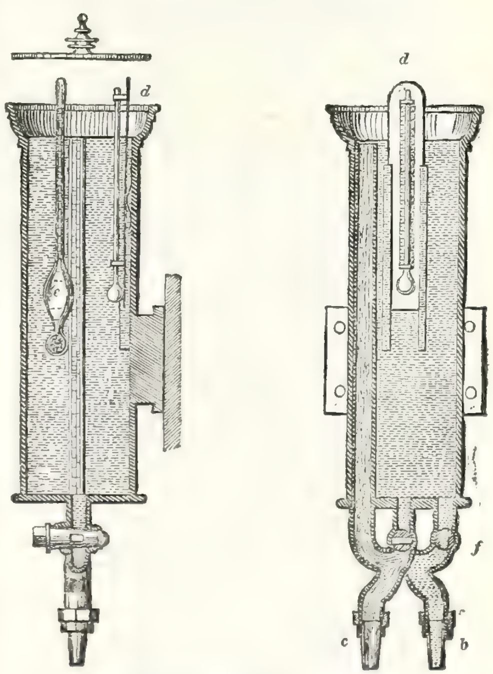
25. Oval Funnel for Steam Vessels; F. J. Wilson.

26. Engine-Room Telegraph; A. P. How.

At the captain's gangway a dial, *a*, is fixed horizontally on the top of a column of wood or cast iron, through which a spindle, *b*, is passed, having keyed on to its lower end a mitre cog-wheel, *c*, gearing into another similar wheel, which is keyed on the spindle to which the engineer's dial, *d*, is fixed. This dial, the alarum-bell, and other machinery are enclosed in a case or cover, the iron back-plate, *f*, being usually fixed to a bulkhead. In the dial, *d*, six pegs, *g*, are fixed, one between each signal; and attached to the spring of the alarum-hammer are two inclined planes, *h h*, each hinged on a pin at one end, and pressed against another pin, *i* (fixed in a projecting part of the hammer-spring), by means of a small spring, *k*. In the front of the cover, an aperture is cut large enough to exhibit the signal in full, but no more, so that only one signal is placed before the eye of the engineer. (See the *Artisan*, July, 1854.)




27. Patent Salinometer; A. P. How.




This instrument consists of a cylinder, or other shaped vessel, *a*, connected with the boiler by the pipe, *b*, the connection on the boiler being below the surface of the water. *f* is a stop-cock, to regulate the quantity of water admitted. It is generally fastened to some partition, bulk-

head, or other suitable place, by a flange, and secured by screws. In the cylinder is a thermometer, *d*. *e* is a hydrometer, floating in the water, at a height corresponding to its density or saltness. *c* is an overflow pipe. The hydrometer is protected by a copper guard. This instrument can be located at any distance from the boiler; the most suitable place being in the engine-room, so as to be in constant view of the engineer.

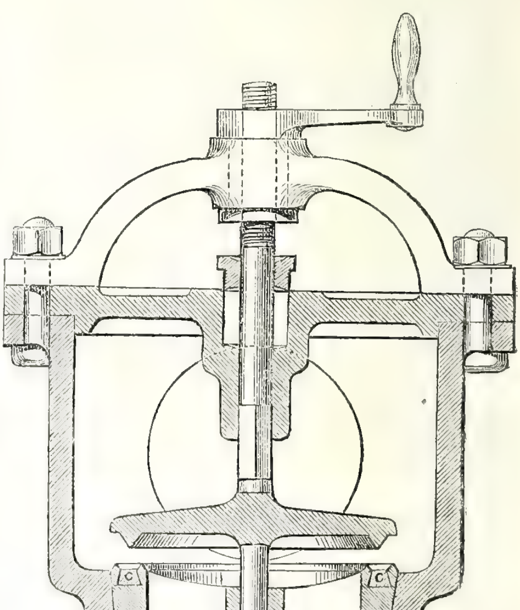
### *28. Patent Cylinder to Steam, Air, or other fluid body Engines; E. F. Hutchins.

This is a uniform leverage or rotary engine. It consists of one cylinder, rotating concentrically with a larger and fixed cylinder, the difference of the sizes of the two cylinders being regulated by the required area of the pistons. The fixed cylinder has one side (or end) cast with it, the other side (or cover) is bolted to it. The inner cylinder is cast in one piece with a wheel. which is keyed on the shaft. The shaft passes through conical bushes in the sides of the fixed cylinder, these bushes can be tightened up so as to compensate for wear and keep the cylinders concentric. The edges of the inner cylinder are ground to packing rings, which are also ground into grooves in the side of the fixed cylinder. The pistons are bolted to the inner cylinder. The action of the steam is limited to the required direction by cut off valves, which are raised by cams, so as to allow for the passage of the pistons, These cams act, with a short throw and a slow motion, on the rods, which by means of a lever transmit a quick motion to the valves, thus saving wear in the working parts. An eccentric with two brasses, works two slide valves, one backwards and the other forwards, which admit and cut off the steam, another eccentric acts in a similar manner when the engine is reversed. A crank, or eccentric, works the air pump. The eduction ports are simply apertures connected with the condenser or atmosphere. The advantages over other rotary engines are—1st. The equality of wear arises from all the wearing parts being concentric. 2nd. The power gained by being able to use the condenser especially for marine purposes. 3rd. The slide valve eccentric motion allows for cutting off the steam at any given point. 4th. The balance of forces arising from the pressure of the steam being always the same on each side of the shaft.

### 29. Patent Governors and Valves; — Judson. Exhibited by Nourse and Co.

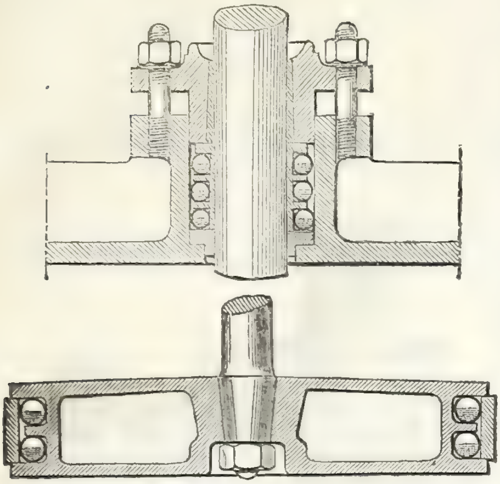
This improvement consists in making regulating valves to open with a rapidly increasing ratio of opening by increasing the width of the opening made in the valve, or by accelerating the opening motion of the ordinary valves in use, or by combining increased width of opening with accelerated valve motion—either of which arrangements compels the valve to uncover the *least* opening (by adding a given resistance) when the load is lightest and the velocity of steam passing the aperture is greatest, and to uncover the *largest* opening when the load is greatest and the velocity of steam is the least. All of the old valves, in connection with their governors, open areas directly the reverse; for, as the retard or check of the engine caused by adding resistance determines the amount of opening made by the valve, it follows that, when the engine is lightly loaded, the opening of the valve is greatest, because the check or retard is then greatest (when a given resistance is added to the load); and as the load increases, the opening made by the valve is continually less and less, because the governor action is diminished by the increasing load. This is evidently wrong, for, with the light load, and the least pressure in the cylinder, the steam passes from the boiler with the greatest velocity, consequently much the least area or opening should be uncovered by the valve, instead of the greatest, in order to pass a given amount of power or steam to the cylinder. The bad effects of the old valve in opening too much with a light load can be seen by the straining hinges, and the stress and distress of the engine, and the consequent irregularity produced in its attempts to regulate by such an imperfect graduation of steam to the cylinder. These valves and governors are so arranged as to give the resistance to the piston's motion (or retard of the engine) the power to open the valve just the exact amount of aperture necessary to counteract that resistance; and from the light to the heavy load, the valve is continually opening increasing amounts of aperture by the addition of equal amounts of resistance, notwithstanding that the action of the governor is continually decreasing in its effects.

### 30. Patent Valve Seating; — Gregory. Exhibited by A. P. How.




Round the underside of this valve is cast an angular projection, and in the valve seating is cast a recess, which contains a ring of India-rubber, C C. On the valve descending, this ring is compressed by the angular projection on the valve, thus rendering it perfectly secure from leakage.

*31. Patent Tubular Packing; Gregory and How.



This packing consists of vulcanised india-rubber tubing, partially filled with liquid, and protected by metallic surfaces, so as to increase its durability. The elasticity of the packing is increased by the additional pressure of the steam. By the increase of pressure an increase of temperature is given to the confined liquid contained in the tubes, while at the same time the liquid preserves them from becoming heated to an injurious extent, and insures their durability. This packing is applicable to all parts of steam engines, pumps, &c.

32. Steam and Water Gauges; G. Fife, M.D.

This invention consists in combining a water gauge, pressure indicator, and alarm, in one apparatus. Branch cocks communicate with the boiler in the usual manner, and have between them the water gauge pipe, fitted with a glass or talc face. This glass face is protected from the effects of undue pressure, and rendered tight by strips of vulcanised india-rubber. To the upper end of the water gauge pipe is screwed a cylindrical casing, inside which, at its lower end, is fitted a small accurately bored cylinder or tube in communication with the top of the water gauge pipe. In this inner cylinder a steam tight piston works, carrying on its upper side a long slotted piece, terminating in a guide spindle passing through the screw cap. One side of the slot in this piece is formed into a rack, and gears with a small pinion, on a transverse spindle, passing through the side of the casing, and carrying an indicating finger, in front of a graduated dial in a small flat cylindrical case protected by a glass face. Inside the cylindrical casing, above the slotted piece, and abutting against a collar framed on the end of this piece, is a helical spring, the other end of which abuts against the inside of the screw-cap. This spring serves to regulate the movement of the piston, and causes it to descend on a decrease of the pressure acting on the under surface of the piston. It is obvious that by means of the rack and pinion, the pressure will always be accurately indicated on the graduated dial. Should the pressure become too great, the consequent rising of the piston will uncover a lateral outlet in the cylinder opposite the tube, which communicates with the alarm whistle; and, in consequence, the steam will rush through and sound this whistle, thereby calling attention to the state of the boiler. A small pipe and stop cock are fitted to the lower end of the water gauge pipe, for blowing off and clearing the pipes.—(See *Practical Mechanics' Journal*, July, 1853,)

33. Tap for hot and cold fluid, &c.; D Barr.

This tap is arranged so that the pressure of the water tends to make it the more secure.

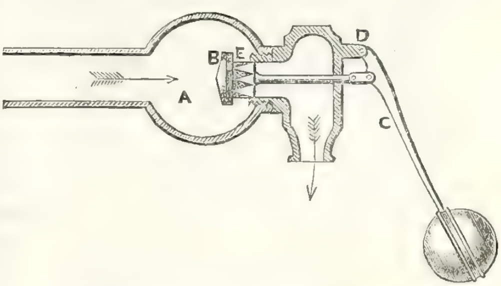
34. Self-closing Cock, or Waste Water Preventer; T. Culpin.

35. Patent Self-closing Lever Tap, applicable either to bib, ball, stop, or beer cocks; G. Davis.

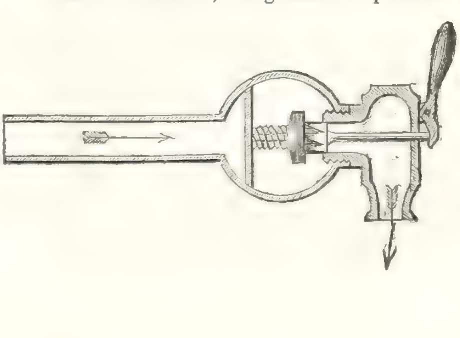
36. Compound Filtering and Non-Filtering Tap; — Ryan. Exhibited by Campin and Co.

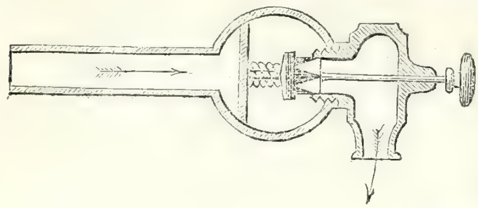
A globular vessel of glass is filled with sponge, charcoal, &c., and constitutes a filtering ch amber, through which the water is either passed or not at pleasure.

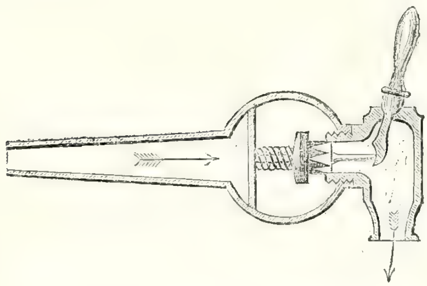
37. Patent Safety Taps; Sudbury, Wright and Co.




The barrel of this tap has a globular swell, in which a valve with a regulating plug is placed. The other part of the barrel is screwed on, and forms the valve seat. To the valve a horizontal rod is attached, and projects through the side of the exit chamber where it is jointed to the ball lever which is mounted on a fixed fulcrum outside the tap. The valve is faced with cork, to render it water-tight. The regulating plug has V-shaped grooves, which prevent the too sudden shutting off of the liquid. On the falling of the ball in the cistern, the lever presses on the horizontal rod, and forces the valve into the globe of the barrel, and the liquid immediately flows through the grooves of the regulating plug, When the ball rises with the water it closes the valve, and the pressure of the liquid being on the back of the valve, the greater the pressure the







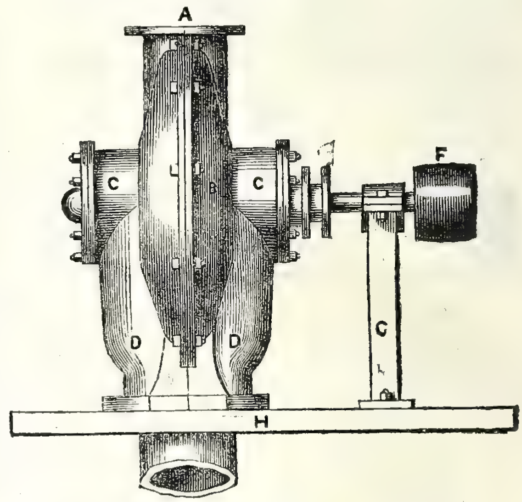
more secure the tap. The hand-taps are similarly constructed, with the exception of a hand lever instead of the ball; and are so formed that pressure shall exist on both sides of the valve, by inserting a spring immediately on the back of the valve to assist the fluid in closing it, which arrangement renders them self-acting, as directly the hand is off the lever the valve closes itself. The pressure of the liquid in these as in the others being on the back of the valve, renders them a most secure tap.

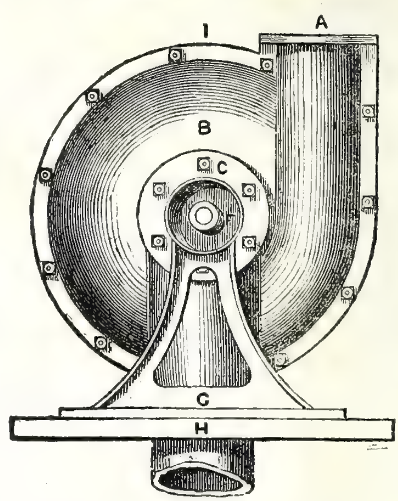
37*a*. Continuous Vapour Fire-Engine, or Flame Extinguisher, for street purposes; T. E. Moore.

38. Patent Double-Action Pump; S. Holman. By a simple arrangement a continuous supply is obtained from one barrel. The piston is solid. The valves are arranged in two pairs; one pair is connected with the upper end, and the other with the lower end. By the removal of the front plate, access is permitted to all the valves simultaneously. The hand-lever is made to vibrate on a fixed fulcrum-pin and a guide-pin, having slots in it equal to the versed line of the arc which the lever, if worked on a fixed point, would describe. This arrangement is applicable to the guiding of reciprocating rods generally.

39. Improved Pump, for raising or forcing water out of mines; T. Griffiths.

40. Patent Double-acting Centrifugal Pump; Gwynne & Co.

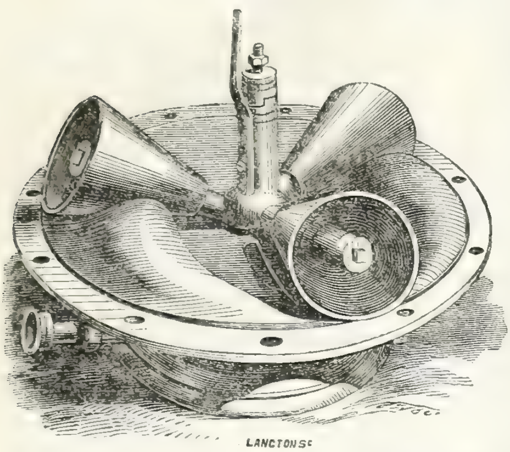



No. 3 pump, capable of raising one ton of water, or other liquid, per minute. No. 1 pump capable of raising 30 gallons, or 300 lbs. weight, per minute. In the annexed wood-cuts (one of which is a side and the other an end view), upon the flange, A A, the discharge pipe is bolted, and may be carried up to any required height; B B is the case or receiver of the pump, inside of which a wheel or piston (made fast upon the spindle) revolves. Motion is communicated to it from the pulley F; C D, C D are the water passages, which converge into one pipe, on the bed-plate *h*, and which pipe communicates with the liquid to be raised.

41. Patent Submersion Gravity Force Pump; J. Wilson.

42. Patent High Pressure Water Meter; Hanson and Chadwick.




This contrivance is stated to effect the following advantages by the use of chambers of vulcanised india-rubber, through which the water passes, and moves, in passing, three metallic conical rollers, connected with a central shaft or spindle attached to the dial works. 1st. It measures water direct from the pipes, and allows it to pass without any appreciable loss of pressure, or the necessity of a cistern. 2nd. It will measure correctly under all variations of pressure. 3rd. It will not allow the smallest quantity of water to escape without being registered. 4th. It works without any noise or concussion, and consequently can never burst or damage the pipes by the sudden and violent "shutting off motion" complained of in other contrivances. 5th. It is a "positive measurer"—a chamber of known capacity being filled and emptied at each revolution of the spindle connected with the index. 6th. It is simple in its construction, having neither lever, crank, or valve in it. 7th. It is substantial, and only liable to a small amount of wear and tear; and its durability will, if required, be guaranteed for ten years. (See *Journal of the Society of Arts*, Vol. II., p. 384. Also, *Minutes of Proceedings of the Inst. of Civil Engineers*, for Session 1853-4.")

*43. Patent Pneumatic Apparatus for obtaining and transmitting motive power; J. C. Purnelle.

This apparatus consists of an engine (1), a regulating vacuum-chest (2), and a powerful double-acting air pump (3). The engine is constructed somewhat similarly to the steam-engine, with a cylinder provided with valves, which open and close it alternately to the atmosphere and to the air pump. The air pump being put in motion, either by hand or by a small steam-engine, produces a vacuum in the chest and that part of the cylinder which may then be open to it—and a difference of pressure upon the two sides of the piston causing it to rise or fall, as the case may be. The air pump being continued at work will maintain a vacuum in the chest, which is put in communication alternately with the top and bottom of the cylinder. This produces reciprocating motion of the piston, and rotatory motion of the driving shaft. The amount of pressure depends upon the area of the cylinder and the perfection of the vacuum formed.

*44. Patent Air or Caloric Engine; G. W. Kelsey.

In this engine the air is expanded by the heat produced by the combustion of gas *within* the air chamber or heater. The intensity of the heat thus produced, is increased by passing a jet of steam through the centre of the flame of each burner. By this means the steam is decomposed into its elementary (hydrogen and oxygen) gases, and consumed, forming an oxy-hydrogen blow-pipe. This engine requires no chimney, no coals, or coke, and it may almost be said no water, and is consequently very light. It is economical in three respects, 1st. in fuel, because the whole of the heat generated is made available; 2nd. in space, as, instead of having one large heater, there may be as many smaller ones as there are gas burners, and then they may be arranged as conveniently as the pipes of an organ; 3rd. in wear, as by placing the flame at a proper distance from the top of the air chamber, it cannot destroy it by burning it out.

*45*a*. The "Little England" Locomotive; G. England and Co. Exhibited by W. and J. H. Johnson.

This is a six-wheel tank engine; it has a pair of driving wheels 4ft. 6in. in diameter, with 3ft. leading wheels, and trailing wheels of the same size beneath the tank, or miniature tender, which is combined with the engine frame. This engine has given very good results as regards economy of fuel, and the builders affirm that it is equal to the task of running six first-class carriages at 60 miles per hour.

*45*b*. Reaction-Balance Water-Meter; T. Kennedy. Exhibited by W. & J. H. Johnson.

Fig. 1. is a vertical section of the meter case, shewing the measuring apparatus in elevation within. Fig. 2 is a vertical section of the adjustable water-valve, detached, and drawn to a scale of one-fourth the real size. Fig. 3 is a corresponding section of the external cylinder of the valve with its internal slotted waterway in elevation; and fig. 4 is a half size side view of the indicating mechanism and the clockwork or continuous mover, as detached from the valves. The fluid to be measured is passed through an adjustable valve, working in connection with an arrangement of clockwork. The valve on the supply pipe consists of a small bored cylinder, fitted with a piston, and having a narrow longitudinal slot on one side. The water being admitted to this cylinder beneath the piston, escapes through this slot into an outer cylinder, communicating with the service pipe or delivering stop-cock. When placed vertically, the piston rod is loaded

with a weight, to keep it steady upon the water, the rod being passed through a stuffing box at the top of the outer cylinder, above which it is connected to a traversing pulley, which is kept constantly revolving by contact with a cone pulley driven at a continuous uniform rate by a common clock movement. The result of this combination is, that as the piston rises in its cylinder, admitting an increased flow of water, it draws the traversing pulley towards the larger end of the cone; and this pulley being connected to the indicating mechanism, at once points out the quantity of water passing through, as it is driven at a more or less increased speed from its position nearer to, or further from, the large end of the cone. Fig. 5 is a vertical section of another valve which may be employed, consisting of a conical barrel or chamber having within it a conical piston or plunger, the diameter of which is such as to fit the smaller end of the barrel. This piston is carried on a vertical rod, which is connected to an indicating apparatus in the manner already described. Fig. 6 exhibits another modification of indicating apparatus, in which a horizontal disc is substituted for the cone. As the rise or fall of the valve piston traverses the indicator near to, or farther from, the periphery of the disc, the dial indications shew a greater or less rate. Fig. 7 is a side elevation of an adjustable balance or pendulum action applied to the clock movement, and arranged so that the valve adjusts the clock's rate of going, and makes it go quicker or slower, in obedience to the position of the piston in its cylinder and the quantity of water passed through, this quantity being read off from the dial of the clock itself, which indicates a greater or less quantity accordingly as it may have been driven at a quick or slow rate for a greater or less period.

*45*c*. Patent Balance Water Meter, with Helical Blades, to work under Pressure; C. W. Siemens.

In this meter the water enters through a grating, and spreads over a conical block. It then passes to drums geared together, but free to revolve in opposite directions—the first drum being armed on its circumference with a set of right-handed, and the second with a set of left-handed screw vanes. The motion of the drums is communicated to an upright spindle, working in a chamber where the motion is reduced several thousand times, after which it passed into the counter chamber. (See *Journal of Society of Arts*, vol. ii., page 385.)

*45*d*. Coal-whipping Engine; F. H. Trevithick. Exhibited by W. and J. H. Johnson.

This engine is portable, and is arranged to stand on the deck of the collier the cargo of which it is to discharge. The actuating engine is of the simplest construction, its steam cylinder being six inches in diameter, with a stroke of 16 inches. A forked connecting rod passes directly upwards to the overhead crank, fast on the horizontal winding shaft, carried on a pair of short brackets surmounting the top of the vertical boiler. This shaft carries a winding barrel with a small overhung fly-wheel fitted with a friction brake at its opposite end. The boiler, which is of the vertical tubular kind, is contrived to answer as a pillar for the winding apparatus. It is a plain cylinder, with an inside firebox, from the convex top of which spring the tubes, 73 in number, and 1⅝ inches in outside diameter, opening at their upper ends into a shallow smoke-box, whence the flue current passes into the chimney, standing up about six feet above the top of the boiler. The engineer is so placed as to be enabled to see the position of the bucket which is being hoisted, and with the reversing handle in one hand, and the brake lever in the other, he has the most perfect control over his machine. The quantity of coal lifted at once is 5 cwt., the bucket chain being passed over a derrick in the usual manner, and then wound on the barrel of the machine.

*45*e*. Prussian Needle Gun and Repeating Pistol; Dr. Kufahl. Exhibited by W. and J. H. Johnson.

Fig. 1 is a side view of the lock portion of a needle rifle, and fig. 2 is a corresponding longitudinal section of the same. It is shown unloaded, and the cock down. It resembles ordinary needle guns as far as regards the outside tube or socket screwed into the barrel, the needle, the needle guide, and the handle. The needle is screwed into a needle-conductor, carrying at its fore-part a piston well packed with an elastic material, and provided behind with two studs projecting downwards, and a disc. To give motion to the needle, by means of the needle-conductor, a tumbler with a rounded head is employed, actuated near its centre of motion by a flat mainspring, a sear-spring, and trigger, and connected outside of the gunstock with a cocking lever. The breech of the gun can never be opened wilfully or by accident, either in the act of firing or for the purpose of introducing a charge while the needle is protruding into the interior of the gun. While loading the tumbler is out of all connection with the needle conductor. This gun is thus much safer in handling than any other, it being impossible to open the breech for loading or any other purpose, or for it to fly open of its own accord, as long as the tumbler, mainspring, and trigger have any communication with, or power of action on the needle. Fig. 3 is a side view, and fig. 4 a longitudinal section, showing the application of the improvements to a repeating needle pistol. The outside tube, or socket, is provided at the top of its foremost part with a longitudinal and a transverse slot, for the reception of the knob or handle of the inner tube. The lower part of the outside tube forms a rectangular box for the reception of the tumbler, the mainspring, the sear, and those parts by which the disc containing the charges is made to revolve. The means of preventing the escape of gas, namely, the packed piston of the needle conductor, and the thin metal tubes of the chambers, are the same as employed in the gun. A strong horizontal bolt is made use of to bring the fore-part of the tube into the barrel and keep it steady whilst the explosion takes place. This bolt is always in contact with the disc at one end, and with an enlarged part of the tumbler at the other. Whilst the pistol is at half or full cock, the disc and the bolt are kept back by the action of a spring, situated between the disc and barrel, and the metal tubes are clear of the latter; but as soon as the trigger is released the prominent curve of the tumbler forces the bolt and disc forward, pushes the metal tube into the barrel, and firmly shuts the joint before the needle can reach the priming to explode the charge.

*46. Patent Coupling and Uncoupling Gear for Railway Carriages and Rolling Stock; Taylor and Cranstoun. Exhibited by W. and J. H. Johnson.

These improvements are especially designed to obviate all accidents arising from the necessity of having to pass between the buffers whilst coupling or uncoupling, as with the arrangements ordinarily in use. They are in practical operation on the Morayshire Railway. Each carriage or waggon, in addition to a central hook as a draw-link, has attached to it three hinged chain links, capable of being raised or lowered at pleasure. These links are made with a central back stop joint, in such manner, that whilst they will act with all necessary flexibility when drawing or being shifted in certain directions, yet when lifted by the elevated lever they will rise in a rigid condition, as if solid. Such draw links may be fitted to both ends, or to one end only, of a carriage or waggon, corresponding draw hooks being attached to the opposite ends. A transverse elevating shaft is carried in bearings beneath each set of links, this shaft having upon it a lever frame piece with stud projections thereon for lifting the links. Each end of the shaft carries a lever conveniently disposed for the hand of an attendant, outside the buffers, so that, when passing along the train, he can quickly lift or lower the links. When the carriages are to be coupled they are placed together in the usual manner, and the main centre draw link being slackened off, the attendant, by means of one of the projecting hand levers of the adjusting shaft, lifts the whole of the links over upon the hooks of the next carriage, thereby coupling the carriages. Then to tighten the central draw hook link a transverse hand wheel shaft is fitted upon the carriage frame, the centre of this shaft having upon it a worm wheel gearing with a small worm wheel, which is at the same time a nut working on a screwed portion of the draw link. Thus, by turning one or other of the hand wheels the necessary tightness of the draw hook is easily secured. In uncoupling the carriages the links are slackened off and are then lifted clear off the hooks, and afterwards dropped to a vertical position by the converse of the operation previously described.

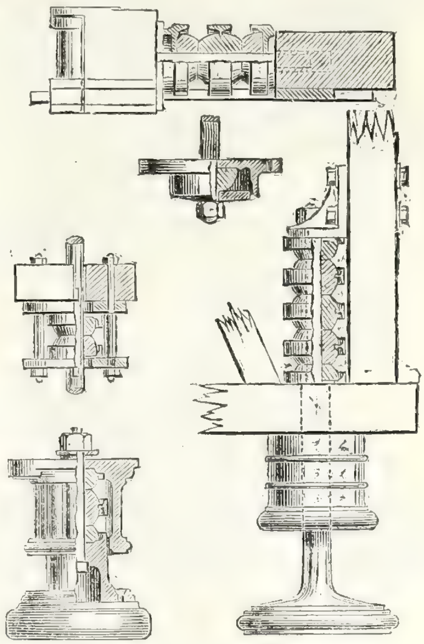
*47. Patent Railway Safety Wheels; E. Wharton.

In these wheels the felloes and tyres are dovetailed together, so that if the tyre should break it cannot fly off. No bolts or rivets are required.

48. Patent Regulator Valve for Locomotive Engines, to shut off steam to prevent accidents on railways; S. Harrison.

This invention is chiefly applicable where two engines are coupled together. It consists in the use of slide valves placed between the pipes that supply the steam to the engine and the steam chests. These valves are worked by a handle acting on the valve spindle, the object of them being to enable the steam to be shut off from one of the engines when anything is out of order, and to allow the steam to enter that which is not out of order. In case of need the driver could instantly close one of the slide valves, and continue to work the locomotive with one engine—causing less delay, and thereby less chance of accidents.

49. Conical India Rubber Springs for Railway and other Carriages; G. Spencer and Co.



The advantages of this new form of India rubber springs over the usual steel springs are:—1st. Perfect immunity from the danger consequent on breakage. 2nd. Extreme lightness, the weight being only one-third of the steel springs. 3rd. Great saving in first cost. 4th. Durability. The essential difference between this form of using India rubber as springs, and all those forms hitherto used or proposed, consists in the conical form in which the material is used, and in the use of confining rings to limit the action of the spring, and increase its power by the lateral confinement.

50. Delostear Axle Box, for Railway Carriages, Trucks, &c.; Dixon, Bell, and Co.

51. Safety Stop or Skid, to prevent Collisions on Railways; J. Johnson.

A ratchet wheel is placed within the ordinary wheel, fast on the axle, into which a pall is thrown by means of levers or bands, when the train is to be stopped.

52. Railway Break; — Noone. Exhibited by C. Chatfield.

This break or stop is intended to act upon the rails, and not upon the wheels. Each series of stops or breaks is raised or depressed by a series of levers, in connection with a horizontal bar, to which motion is given by the break screw.

*53. Invention for Retarding and Stopping Railway Trains; J. Ellerthorpe.

The main feature of this invention is the simultaneous application of breaks to all the wheels of a carriage or train by its own motion. To effect this, a rod or shaft of iron is extended along the length of the train and beneath the carriages in such a manner that it may, at the pleasure of the guard, or other attendant, be thrown into a rapid rotatory motion by the axle of the carriage. This motion immediately causes the breaks attached to the shaft by right and left-handed screws to advance or recede, and so to check or stop the motion of the whole; and as this is done to all the wheels at once, and the power applied by the train itself, the time required to stop any train would be comparatively small.

54. Railway Safety Break, to prevent accidents in descending an incline; W. Gosling.

Parallel levers are placed under the carriages so as to act upon the axles. The levers extend beyond the ends of the carriages and therefore press upon others, by which the train is converted into a sledge.

55. Railway Danger Signal to be attached to a Locomotive Engine and Tender, to prevent collisions on railways; W. Gosling.

This invention consists of a pendulum attached to the under-side of a locomotive tender, which, coming in contact with a stop when turned up on a sleeper, raises a lever placed by the side of the tender, from which connecting rods raise the break, turn off the steam, and ring a bell to apprise the driver of danger.

56. Railway Communicator, to enable Passengers and Guard to communicate with the Driver. Also to enable the Guard to ascertain immediately the carriage from which the communication is made; W. Gosling.

57. Apparatus for Preventing Collisions on Railways; C. J. Brunker.

58. Railway Guards' Alarum Sound Signal; H. King.

From the roof of the guard's carriage a pair of powerful bellows is to be suspended, always kept distended for use by means of springs. To the nozzle of the bellows a small tube is attached, which tube passes upwards through the roof of the carriage, upon which a whistle is placed.

59. Railway Passengers' Train Signal; W. Glazier.

This model is intended to represent an arrangement of gutta percha tubing and valves, for the purpose of affording to railway passengers the means of communicating with the guard, as well as the guard with the driver. By means of a lever fixed inside the carriage, passengers have the power of instantaneously signalling the guard, and of then transmitting the message. In affixing this signal to carriages, no alteration in their construction is necessary. A simple pressure on the lever admits a current of air into the tube (caused by the velocity of the train); this current is employed for signalling the guard, the valve being reversible, so that no difficulty will be experienced in attaching fresh carriages to a train, and continuing the current of air to the guard's van when required.

60. Railway Guard and Driver's Signal, for intercommunication between the guards and drivers on trains; A. Bird.

61. Patent Improved Detonating Railway Signal; A. A. Routledge.

62. Patent Economic Signal Lamp; Saxby and Co.

By this invention one lamp only is required to give all the necessary signals to both the "up" and "down" lines, instead of two as now used; while the working of it is simple. The lamp is so constructed that gas may be introduced without altering the fittings, and it can be fixed to the old signal posts. Upon a bracket are two handles, placed to the right and left of the centre; the right-hand handle gives the signal to that portion of the line on the right of the signalman, the left-hand handle gives the signal to that portion of the line upon the left of the operator. These handles are attached to two vertical rods, one within the other. On the top of one of these rods the lantern is fixed, carrying with it the different coloured glass. To the top of the other a simple horizontal disc is fixed, which carries the coloured glasses. The lantern only makes half a revolution. Each side of the bracket carrying the handles is painted in three colours—white, red, and green—and the operator has only to place either or both of the handles over the centre of either of the colours to cause that coloured light to be shown by either or both of the lenses of the lamp above. In the centre of each colour is a stud, or pin, to retain the handle in its place, so that a signal, when given, cannot be accidentally altered. These lamps are in use on the London, Brighton, and South Coast Railway.

63. Hand Signal Lamp; G. H. Ingall.

*64. Station and Train Signal; G. H. Ingall.

*65. Patent Communication between Passengers and Guards; G. H. Ingall.

*66. Patent Railway Train Indicator, for Preventing Collisions on Railways by showing the position of the Train between each Station; G. H. Ingall.

*67. Self-acting Post, for Curves and Approaches to Stations; G. H. Ingall.

*68. Patent for Enabling the Engine Driver to pass a Train from one Line of Rails to another without the Assistance of a Pointsman; G. H. Ingall.

*69. Patent Railway Sanding Apparatus and Drivers' Time Keeper; J. Beall.

This apparatus consists of a means whereby dry sifted sand, grit, or other suitable material may be dropped on to lines of railway immediately in front of the driving wheels of a locomotive engine, in suitable quanities, as the slippery state of the rails, or the rate of inclination of the line may require; and where the line of railway is such as not to require such additional bite to the driving wheels of the locomotive, the dropping of the dry sifted sand, grit, &c., is stopped by the closing of a valve, under the control of the driver.

70. Patent Rails for Railways, to be rolled in two or more parts, top and bottom, so as to renew the top without the bottom, when worn; E. Bagot, C.E.

One of the models represents a broad flange sleeper rail, to be laid direct upon ballasting, and thus save sleepers and chairs; and also save the renewal of the broad flat base, when only the top requires it. The advantages claimed are:—Permanent base, wrought iron sleeper; moveable top, easily changed when worn; economy in first cost of construction of road; increased saving, each renewal of top; less labour in repairs, and no disturbance of ballasting; top and bottom breaking joint, thus acting as "fishing;" better joints, without the expense of "fishes;" more steady uniform road; more comfort, and fewer accidents; and different iron in top from bottom.

71. Continuous Rail, for Railways; A. S. Jee.

This rail is made in two halves, longitudinally, which being fastened together by bolts and nuts, or by rivets, in such manner that they will break joint with one another, form a continuous rail.

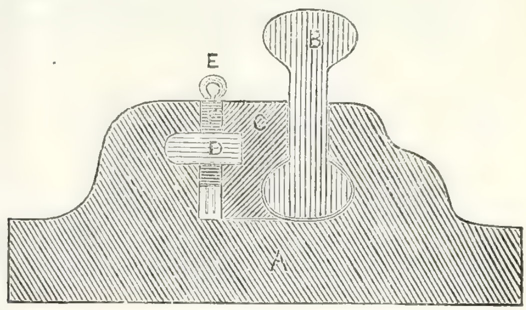
72. Patent Railway Chairs; I. Ashworth.

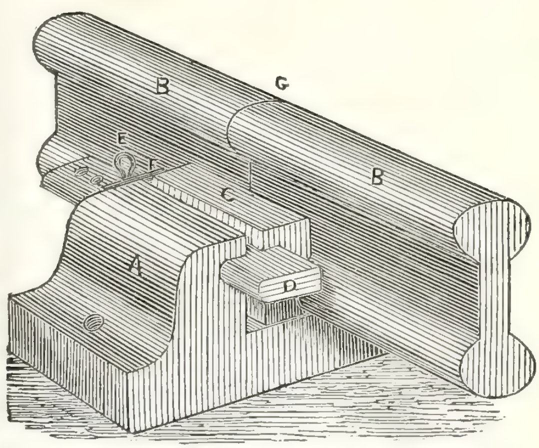
In this invention the ordinary wooden key is replaced by a plate or bar of iron, somewhat smaller than the space between the chair and the rail. Set screws are screwed through the side of the chair, and pressing against the bar of iron secure the rail in its position. Lock-nuts are introduced between the head of the screw and the face of the chair, preventing any shifting of the rail.

73. Patent Railway Chair; J. Coates.

The wooden key is here replaced by one of iron, but smaller than the space between the rail and the chair. The key is kept in position by means of a cotter driven between it and the chair, and parallel to the rail.

74. Self-keeping Railway Chair; T. Greenshields.




The rail is firmly secured in the chair by means of a wedge-shaped bracketed piece of iron, that tightens as it is driven in until the rail is securely fixed in position; a bolt or trenail is passed through the bracketed piece and the bottom of the chair and driven into the sleeper, and, thus fixed, it is not liable to shift or become loose. The joint where the end of two rails meet is secured by a chair at the end of each rail; this mode admits of readily adjusting any inequality in the two rails.

75. The Rocket Railway; F. J. Wilson.

76. The Trough Tramway: F. J. Wilson.

77. The Letter Bag Railway; F. J. Wilson.

78. Patent Railway Traverser; T. S. Watson, B.A.

A portion of the rails, chairs, sleepers and ballasting across the permanent way, is removed

to form a space sufficiently wide and deep for the traverser to work in. The spaces in the rails are supplied by moveable rails, each of which is supported by two chairs placed under its extremities. Every chair is carried on two wheels, by which it traverses along a rail supported transversely to the line on iron arches, or girders, springing from the sides of the space in which the traverser works. Motion is communicated to each line of chairs by an endless chain passing alongside of, and attached to, each chair. The two endless chains are carried round two pairs of wheels, fixed on axles under the platforms beyond the outer line of rail. Each axle is connected by a system of cogwheels, or other convienent method, with a winch, working in an upright pillar on the platform, which one man is able to turn. The advantages proposed are, that the traverser is always ready to transfer a carriage in either direction, not requiring after shifting one carriage to be brought back again for the next—it moves, at one time, as many carriages as there are lines of rail less one—it is worked with much less labour than any other traverser or turn-table, and as the whole of it always either forms a part of the line of rails, or is out of the way beneath it, does not incumber the line when not in use. It saves the time and labour expended in turning the carriage on the turntable and in pushing it across the line, and it removes the necessity for the clumsy and dangerous openings at the edge of the platform for the turntable to revolve in.

79. Patent Safety Railway Carriages; F. S. Thomas.

# MANUFACTURING MACHINES AND TOOLS.

80. Patent Tape Loom; Lord Berriedale.

This loom is intended for manufacturing narrow goods of all kinds, such as tapes, ribbons, and other goods, where each loom contains an extended series of shuttles or weft-conductors working in a continuous line, and all, or most of them, in action at once, upon its separate line of fabric. In weaving such fabrics in the ordinary manner, the whole set of shuttles must always be stopped whenever the weft thread of any single one breaks, or whenever it is necessary, from any cause, that one or more shuttles should be stopped or removed. In this loom, the shuttles are so arranged, that any one of them may be stopped and taken out without disturbing the rest or stopping the loom. This is accomplished by adapting a species of detached duplex race for each individual shuttle, one above the other, the upper one only being actually used for the traverse of that particular shuttle therein, whilst the lower one is contrived for the periodical entry therein of the next shuttle on each side of the particular one which is stopped. So long as the whole of the shuttles are in regular work with unbroken threads, the series works just as in the ordinary way; that is, the whole line traverses a certain distance across the line of goods—the first shuttle filling up the place left by the second, and the second that of the third, and so on throughout the series. But when any given shuttle is to be stopped and removed, the particular race or guide of that shuttle is made to ascend by a spring detent action, so that the intended shuttle shall be carried up out of the line; whilst the same movement obviously carries up the lower or duplicate race into the line of shuttles, to afford a place for the reception of the contiguous shuttle on each side of the one removed, as they alternately come across from each side. The whole of the other shuttles still continue to weave, whilst the elevated or disarranged shuttle may be removed by the attendant, and reinserted in its race when again ready for work; when so inserted, the duplex race is made to descend, and the removed shuttle is thus brought back to its line of action. It is obvious that the weaver must watch an opportunity, both at the removal and return of the shuttle, so that the loom's action may not not be interfered with in any way.—(See *Practical Mechanics' Journal* for June, 1853.)

*81. Self-Acting spinning Mule; H. Brierly.

82. Improved shuttle Peg; C. Catlow and T. Comstive.

This improvement is intended to prevent the knocking off of "cops." It consists of a tapered spring, the stronger end being brazed on at the small end of the peg, so that the front end of the spring is always the stronger.

*83. Treading Motion; C. Catlow.

The treading trappets, when moved, cause the treddles to be lifted by the springs, which alternately raise the yarns.

*84. Improvements in Machinery or apparatus for Ticketing or Labelling Spools, parcels of the same, &c.; W. Bishop.

85. Model of Renton's Patent Furnace for Making Wrought Iron direct from the Ore, with samples; E. Rider.

(See *Journal of Society of Arts*, vol. iii., p. 247.)

86. Patent Forging Machine; W. Ryder.

This machine is for forging rollers, spindles, bolts, studs, files, shaft ends, and various other articles in iron or steel—round, square, parallel, or taper. (See the *Artisan*, for 1851.)

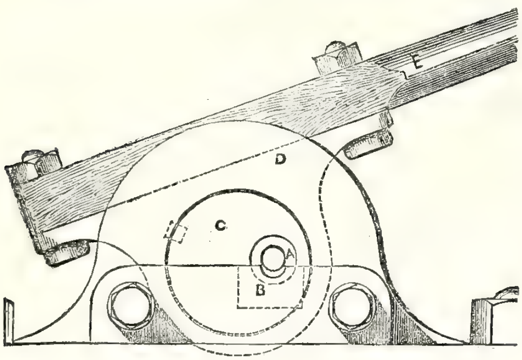
87. Patent Improvements in the Manufacture of Iron Tubes; J. Madeley.

88. Patent Circular Plate Cutting Machine; J. Sibley and Son.

This machine consists of two horizontal rollers, one placed above the other, having cog wheels at one end, and circular shear-edged cutters at the other. Motion is given by means of a winch handle. The plate to be cut is held in a clamp, fixed upon a slide rest at the required distance from the cutters. A quadrant is placed between the clamp and the rest, for regulating the diameter of the plate to be cut. A helical spring acts upon the upper cutting roller, to adapt the machine to plates of varying thickness. This machine is for the use of tin plate workers, braziers, meter makers, and others requiring the lighter kinds of circular

plates, cut from the centre point or from a hole in the centre, where they are required for machine purposes, or even without a centre at all. Specimens are exhibited of plates cut by a larger machine on the same principle in ten seconds.

89. Patent Machine for Cutting Bolts, Rods, Spindles, Wire, &c.; A. P. How.




This machine consists of a cast-iron base plate and bearing, D, to which is attached the die-rest by two studs. The die B may be removed and replaced by a larger or smaller one, as required. In the bearing D is the disc C, containing the circular die A, which, as in the case of the die B, may be removed and substituted at pleasure. The bar or rod to be cut is introduced through this aperture of the die **A**, to the distance required; the lever E, being depressed, the bar is cut by the pressure and cutting action of the dies A and B. The facility for using several sizes of dies in the same machine is an especial convenience.

90. Patent Rotary and Ratchet Drill combined; — Chesterman. Exhibited by Cutts, Chesterman, and Bedingfield.

This instrument can be used either as the ordinary ratchet drill, or, by applying the handle, the rotatory motion may be obtained, thus securing expedition in drilling, and the power of using it where the ordinary ratchet cannot be applied.

91. Improved Drill and Bit Stock: C. F. Stansbury. Exhibited by Nourse and Co.

The improvement consists in so constructing the drill stock, that by means of a reciprocating motion of the handle a continuous rotary motion in one direction is given to the drill or bit. This has long been a desideratum, as the drill stocks in common use reverse the motion of the drill at every stroke, thus losing half the time, and unnecessarily wearing the tool. This drill stock wears the tool much less, and loses no time. In making this drill stock, a metallic rod is employed, similar in transverse section to those usually used for such a purpose, but instead of giving it a similar twist throughout, it is twisted one half of its length to the right, and the other half to the left. On the rod thus prepared, a sliding handle is loosely placed, having ratchet teeth in each of its ends corresponding with the teeth of two slides placed respectively on each end of the rod. These slides fit so closely to the rod as to cause it to revolve when a reciprocating motion is imparted to them. They are loosely held in place by means of caps on the ends of the handle. The handle is of such a length as to prevent the slides from ever passing the middle of the rod. The operation of the improved drill and bit stock is as follows:—When the handle is raised, its upper ratchet teeth engage those of the upper slide, which, being thus fixed, imparts rotary motion to the rod; when the motion of the handle is reversed, the upper slide is released, the lower ratchet teeth of the handle engage those of the lower slide, which in its turn becomes fixed, and imparts rotation to the rod. The rod having a different twist on its lower half from that of the upper, it is obvious that the lower slide, in descending, must give the motion in the same direction to the rod that the upper slide imparts to it in ascending.

*92. New Mode of Grinding and Drilling Steel and other Metals; by the use of which the workmen are not liable to those painful and dangerous diseases of the chest to which they are subject by the old process; — Chesterman. Exhibited by Cutts, Chesterman, and Bedingfield.

For the purpose of grinding both sides of a flat article, or the entire periphery of a circular or similarly-shaped article, the inventor fixes upon a central tube or axis, a grindstone in the form of a roller or cylinder, and makes this stone plain or indented with semicircular or other grooves, according to the shape of the article to be ground, and over this grindstone roller he mounts another similar to it. Upon rotatory motion being imparted to the rollers, and the end of the article to be ground being inserted between them, they will draw it through, but without grinding it; the article is then to be drawn or pushed by the workman in a contrary direction to the rotation of the rollers, and the grinding will then take place in its passage between them. The sides of one of the rollers, when the articles to be ground are flat, are also provided with collars formed of grindstone, and of a larger diameter than that of the rollers, whereby the edges, as well as the sides of the metal article, may be ground, where requisite, at the same operation. Means are provided for adjusting these rollers to suit the thickness of the articles to be ground, and also for adjusting the stones on the central tube or axis. For the purpose of grinding one side only of a steel or metal article at a time, a plain wooden roller is substituted for one of the grindstone rollers; and combined with this arrangement are guide-rollers for cross grinding. These improvements in grinding will be found of especial advantage in the case of saw-grinders, who, as a body, are subject to severe diseases of the chest and lungs, called "the Grinder's Complaint," caused by their sitting or standing over the stone. To such an extent is this complaint prevalent, that it is no uncommon thing for persons thus employed to become incapacitated from following their occupation at a comparatively early age. By the present improvements this evil will be in a great measure obviated, as the men will be enabled to grind articles at a

considerable distance from the stone, and in front of it instead of leaning over it, as is the common practice. Another important consideration is, that in the event of a grindstone flying to pieces —by no means an uncommon occurrence—the men will be much less likely to be injured, or perhaps killed, while standing at a distance from the stone, than if they were over it, as they would be under the ordinary system.—(See *Mechanics' Magazine*, vol. I. page 458.)

*93. Patent Cross Boring and shaping Machine; J. Haley.

*94*a*. Blowing Engine; Neilson and Co. Exhibited by W. and J. H. Johnson.

Instead of using one large steam cylinder at one end of a vibrating beam, with an air-forcing cylinder at the other, as usually arranged, Mr. Walter Neilson, the designer of this blowing engine, adopts a pair of small inverted vertical cylinders, which drive the great blowing piston through a wheel and pinion. The great blowing cylinder is set vertically, on a low frame, and its piston has two rods working out above, with an overhead crosshead guided by slotted standards. Side rods pass from this crosshead to pins in a pair of flywheels on a central shaft beneath the main cylinder, this shaft having upon it a central spur-wheel. This wheel is driven by a pinion on the first motion shaft of the engine. The steam cylinders are bolted to the blowing cylinder, and their pistons are connected directly to cranks on their first motion shaft, beneath. The small steam pistons of this blower, working at a high velocity, communicate a slow, steady motion to the blowing piston.

*94*b*. Pillar Drilling Machine; J. Porter. Exhibited by W. and J. H. Johnson.

In this tool the drilling spindle is so arranged that it is always in its extreme bearings, whether it is in its highest or lowest position. It has both manual and self-acting feeds. Longitudinal play in the spindle is avoided by making the main feed nut in two sections, so that a set-up can always be obtained, for tightening the nut against its screw threads. Without such a provision the drill point is apt to break suddenly through its work when near the end of its hole, and thus spoil the work.

*94*c*. Steam-Heater for Water; Maitland and Gorrie. Exhibited by W. and J. H. Johnson.

This apparatus is intended for heating large bodies of water for manufacturing or horticultural purposes—the object of the inventors being the exposure of a large surface of water to the direct action of a body of steam. The heating chamber is divided horizontally by a number of perforated plates, fitted with short tubes standing but slightly above the level of the plates. The heating steam is supplied by a pipe at the bottom, and it passes upwards, from shelf to shelf, through the tubular apertures, whilst the water, which is introduced at the top, descends from plate to plate, by means of large dripping pipes, the upper edges of which are a short distance above the plate in each case, whilst their lower extremities dip into cups upon the plate below—these cups preventing the ascent of the steam through the dripping pipes. The dripping pipes and cups are placed alternately at each end of the plates, so that the water has to traverse the whole length of a plate before it can find its way to the plate below. In this way an immense liquid surface is exposed to the direct steam action, whilst the currents of water and steam do not interfere with each other, and all regurgitation and noise is avoided. The steam in its ascent becomes condensed, and mingles with the water, which passes off in a heated state, by a syphon or weighted valve at the bottom. This heater is in active operation at the Carsebridge Distillery, Alloa, as well as in many noblemen and gentlemen's conservatories.

*94*d*. Blast-Furnace for Iron Smelting; Wright and Brown. Exhibited by W. and J. H. Johnson.

In the cupola the cold air enters from the blowing apparatus by a pipe, and passes through the cupola wall into the central portion of the bottom of the cupola. The air diverges downwards in this chamber, and passes out through vertical division-walls by archways into expanded chambers at the sides. The arrows indicate the course of the air, showing how it circulates to the extreme end of these chambers, and returns along their arched tops. The air is by this means heated to a very high temperature, in which condition it re-enters the main body of the cupola through lateral ports. Here it permeates the melting mass of metal and coke, through which it finds its way in the usual manner. In the smelting-furnace, the air from the blast-engine is supplied by four pipes, the quadruple current keeping up a constantly uniform air-pressure in the central space beneath the mass of melting materials. This compressed air can only escape through four lateral archways, and it passes in contact with the surface of the melted mass of material on the furnace bottom, as well as that contained in the archway passages and their external chambers. The heated air rises up through these chambers and returns towards the body of the furnace through converging thoroughfares, and penetrates the melting mass of metal and materials by issuing through side ports into the body of the furnace. This system of self air-heating furnaces may be carried out with various forms of chambers and apparatus, and it is applicable to all forms of melting or reducing furnaces.

*94*e*. Grease-tight and Dust-excluding Axle-Box; Patent Axle-Box Company. Exhibited by W. and J. H. Johnson.

Three modifications of axle-boxes are here shown, comprehending arrangements deduced from a combination of patented inventions, and recommended by the Patent Axle-Box Company. Fig. 1 is a longitudinal section of one form of axle-box; Fig. 2 being a corresponding inner face view; and Fig. 3 an external elevation of the shield detached. The actual grease receptacle is made with a hinged cover, and the lower section of the box is stuffed with sponge to imbibe whatever oily matter gets down to the bottom of the box. The box being entirely closed at its external end prevents any escape of oil there; whilst the other end, which is necessarily open for the passage through of the axle, is almost hermetically sealed by a vertical shield. This shield is moulded out of papier maché, or rough cheap pasteboard, and it is retained in its place laterally by recessed pieces cast on the

axle-box end. A central swell or boss portion is moulded upon it to surround the axle and give a superior bearing surface at this point. Very little wear takes place between the axle and the shield—the only appreciable rubbing parts—and hence, when once well fitted, this retaining cover will last in an unimpaired condition for a very long time. Fig. 4 is a longitudinal section; Fig. 5 is a corresponding inner end view; and Fig. 6 is a transverse section of a somewhat modified form of this class of box. In this box the grease passes downwards through a series of vertical passages in the brass, these openings being fitted with sponge or other porous material. A piece of sponge is also held in a recess cast on the inside of the cover-plate of the box, and is made to descend into a channel through which the grease flows on its way to the brass. By this means the downward supply of grease is regulated or moderated, whilst the porous material thus interposed filters the grease to a pure condition before it can reach the parts to be lubricated. The guard shield for preventing the escape of oil at the inner end of the box is retained in vertical grooves, as in the former example, and is made either of pulpy material or of wood, the action being precisely the same as that described in reference to the earlier figures. Fig. 7 is an external end view, and Fig. 8 a transverse section of another form, differing but slightly from the last. The brass is dovetailed into the box, and it is made double, so that, when worn on one side, it may be reversed, and thus begin anew. The oil escape on the axle side of the box is prevented by an external metal washer, or shield, formed with two parallel vertical slots, for shipping on a pair of dovetailed stud projections on the box end.

*94*f*. Wood-planing Machine; J. Mc Dowall and Sons. Exhibited by W. and J. H. Johnson.

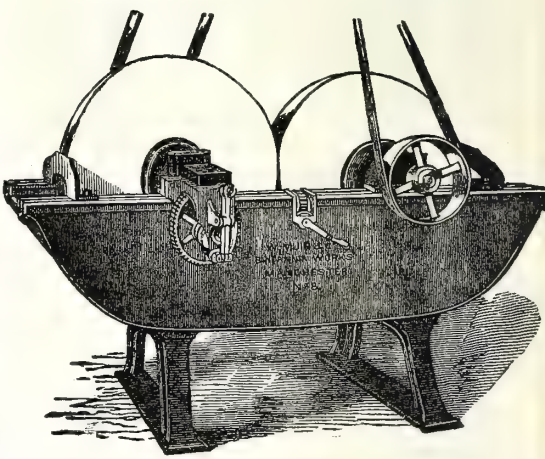
In this machinery the cutting details for operating upon both the upper and under sides of the wood, and also the two lateral edges, are disposed near the centre, and the deal to be planed is passed through the machine by means of a series of nipping feed cams. There are six sets of these feed cams—three at each end of the machine—and they are carried by separate frames, to which a backward and forward motion is given by a system of revolving cams and levers acting beneath the framing of the machine. The feed cams are constructed so as to nip the deal only when moving in one direction, namely the direction in which the deal is passing through the machine, and they pass back freely over the deal when returning for a fresh feeding movement. The movements of the cams do not coincide with each other, but are arranged so that one cam at each end shall always be carrying the deal forward, the movement being taken up by another cam before being dropped by the one in action, so that a continuous and regular feed motion is obtained. As the board is thus carried forward, it comes first above three finishing planes, over which it is held down by three rollers. After passing these pressers, the emerging end of the wood, as planed and finished on its under surface, proceeds beneath a pair of pressing rollers, between which the planing of its upper surface takes place. A little before the deal reaches the cutters for operating upon its upper surface, its two lateral edges are acted upon by cutters revolving upon vertical spindles, and arranged in the present example for tongueing and grooving the opposite edges of the deal, as is done for the purpose of laying flooring. Having undergone the action of the edge cutter and top surface planers, or "thicknessers," the deal is drawn completely through the machine in a finished state.

95. Registered Screw Jack; W. Dicks.

The stem or screw of this jack is raised or lowered by means of a nut, which is actuated by an endless screw, worked by a forked lever.

96. Patent Improved Vice; J. C. March.

97. Patent Grindstones; W. Muir and Co.



These grindstones require no adjustment. The peripheries touch each other, and by a lateral motion given to one of them, the edge of each stone is kept perfectly true.

98. Upright Shoemakers' Bench; J. Sparkes Hall.

It is generally known that the bent sitting posture in which shoemakers work is highly injurious to health. The posture is maintained in some cases for as much as twelve or fourteen hours in a confined atmosphere; the spine, stomach, and bowels become disordered, and at a comparatively early age, numbers of this class solicit admission to the Hospital for Consumption.

99. The Iron Clicker; a machine for cutting out boots and shoes. J. Sparkes Hall.

By the use of this machine, one person may cut, with greater correctness, more boots than six persons could accomplish in the same time by the ordinary process; and the saving in material amounts to 25 per cent. A piece of leather generally used for one pair of ladies' boots of a particular pattern, will be sufficient for three pairs if cut according to the new plan.

99*a*. Double-action Eyelet Hole, Stay, or Boot Punch, worked by a treadle; T. E. Moore.

100. Patent Crushing and Grinding Machine; W. F. Plummer.

This machine is intended for grinding white lead, white oxide of zinc, and for all other purposes for which horizontal stones are used. It

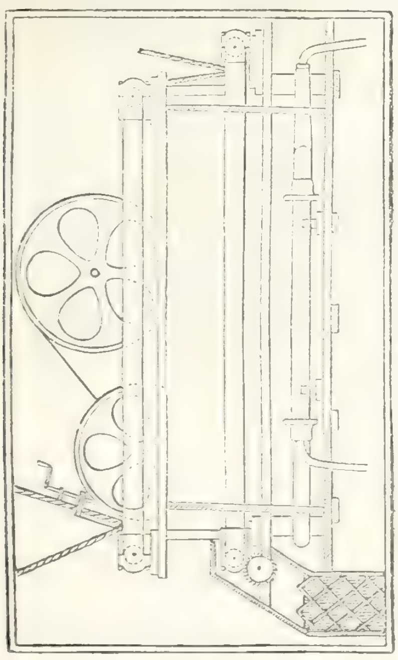
consists of a set of three rollers, composed of granite, so arranged as to be self-adjusting when at work, rising by the substance passing between them, and falling by their own gravity. This plan leaves the rollers free to pass any foreign substance, such as a nail or other hard substance, that may enter the machine. Any extra pressure that may be required is given by means of set-screws acting on springs. The advantages claimed for this machine are that the article produced is superior in texture and of uniform consistency; that less oil is required; that the stones do not require re-dressing; that the colour to be ground may be changed in a few minutes; and that it is kept quite cool compared with that ground with horizontal stones.

101. Machine for Separating the Flax Seed from the Straw; W. Dray and Co.

The mode of operation is by passing the heads of the straw between two rollers. These afford just sufficient pressure to throw out the seed from the boll.

*102. Machinery for Winnowing, Washing, Sifting, or separating Corn, Gravel, Minerals, and other materials; W. Smith and G. Hill.

103. Improved Drying Stove; J. & J. C. Adnam.



Adnam's Drying Stove.

This stove is used in the manufacture of Adnam's improved groats and barley. The stove is heated by steam, and filled with moveable aprons, over which the grain is allowed to traverse, and delivered into the hopper at the end of the stove. The speed of the apron is arranged according to the temperature of the stove, and the quantity of grain required to be dried.

104. Apparatus for Roasting Coffee and Cocoa, for the Use of Soldiers in Camp, Sailors on Shipboard, Emigrants, and Families; A. Savage.

No. 1. This apparatus may be used over a fire lighted on the ground, the hooked spike which supports the roaster when in use being driven into the earth until it rests on its flanch. The spindle is supported by the hook on which it turns, the cylinder being over the fire. It is kept steady by the additional handle, held in the left hand, and the winch turned by the right hand. The additional handle is also very useful to enable the user to lift the roaster away from the fire, as by sliding it along the spindle it enables him to do so without risk of burning the left hand. When used over a galley-fire on board ship, or over a common kitchen range or stove, a suitable support, which fits on the stove, is substituted for the hooked spike, driven into the earth, which supports the roaster over a camp-fire on the ground. For naval use it is preferable to have a cover to put over the roaster, to retain the heat; and for domestic use a smaller cylinder would be more suitable. This apparatus is capable of roasting about sixteen pounds of coffee at once; but roasters on this plan may be made to roast from a quarter of a pound to thirty pounds weight, to suit the various requirements of private families, emigrants, hotel-keepers, or the wants of a ship's crew. This apparatus is made to receive the mill No. 2, for grinding coffee or cocoa, inside it, with the necessary tools. It will also hold about twenty pounds of unroasted coffee, although not larger than a side drum. The piece of wood to which the mill No. 2 is clamped may be supposed to represent the portions of two tent poles, of different diameters—the clamps being capable of embracing any pole whose diameter does not exceed four inches, or is not less than two inches. Ordinary coach screws would be preferable for fixing the mill to a flat side post or stancheon, or to a dresser, counter, table, stool, or chair. No. 3. Another form of mill, especially designed for use on board ship. No. 4. Mill for grinding coffee, drugs, &c. No. 5. Mill for grinding coffee, cocoa, pepper, spices, &c., for domestic and naval use.

105. Masticating Machine; A. Lyon.

This machine, as well as cutting or masticating the food, is intended to keep it hot while the operation is effected. This is accomplished by means of two hot-water bottles, which form the inside of the machine.

106. Improved Mincing or Cutting Machine; A. Lyon.

This machine is lined with white metal, to avoid rust or absorption.

107. Improved method of purifying Coal-gas by clay and lime; Rev. W. R. Bowditch.

Specimen No 1. Clay before use. Specimen No. 2. Clay as taken from the purifier after use. Specimen No. 3. Clay after exposure to the atmosphere. This contains a large quantity of nitrogen, phosphorus, and sulphur, and is a valuable new manure. This process consists in exposing gas alternately to moistened clay and lime, by which means the sulphurized and nitrogenized products of distillation are more completely removed than by any mode of purifica-

tion in use. Gas is thus rendered more wholesome, and its illuminating power is improved. The usual test for sulphur in gas is acetate of lead, and when it shows no reaction with that substance, it is thought to be sufficiently purified. The use of clay, however, shows the fallacy of this test. When the foul clay is digested in spirits of wine, a compound of sulphur is dissolved in abundance, which gives no reaction with acetate of lead; but yet, if this spirit be burnt in a clean spirit lamp, the products of combustion are found to be highly charged with sulphuric acid. Clay removes the ready-formed ammonia, which exerts a very corrosive action upon brass fittings, and diminishes the illuminating power of the gas. It also abstracts several other compounds of nitrogen, to which is due the dark greenish belt in an ordinary flat gas flame. The new manure thus obtained has been tried with great success upon white turnips and broccoli, and is now being used for various descriptions of corn, &c.

108. Domestic Purifier, for the Use of Clay upon the Consumer's Premises; Rev. W. R. Bowditch.

This purifier is fixed adjacent to the meter. It is filled with clay which has been broken small and moistened, and the gas passed through it. This clay will be found to remove sulphuretted hydrogen—which may be driven off by a mineral acid, and detected by lead paper and ammonia, which caustic lime will repel, and the sense of smell, or turmeric paper, will detect. Other compounds removed by it may be detected by the proper chemical tests.

109. Super-Phosphate Compost and Gas Purifier; J. W. Perkins.

# BUILDING CONTRIVANCES AND MATERIALS, AND HARDWARE.

110. Patent Indurated Stone; the Indurated Stone Company.

These specimens consist of a comparatively worthless sandstone, which, on being worked with a small amount of labour, and subsequently impregnated with a preparation of tar or resinous material, becomes as hard as granite, and absolutely impervious, indestructible, and non-vegetative. The merits of the invention consist in the advantageous adaptation of any cheap and otherwise unusable stones, as well as loam, chalk, and even sand, to building and monumental purposes of every kind; and, as a consequence of the small cost of the original material, at prices far below those of stones, paving tiles, &c., in ordinary use. The specimens consist of a piece of the stone in its natural state, Stevens' hollow bricks and culvert bricks, pavings and kerbs, pitching bricks, a grindstone, a sink, a black polished chimney piece, a green polished jam, a brown polished slab (these latter showing the natural vein of the stone), a carved head and foot stone, several indurated plaster of Paris casts, also an example of Stevens' roofing, with indurated slabs and joints.

111. Patent Siliceous Stone and Filters; the Siliceous Stone Company.

112. Patent for the Preservation of the Surfaces of Stone, &c.; J. B. Daines.

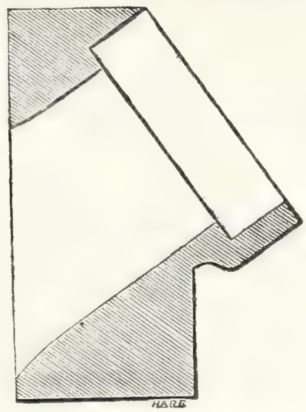
The mode of treatment under this patent is, by first dressing the stone or other surface to be operated upon in cases where decay has commenced, or the material is fragile, with a compound solution of certain stone-producing constituents, for the purpose of adding density thereto, as also for the purpose of neutralizing alkaline efflorescence, and to form a basis to receive the solution of sulphur obtained in linseed oil, which is to be applied with a painter's brush, until the surface operated upon will absorb no more.

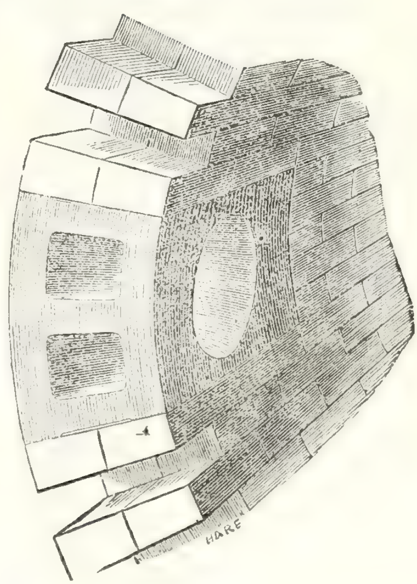
113. Waterproof Artificial Stone for Pavements, inverts for Sewers, Steps, &c.; T. Furse.

114. Specimens of Lizard Serpentine, cut by improved machinery, for chimney pieces, and architectural and ornamental purposes generally; the Lizard Serpentine Company.

115. Patent Junction Blocks; H. Doulton and Co.

Each block is made to correspond in thickness with the sides of the brick sewer, so as to build or bond in with the brickwork; the inner surface is made to correspond with the internal figure of the sewer. Each block has a socket, either within its thickness or just protruding beyond it, to receive the end of a pipe. They are made to receive pipes, entering either straight or obliquely. When fixed they form part of the sewer; they cannot be improperly placed, and a certain and proper fall is secured at the point where the junction is made.

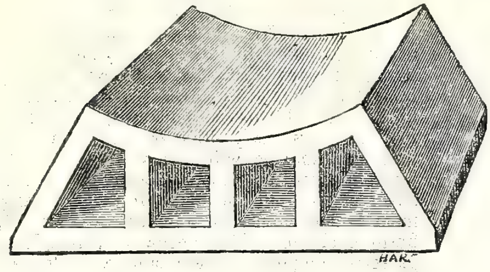



116. Invert Blocks for Sewers; H. Doulton and Co.

These blocks are made in glazed stoneware, and have an even and imperishable surface for the bottoms of brick sewers, and also a sure foundation for the structure. They have been used extensively by the Metropolitan and City Commissioners of Sewers, and for the main sewers in many provincial towns. They offer the means

for carrying off all superfluous water while the sewer is in course of construction, and when required give a channel for land drainage independent of the sewage, as they may be perforated at the sides.



117. Half Socket Drain Pipes; H. Doulton and Co.

By the use of these pipes, pipes may be removed, the drain examined, and junctions inserted, without injury to the tubes.

118. Patent Pipes, for the conveyance of Water and Gas; W. Waite.

These pipes are composed of an internal lining of earthenware or glass, surrounded by a strong coating of hard bituminous mastic. The use of metal pipes for the supply of water having been shown to be injurious, glass or earthenware must ultimately supersede them. This invention removes the great difficulty hitherto attending that substitution, by obviating the liability of glass and earthenware to fracture, and so strengthening those materials as to enable them to withstand any required amount of external or internal pressure.

119. Patent Drain Pipe; G. Jennings.

120. Earthenware Pipes for Roofs and Gutters; —

121. Patent Hoop Iron Bond for Building purposes; F. Tyerman.

The object of this patent is to give to the ordinary hoop iron at present so extensively used as bonds in buildings, an additional key, whereby its tying or holding qualities may be increased. This is effected by nicking the hoop iron at distances of about a foot apart, on both sides alternately, and turning up or down a triangular piece so as to form a claw.

122. Improved Trapped Street Gully; the Phœnix Foundry Company, Lancaster.

The sludge box resting upon the bottom of the gully, forms a double syphon trap. This construction presents the following advantages. 1st. Perfect facility for flushing. 2nd. Great head to overcome stoppage. 3rd. The part constituting the trap has small surface of evaporation; and 4th. It is entirely out of the reach of the sun's rays.

123. A Self-acting House-drain Flusher, made the full size requisite for an ordinary Dwelling-house; Dr. Gray, Dublin.

This apparatus is intended to scour out the house drain daily by the sudden discharge through it of a quantity of pure water sufficient to sweep away all matter, liquid or otherwise, that may have accumulated in the drain, leaving the drain perfectly washed as well as cleansed after each operation, and thus maintaining it always in the condition most suitable for its perfect action as a conduit for the removal of refuse matter. It has been ascertained by a series of experiments, carefully conducted by the inventor, that the discharge from a water-closet of the ordinary class is not sufficient to "sweep" the soil out of the drain pipe into the street sewer, even where no "accidental" obstruction exists:—that the soil in some cases takes days, and even weeks, in its gradual passage into the street sewer, during the entire of which time it not only constantly gives off foul gases that fill the drain and are ready to force an entrance into the house at every chink, but materially tends to facilitate the formation of accumulations that may ultimately choke the drain and necessitate its being opened, after having caused much suffering and annoyance, and possibly disease and death. These experiments suggested the idea of a self-acting cleansing apparatus ,that would daily scour out the drain, and sweep all matters passed into it away from the dwelling before decomposition could set in; thus freeing the house from all offensive and noxious effluvia, and giving security against all ordinary causes of stoppage of the drain. The apparatus exhibited effects these ends, and is so designed that it economises the water, accumulating a small constant supply received from the general main, and, when accumulated, discharging it into the drain through a large valve as a flush—thus effecting the scour at a cost of about 25 gallons daily for a medium-sized house, which at 6d. per 1000 gallons amounts to about 4s. 6d. as the yearly cost of keeping the house-drain always sweet, free from deposit and from foul air, in perfect action, and secure against stoppage. Twenty-five gallons is the quantity deemed requisite for a moderate-sized house; fifteen would suffice for a small house; fifty would be abundant for a large hotel with a single pipe drain. It may be observed that the apparatus is entirely self-acting, and once put into operation requires no superintendence whatever, but will perform its stated functions without interruption once a day, or at any other periods arranged; and may continue so to act for years without requiring any repair if the water supply be preserved. The accompanying woodcuts show the mechanical arrangements of the apparatus. The letters correspond in the several figures. The apparatus consists essentially of a cistern, Q, in which the water accumulates; of a supply apparatus, P, fig. 1, by altering the position of which the supply may be regulated or stopped;

of a large valve, H, for the discharge of the accumulated water; of a float, A, for raising the valve, H, from its seat; of a float chamber, B, in which the float, A, sits; of a valvular communication, F, fig. 3, which suddenly allows some of the water accumulated in the cistern to rush into the float chamber, B, and to cause the float, A, to open the discharge valve, B, and, of a syphon pipe, N, which carries off the water that entered the chamber, B, and thus,

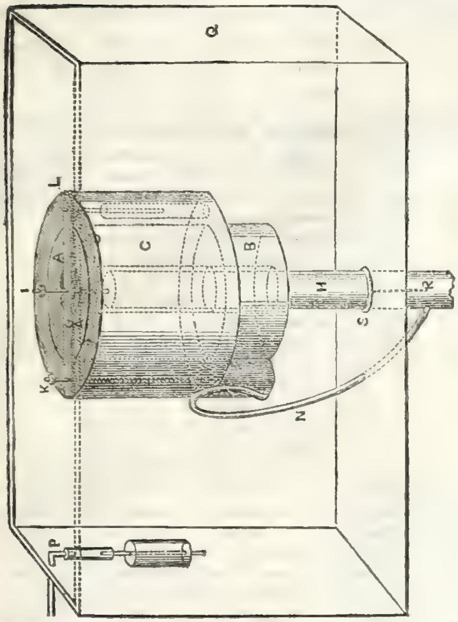


Fig 1.

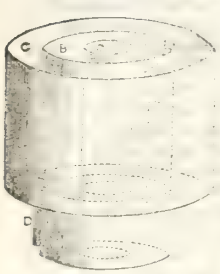


Fig. 2.

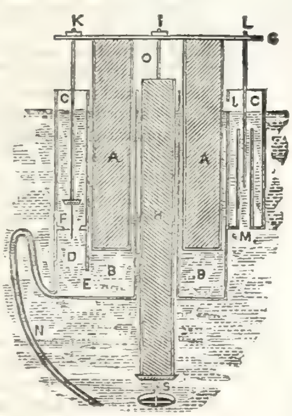


Fig. 3.

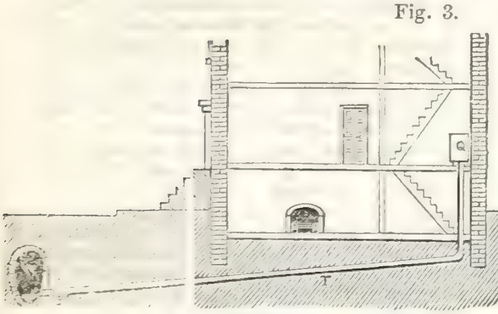


Fig. 4

by letting down the float, A, and the valve, H, to its seat, reduces the apparatus to the inaction represented in fig. 1, and allows the water again to accumulate in the cistern for another flush. Fig. 1 represents the cistern with the self-acting apparatus *in situ*, the float down, and the valves closed. Fig. 2 gives a perspective view of the chambers, the float and buoyant valve, H. fig. 1, being removed. Fig. 3 shows the chambers, the float and the valves in section; the float up, and both chamber and discharge valve open. Fig. 4 shows the position of the flushing cistern in connexion wtih the drain pipe, and a junction water trap, V, to shut out the gases of the street sewer from the house drain, an arrangement which cannot be adopted save with the flushing adjunct. The mechanism, though apparently complex, is very simple. The one shown is made of zinc, and by an ordinary tinman. The valve, H, I face with leather or india-rubber, and the seat, S, Fig. 3, I make of wood, earthenware, or bottle glass, as more economic than metal.

124. Patent Noiseless Cast Iron Chimney Cap; J. Kite.

This cap is composed of an inner and an outer case, closed at the top, the inner one having openings in the centres of each side with bevilled flanges, the outer one opening at the angles, so that no direct draught can descend the chimney, while the smoke is aided in its issue.

125. Patent Chimney-top, for Producing an Upward Current; T. Hawkins, LL.D.

126. Patent Cowl; T. Hawkins, LL.D.

127. Patent Verrotic Chimney Cleaning Machine; E. W. K. Turner.

This machine is designed for thoroughly cleansing or scraping, thereby preventing the accumulation of hard soot in the slopes or angles, which is the principal cause of chimnies taking fire. It is composed of thin strips of steel, properly tempered, and bent into a series of triangular or fan-shaped pieces. A number of these are arranged so as to form a circle, in the centre of which is a vulcanised India rubber block, to which the scrapers are attached, thus forming a figure resembling a wheel. This machine, when in operation, always presents a scraper acting at right angles with the chimney; the scrapers are rendered perfectly elastic by being twisted slightly so as to present their flat sides as they approach the centre. Several other improvements are made to suit particular purposes, such as a balance wheel for ascending a right angle by elevating the point of contact above the line of propulsion. Also a joint for allowing the head or brushes to drop when descending the slopes, instead of being pressed hard against the top as at present. Also an arrangement for causing the brush, &c., to ascend in a semi-collapsed form.

128. Three Models, showing the application of Zinc to various kinds of Roofs; the Vielle Montagne Zinc Mining Company.

128*a*. Patent Scaffolding Bracket; Dixon, Bell, and Co.

This bracket is made of wrought-iron, and is fixed upon the standard pole, by means of two arms with screwed ends, and a clamping plate, secured and tightened up against the back of the pole by nuts passed upon the screwed arm

The screwed ends of the arms pass through slots in the clamping plate, one of the slots being cut through the end of the plate, to enable the plate to be shifted so as to pass the bracket upon the pole. The ledger or cross pole is supported upon a curved arm, formed upon the bracket for the purpose, and it is held in position by a strap connected to the bracket by a common and swivel joint. The strap is tightened down upon the ledger by means of a screw bolt, working in a projection on the upper part of the bracket. The bracket-piece for ledgers of rectangular section is formed with two curved arms, with their straps and screws for supporting the ledgers or cross poles. (See *Practical Mechanics' Journal*, October, 1847.)

129. Patent Sanitary Parquet Paving for Kitchen floors, halls, passages, footpaths, &c.; W. Norris.

This paving is manufactured in blocks of any required form or dimensions, each block being composed of small pieces of wood set upon asphaltic concrete. The wood used may be any suitable scraps or that which is imported in short lengths, duty free, and usually sold for firewood. By arranging different kinds of wood or staining the pieces of different shades, a variety of patterns may be introduced. The blocks are cemented together by asphalt, and when so cemented constitute a flooring perfectly impervious to damp or vapour, and impenetrable by any kind of vermin. The wood used being of the cheapest description and no joists being required, this flooring can be laid down as cheaply as the commonest deal flooring or even stone flags.

130. Patent Rope Moulding for circular and sweep frames; G. Sterry.

This moulding can be made to any pattern or size, and is adapted for all purposes. It has the advantage of being more stable than wood, quite as durable, and much less expensive for all ornamental purposes.

131. Patent Crystal Window; Lloyd and Su mmerfield.

132. Patent Reversible Balance Safety Sashes; W. Nash.

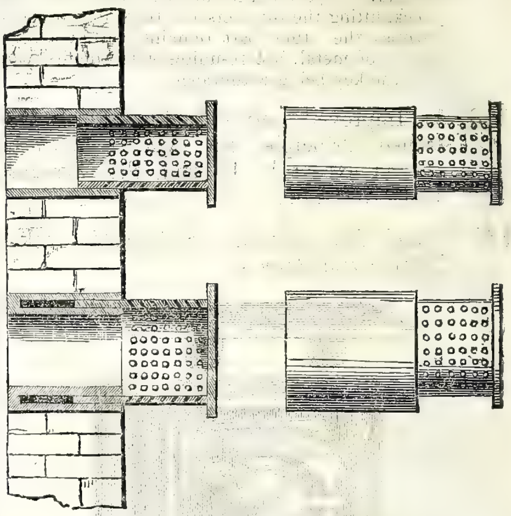
These sashes are intended to prevent accidents while cleaning, repairing, and painting windows. Weights and lines are superseded by the use of racks fixed on each side of the sash. These racks work in small pinions attached to the centre of the frame. The axes of the pinions form a centre on which the whole window may be reversed.

133. Patent Cleats or Stops, attached to a Venetian Blind and an ordinary Window Blind; S. M. Saxby. Exhibited by T. Pemberton and Sons.

This cleat is said to be noiseless in action, and it stops the blind the moment the cord is released. The action of raising the blind lifts an eccentric cleat from its position and affords a free passage to the cords. When in action the eccentric cleat maintains an upright position, but when the cords are released, it falls and holds them firmly.

*134. Improvements in Bells and their gear; W. L. Baker.

135. Patent Ventilators; B. Looker, jun.



These ventilators consist of tubes fixed into an external wall, in which others are placed, perforated with small holes in an oblique direction, two-thirds of their length. The latter are closed at the inner ends, and made to slide in the larger tubes, by which the ventilation may be regulated with ease, or they may be made a fixture at any point.

*136. Improved Ventilator; F. Lyte.

A large mirror, formed by two plates of glass cemented together, is surmounted by a tube filled with mercury, forming a large and sensitive thermometer. This, being fixed in a wall, forms a thermometer and mirror at the same time, and any heat applied will cause the mercury to rise. A piston runs in the tube, with a spring placed above it, to keep the piston always pressed on the surface of the mercury. The ventilator slides in a frame, and is attached to the piston-rod by a screw as the pendulum is attached to a clock; a piece of lead is fixed along the bottom of the ventilator, which causes it to fall by its own weight, when the piston rises and thus relaxes the cord, but as soon as the mercury falls the spiral spring presses back the piston and draws up the ventilator. A second tube may be let into the side of the mirror, of the same size as the first, and then by a piston in it being withdrawn the mercury may be made to begin to push up the piston in the other tube at any given temperature; or, by shortening or lengthening the string which attaches the piston in the first tube to the ventilator, by means of the screw above mentioned, the same end may be met. The power of the expansion of mercury being insuperable, the rise of the piston may be multiplied by a rack and pinion attached, so as to make the ventilator open a great deal for only a slight change of temperature.

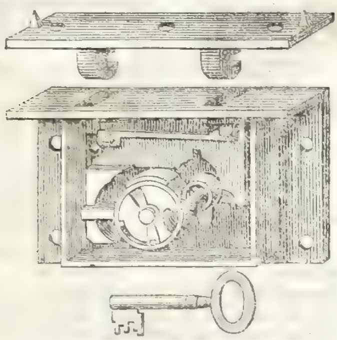
137. Patent Lock, with Separating Key; R. Button.

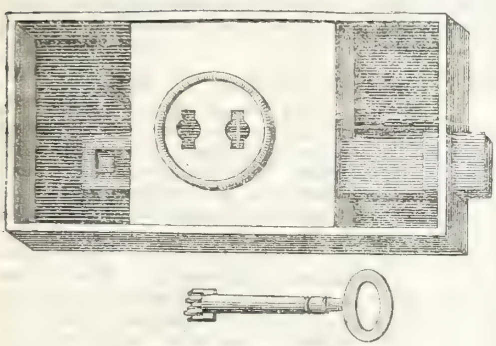
This lock is solid in all its interior works, is powder proof, is not liable to get out of order, and is simple in construction. It is not possible to obtain access to, or get a view of, the interior. The key is made in two parts—and on being introduced into the lock, and while turning it

round, one part slides into the interior of the lock, lifting the tumblers and throwing the bolt, whilst the other part remains within a solid circle of metal, but re-unites with the first part on the key being withdrawn.

138. An Improved Letter-Lock, on a new Detached Principle, and which cannot be Picked except by Ringing the Changes; F. H. Wenham.

139. Closed Key-hole and Safeguard Locks; Tucker and Reeves.





These locks cannot be unlocked while the key or any other instrument remains in the true key hole. They are constructed so as to prevent picking by pressure or by other means, all communication with the security parts being entirely cut off by the action of an internal revolving key hole, which becomes absolutely closed up, so that no picking instruments whatever can remain in it before pressure can be produced. They are also so made that their security cannot be destroyed, either by tampering with the key, or with the lock through the key hole. They are cheap, durable, and not likely to get out of order, or be deranged by dirt or glutinous oil.

140. Patent Improved Locks; J. Simon Holland.
The distinguishing features of the "Albion" lock are the curtain and the additional set of tumblers. The curtain effectually prevents the introduction of gunpowder, and also T-headed bolts, which are used by burglars to tear a lock to pieces. It also confines the angular action of picks within very narrow limits, and renders it necessary to have as many picks as curtain plates. By having the curtain plates of various lengths, changes may be rung on them, as well as on the tumblers, thus squaring the number of changes given by any other tumbler lock having the same number of tumblers. The second set of tumblers come into play only after the first set have been locked in their action; they then oppose the withdrawal of the bolt, and while doing so cannot be in any way interfered with, so as to ascertain which amongst them are so opposing. Thus, after a set of "notches" have been entered by the main stump it is impossible to tell, by feeling the bellies of the tumblers, whether their notches are true or false ones. The "latch" lock is gunpowder-proof. Turn the handle against the sun, then insert the key. Turn the handle with the sun, and you open the lock. In the "Mortice" lock—the two ribs give increased fastening in a thin door.

141. Patent Arrangement to Detect any Tampering with the Key of a Lock. J. Simon Holland.
The strong room of a bank may be locked, and the key given to the porter to take to the banker's residence, and should he, on taking it to the residence in the evening, or to the bank in the morning, make any attempt to copy it, this will be evident immediately on giving it up; or should any one tamper with it during the day, it will be evident, and thus give an opportunity to alter the arrangement of the tumblers and baffle any surreptitious attempt. This is effected by means of a small counter contained in a case attached to the key. After using the key it is drawn into the case, and moves one tooth, which becomes visible through a small hole in the case. The first wheel of the counter contains 31 teeth, the second 24, the third and fourth each 26 teeth. If the key be pushed out before placing the case in a recess outside the keyhole it will not reach the works of the lock when placed in the keyhole, and the key must be drawn into the case before it can be removed. Thus, if a person is entrusted to unlock a lock once only, he ought to bring back the key with its counter advanced only one tooth; if, besides unlocking, he pushes the key out of its case to examine it, the counter will be advanced two teeth.

142. Patent Door Lock Furniture, in china, glass, wood, and metal; B. Pitt.
In this furniture the necks of the knobs extend to the sides of the lock, thereby obtaining a longer bearing on the spindle and in the door. The screws being tapped through the spindles, they become firmly fixed; and even should the doors be thin, the screws cannot come off, as in pulling the door the pressure is against the lock.

143. Self Adjusting Bush and Spindle, for Door Knobs and Handles, &c.; F. Clark.
By turning the "milled" shoulder near the rose plate of the door, the distance between the two knobs or handles of the door is increased or diminished, so as to render one and the same spindle (within given limits), suitable for doors of different thicknesses: by turning the knob or handle when the milled shoulder is screwed on the spindle close to the door, the spindle is turned just as it is by an ordinary knob or handle, and acts on the latch of the lock or latch. No screws, &c., are required to secure the knob to the spindle.

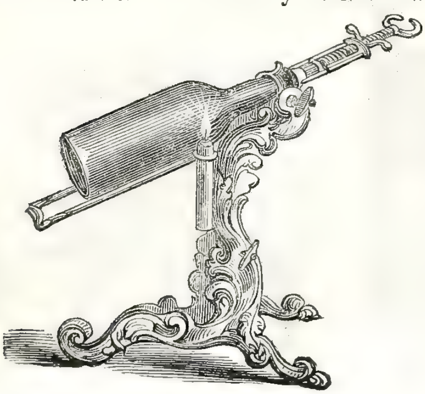
**144.** Improved Castor; F. Clark.

The same principle is applied to this object as that adopted for the spindle and bush for door knobs, &c. The arms for the bearings of the roller are cast in one piece with a spindle or pivot, and the same is provided with a shoulder-piece, cup-shaped and turned over a **V** groove outside at bottom of the "sheath," the end of spindle or pivot being first introducd into an orifice at the bottom of the sheath, whereby the roller is secured to the sheath, and revolves round it as in ordinary castors, but with less liability of destruction to the pivot, &c.

145. Brushing and Cleansing Machines; C. B. Clough.

These improvements relate as well to certain mechanical arrangements of rotatory brushes for various cleansing purposes, as to the application of gutta percha, leather, india-rubber, or other elastic material, to form the foundations of brushes, as well as for the rollers employed in the apparatus. The apparatus exhibited is applicable to the ordinary domestic purposes of brushing and cleaning; but principally for use at doorways and other places, for brushing and cleaning boots, shoes, &c. A framework supports two revolving shafts, the upper one being the driving-shaft, furnished with a winch-handle. Upon the other end of the upper shaft a pulley is keyed, which gives motion to the lower shaft, on which two brushes are keyed. (See *Practical Mechanics' Journal*, April, 1853.)

146. Patent Uncorking and Decanting Machine; — Lane. Exhibited by T. G. Shaw.



By this mechanism the cork may be drawn from the bottle without danger or difficulty, and the contents poured out, in whole or in part, without the slightest disturbance of the crust or sediment, and the bottle will remain at any elevation till again raised or lowered.

147. Copper Warming Pan; W. Young.

148. Patent Self-feeding Knife and Fork Cleaning Machine; R. Terrett.

This machine is composed of two pieces of framing, one of which contains the apparatus for cleaning the knives, and slides within the other. The knives are inserted at apertures in the outer frame, and passed through the sliding frame, which is drawn backwards and forwards until the knives are sufficiently clean. The machine is fed with emery or brick dust by a small box placed on the top of the sliding frame, the supply from which is easily regulated. The pressure is adjusted by means of a screw.

148*a*. The Furbator; a Patent Machine for cleansing and sharpening table-knives; Hilliard and Chapman.

In this apparatus the knife-cleaning operation is effected in the usual way, by means of a pair of polishing discs, to which rapid rotatory motion is given, whilst the knives are held between the revolving surfaces, the improvements relating to the general details of construction, and particularly to the formation and arrangement of the polishing surfaces. The discs are mounted in a cylindrical box or case, of cast-iron, which is formed in two halves, the division passing through the bearings of the disc spindle. Thus, when the upper half of the case is removed, the discs are exposed, and may be lifted out upon their spindle, without any further trouble with screws or other fastenings. The cover may be hinged to it at one side, so as to turn over when it is wished to examine the discs. Radiating ribs are cast upon the faces of the discs; and holes are formed in the discs at various parts, immediately under the ribs, so that wires or cords for securing the polishing leathers, may be passed under them. The discs are pressed together by powerful springs, which act upon the outsides of the discs, and abut against small discs upon the spindle. The discs and casing of the knife-cleaners are made of cast-iron, thereby avoiding the tendency to warp and get out of shape attending those of wood as hitherto constructed. It has also been customary to adjust the pressure of the discs by means of screws—a system involving uncertainty, and requiring frequent alterations to suit different sizes of knives—or, perhaps, the operator will omit to alter the screws, in which case a thin-bladed knife will scarcely be touched, whilst a thicker one will be injuriously ground down. These defects have been overcome by employing springs to press the two discs together. In addition to the foregoing, means have been devised of sharpening the knives in connection with the knife-cleaner.—[See *Practical Mechanics' Journal*, December, 1854.]

149. Rule-Jointed Fire-Brick Register Stove, by which the fire can be made larger or smaller at pleasure; T. Waller.

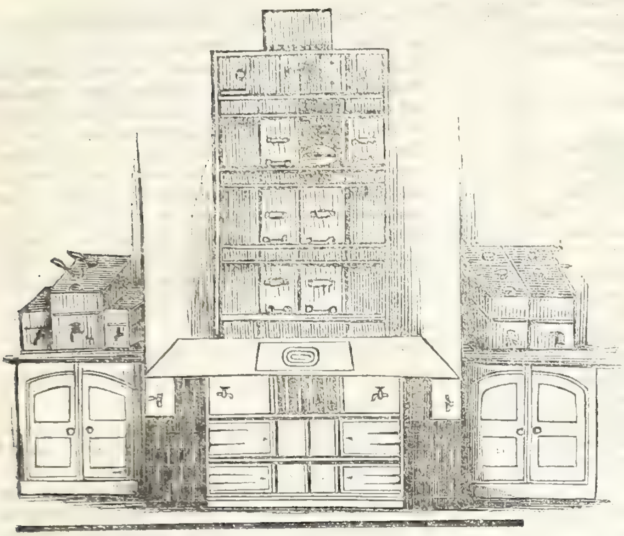
150. Patent Smokeless and Sustaining Fire-Grate; W. Jeakes.

The fire-place is here made sufficiently large to contain the required charge of fuel. The fire is lit at the top, and burns downward. As the fuel is consumed, the bars are lowered.

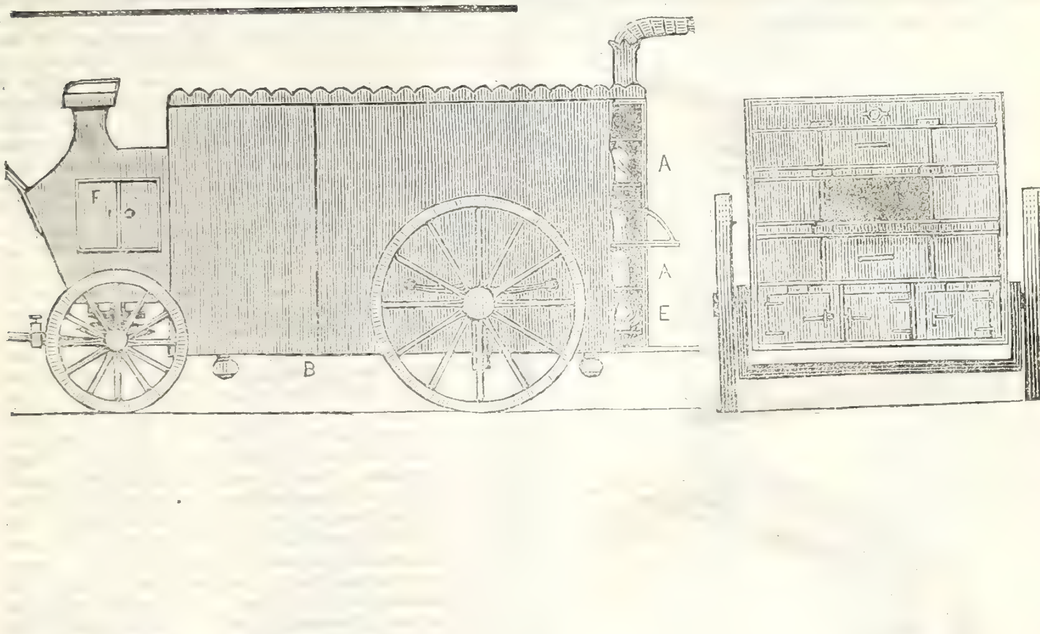
151. Improvements in Fire-places, Grates, or Furnaces; M. McSarles.

152. Crimean Army Stove; Price's Patent Candle Company.

153. Patent Cooking Apparatus; G. J. Norton.

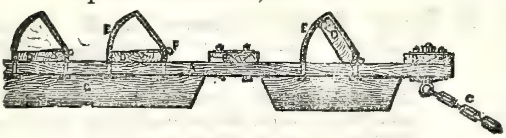


This apparatus combines within itself roasting, boiling, baking and steaming; also warm closets and proving-stoves—all with one fire—at a saving of at least 50 per cent. This is accomplished by introducing into the lower part of the chimney a number of vertical and horizontal passages, through which the hot air from the fire passes, and between which the different baking, warm-closets, and proving stoves are placed. If erected in conjunction with the patentee's roasting range, it is adapted for large establishments. The same principle has been applied to a portable military oven on wheels.



# NAVAL AND MILITARY MECHANISM AND PHILOSOPHICAL INSTRUMENTS.

154. Patent Improved Floating Breakwater, for Harbours of Refuge, and for the Protection of Coasts, Harbours, Sea-walls, and other exposed situations; J. Davidson.



This invention consists of a horizontal raft, or rafts, of one plank across another, of such a size as to cover a number of waves, to prevent it from undulating; sufficiently strong to prevent it from yielding to the wave; moored to allow it to rise and fall with the tide; made half the specific gravity of the water—their great buoyancy keeping them from sinking, their great weight from rising. The rafts being in the middle of the wave, that portion of the wave being driven above the rafts, will fall through them, filling up the vacancy below, and pass off at the other edge smooth water. (See *Practical Mechanics' Journal*, Dec. 1, 1854.)

155. Patent Bow Lines; the Phœnix Foundry Company, Lancaster.

These lines are designed to offer resistance to the water *only laterally*, and to avoid entirely the loss of power (more or less common to all other shapes of bow) arising from resistance to vertical pressure. Attention is drawn to the lines bounding the sections, contrasting the new entrance lines, with the after lines, which latter are of the ordinary inclined plane character.

156. Patent Composition for Coating Iron Ships' Bottoms; G. Crane and Co.

This composition, after several trials, has been proved to resist the adhesion of barnacles and seaweed during a period of nearly twelve months. The composition consists of red and white lead, litharge, and japanner's gold size; also boiled oil, turps, &c, The cost for two coats, laid on with a trowel, is about 3s. per square yard.

157. Improvements in Tillers or Yokes; T. Skelton.

The object of this invention is for taking up the slack of the steering rope. It consists in fitting two blocks or sheaves on the tiller or yoke between those on the free end and the rudder head, the same yoke or tiller will do for a single or a double purchase without any alteration in the blocks or sheaves, and by throwing the two additional blocks or sheaves out of gear, it can be used as a common yoke or tiller. The model shows both the single and double purchase.

158. Patent Rudder Fittings; C. N. Nixon.

For Ships.

Fig. 1.

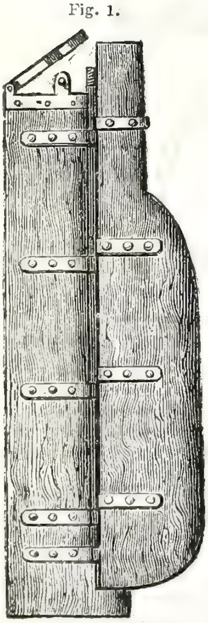


Fig. 2.

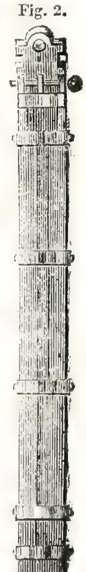


Fig. 3.

For Boats.

Fig. 4.

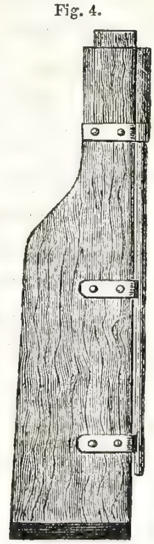


Fig. 5.

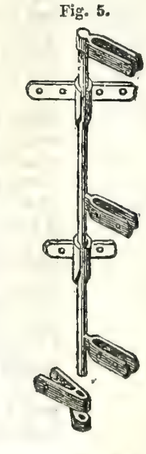


Fig. 1.—Represents the stern-post and rudder, fitted after this method. Fig. 2.—Front view of stern-post, having open gudgeons, B, closed gudgeons, C, and solid socket gudgeon, D—for pivot to work in—Cap A, with hole to admit of the bar passing through and rising a certain height, according to the size of the vessel. Fig. 3.—Front view of rudder, having a long bar—which may be in one length, or several parts—secured with braces, having narrow necks which pass through the open gudgeons, the bottom of the bar, a pivot, which works as above stated. Fig. 4.—Side view of a rudder, adapted for Launches and every description of boat. Fig. 5.—Boat's fittings detached, shewing how the bar passes.

159. Patent Bow-Propellers and Roller-Hause-Holes; Lieut. Morrison, R.N.

The bow-propellers consist of one or more screws, affixed in front of the vessel's cutwater; there being a false cutwater attached to the bow, into which the bearings of the shafts for the screws are made to work. The false cutwater is carried down from the real cutwater, and established into the fore foot, or kelson. On each side of the false cutwater strong curved iron girders are carried to the bows and braced thereto, to support the false cutwater and protect the screws from the friction of the ship's cable. The roller-hause-holes are tubes, which project some feet from the vessel, and are fitted internally with strong iron rollers, on which the cable plays. By these means the cable is carried clear of the screws, when the ship runs ahead of her anchor; and there is an increased leverage gained in heaving in cable and weighing anchor.

160. Apparatus for Lowering and Disengaging a Ship's Boat from the Boat itself; F. Rixon.

The object of this invention is to enable parties in a boat attached to a ship to lower the boat themselves, and having lowered it, to disengage it from the ship both ends simultaneously. This is effected in the following manner:—The davits from which the boat is suspended are made to work upon joints attached to the bulwark of the ship, and their extremities are connected by a cross bar forming a swing frame, always parallel with the bulwark of the ship. In the centre of this crossbar pullies or blocks are mounted to receive a length of rope or chain, which passing over other pullies or blocks connected to a standard affixed to the bulwarks of the ship, sustains the boat and the davits in their elevated position. One end of this rope or chain is secured to the centre of the cross-bar, and the other to a barrel mounted in brackets attached to the crossbar. On the axle of this barrel a winch handle may be fixed for winding up or letting out the rope, and on the same axle is a friction pulley with a friction strap, acted on by a screw to tighten it, and thereby prevent the boat descending too rapidly. Carried by brackets affixed to the crossbar is a circular revolving shaft, the ends of which are hooked to receive eyes, forming the terminals of the chains by which the boat is suspended. This shaft has a central lever, which when pressed down after the boat is lowered, releases the suspending chains, and, thereby, the boat is instantly disconnected from the ship.

161. Portable Anchor; G. Firmin.

162. Portable Skeleton Anchor; J. Griffiths.

This anchor is so constructed as to stow in less than one-third of its full size. It cants in its proper position, and is equally strong with those in general use. It can be fitted or taken to pieces in a few minutes, and stowed as best suits the trim of the vessel; and the holding-power in light soils can be increased by the addition of storm-fins on the flukes, removeable with ease. It is also convenient to transport to foreign stations or dockyards without the risk of springing the masts or yards, and to supply ships in distress during the winter months.

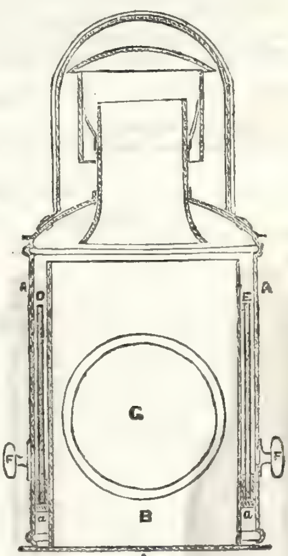
163. Patent Double Concave Small Palmed Anchor; Lieutenant W. Rodger, R.N. Manufactured by Fox, Henderson and Co.

The improvements in this anchor relate principally to the arms, the palms, and the stock; the peculiar forms of which cause it to penetrate deeper into the ground than anchors of the ordinary construction, thereby increasing the holding power with a less weight. It has also the advantage of additional strength.

164. Ship Communication and Life Line; R. J. Sibbald.

165. Patent Appliances for Ships' Capstans, Windlasses, Chain-lifters, &c.; I. S. Grylls.

166. Patent Nautical Signal Lamp; C. Lewis.




In this lamp an internal shield is provided, placed on the inside of the casing. Two metallic frames, containing red and green glass respectively, are free to slide between the shield and the cases when acted upon by handles from the outside.

167. Patent Bowspirt Lantern, with coloured lenses; G. and J. Oliver.

The three coloured lenses are set round a cylinder having reflecting surfaces above, below and around them. The lantern being a fixture, when the vessel is an the port tack, the red will be most seen; when on the starboard, the green; and before the wind, all three lights.

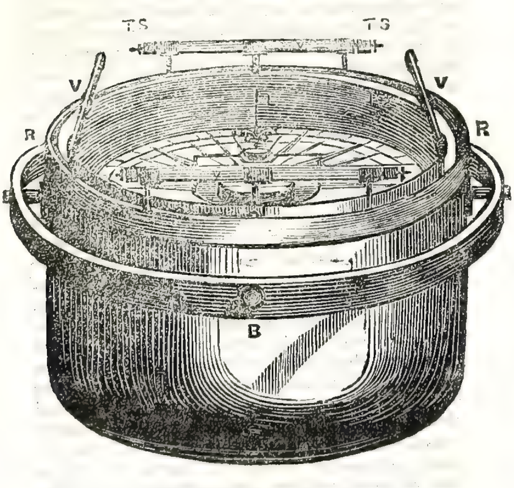
168. Mariners and Emigrants' Safety Pillow ; J. Johnson.

169. American Fog Horn; McNaught and Wood.

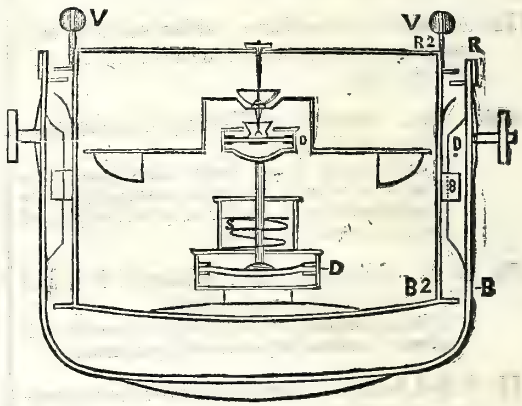
170. Patent Improvement in the Mariners and other Compasses ; J. Bigg.

This improvement consists in placing two or more concentric rings of magnets around the compass box, to prevent the disturbing influence of iron, steel, and other matters causing aberration in the needles, from the true magnetic meridian. The inner ring consists of ten, twelve, or any greater number of magnets, separated by placing, between the north and south pole of each magnet,—an armature of soft iron, thus forming a complete ring. These armatures are fixed to the centre of the outer magnets by a screw or rivet. The poles of these magnets do not touch each other, but have a space between them. In making new compasses, these concentric rings of magnets may be very simply secured inside the compass box; but in applying this improvements to compasses already fitted or in use on board ship they will, in most instances, require to be placed outside the compass box, to prevent them (from want of room), interferring with the free action of the compass card. The disturbing influence of either iron or steel on the needles of the compass, is completely prevented by the concentric ring of magnets thus placed, if brought within 15 inches or even 1 foot of the compass box. Four compasses have been fitted on this principle—2 for the Royal Mail Co., and 2 for the General Screw Steam-ship Co., on board whose ships they are to be tested.

171. Patent Floating Compass for counteracting vibration, with Binnacle attached ; I. Gray, Liverpool.




B.—Outer Bowl, containing fluid in which
B2—Inner Bowl is floated.
R—Rim of Outer Bowl,
R2—Rim of Inner Bowl.
V.—Vulcanised India-rubber, or other springs to keep the Inner Bowl (B2) in central position within the Outer Bowl B.
T.S.—Tangential Screws to adjust and bring the Inner Bowl (B2) exactly into the centre of the Outer Bowl (B).
D.—Guides to prevent any rotatory motion, which the Inner Bowl might otherwise be subject to, also to keep the Lubber's Point exactly fair, or parallel with the ship's keel.
L.—Lubber's Point.
D —Elastic Discs.
S.—Spiral Spring.
8.—Guide on the Inner Bowl.




The inventor, having discovered that when a compass was held by the hand in a vessel containing fluid, the direct action was cut off from the exterior influences incidental to the magnetic character of iron ships, as well as the disturbances arising from machinery, has applied this principle in the construction of the Floating Compass. He also found that in extreme stress of weather there were some exceptions in the oscillatory motion of the card, arising from the male pieces coming in contact with the female guides, in order to keep what is technically termed the *lubber's point* in a line with the ship's keel. This he has obviated through the aid of a simple adjustment, kept in a state of suspension in the fluid. Instructions for Use.—Open the small shutter in the top of the outer rim, and insert the funnel; pour in water until the rim of the inner bowl floats to the height of the milled edge of the outer one, keeping it always the same, by adding more fluid as it evaporates. By placing your hand upon the glass, and pressing it down, you can discover whether it rides easily. If in cold weather the water freezes, add a little common spirit, or light your lamps. The bands attached to the bottom of the bowl may be connected with the binnacle, to prevent it rolling too far in a heavy sea.

172. Tarpaulin Roller Tent for Military purposes ; J. Rock, jun.

This tent is made upon the same principle as the railway tarpaulin roller for goods waggons, in use on the Southern railways. The tarpaulin is the most efficient of temporary coverings, but is liable to damage unless attached to a roller. A tent made as shown by the model will accomodate one man for every two square yards of tarpaulin used. The roller gives great facilities for pitching or striking the tent in all weathers, as well as for ventilation by night or day.

173. A Revolving Rifle, in which the action of Cocking and Discharging is performed by the same Trigger; F. H. Wenham. Manufactured by Deane, Adams, and Deane.

Draw the trigger as far back as it will go, and it will remain so; this revolves the chamber and places the hammer at full cock. When the trigger is pulled a second time the rifle will be discharged. The same operation is performed for each of the five charges contained in the revolving chamber.

174. A Rest for the Rifle, which ensures and retains a correct aim in the act of firing; C. W. Forbes.

*175. Patent Method of Testing Gun-barrels; J. Simond Holland.

If any flexure of the barrel takes place when filled with water at very high pressure by means of a hydraulic pump, such flexure will be pointed out by a pointer on a disc.

176. Rough and Imperfect Specimen of Material for Guns; J. Simon Holland.

This is composed of right and left handed coils of wire cemented together with gun metal.

177. Rifled Shot, to rotate when fired from common musket or smooth bored barrel; G. F. Morrel.

178. Projectiles; J. Norton.

1. Fog Signal—to be placed on the rails. This model is merely stuffed with paper: the unfilled varnished papers show the stages of formation. It is evident that it cannot *rust* or become *damp*. 2. Whistling Bolt—to be shot by the guard of a train high over the head of the engine-driver, or on one side of him. The cartridge can be attached to the end of the bolt, and is fired without previous opening. 3. Fire-ball Bolt. The quick match is placed between the shaft and the ball: the latter of course can be made to produce any colour of fire or flame. 4. Explosive Percussion Bolt Signal. The igniter is the *last* inserted; and the bolt, falling on grass or soft clay, is sure to explode by the fracture and consequent friction of the glass tube igniter. 5. Elastic Expanding Sabot. Its base is fortified by a circular piece of sole or stout leather, glued on with gutta percha: with this Sabot *iron* shot may be fired from a rifle without injury to the rifle or other gun. 6. Cartridge, that does not require to be *opened* previous to or in the act of loading. It can be drawn *entire*, when required, without spilling any portion of the powder. 7. Implement for Firing Cannon without a vent or touch-hole: it is easily fitted on at the mouth of the gun, and the firing of the gun cannot derange it. 8. Shot or Shell made of pressed clay, cement, or artificial stone for Artillery. It will be efficient against all but stone walls. 9. Frictional Exploding Signal, that may be thrown from the hand, and caused to explode at the end of a cord high in the air: it can be used to warn a train *following* not to run into a train brought to a stand by an accident, as in the melancholy case near Straffan. 10. Glass-tube Igniter. When charged with percussion-powder or lucifer-composition, the ends are closed with cork, glued in with liquid glue. 11. Sabot, made of pressed leather, of such a form as to enclose the lower half of a spherical shot or ball. 12. Improved Cordage, so as to give greater strength to the strands forming the rope, cord or band. 13. Rifle Arrow or Bolt, adapted to Sharp's American breech-loading rifle. This has been shot to the distance of nine hundred yards. The cartridge may be attached to it, so as to enter the barrel without cutting off the end, as is the manner with Mr. Sharp's cartridge which is attached to his shot. This bolt is peculiarly efficient for *vertical* fire, to dislodge an enemy from behind strong buildings, ramparts, or other cover.

179. Hand Barrow Ambulance; F. J. Wilson.

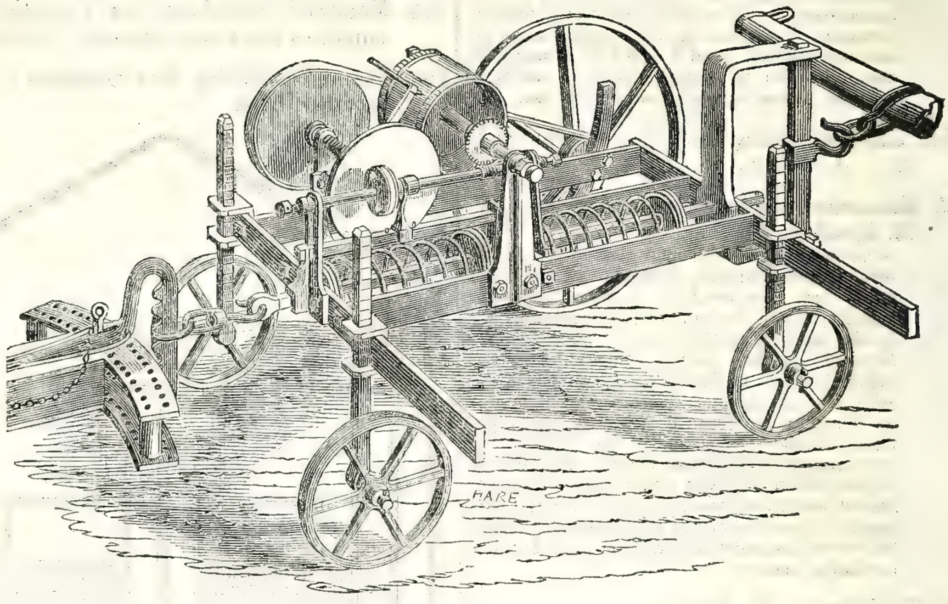
180. Patent Portable Water Filters, for Army purposes; Griffith Owen.

These filters are made of gutta percha. Each hospital conveyance cart attached to the army in the east, carries one of them in a wicker case and sling. These weigh 18 lbs. each, and are capable of yielding nearly fifty gallons of clear water in twenty-four hours when in use.

181. Patent Self-registering Dynamometer for testing the Draught of Ploughs: E. H Bentall.

In this instrument the force exerted by the horses being made to compress two spiral springs, the register of the draught is regulated by this compression. The instrument is supported by an iron frame and four wheels. A strap from the nave of one of these wheels drives a rigger, and with it a metal disc fixed on the same axle. The flat surface of this disc acts on an edged runner, which is capable of sliding on its axle, and is, during the experiment, moved by means of a fork connected with the spiral springs to various distances from the centre of the disc proportioned to the compression of the springs; it is, therefore, driven faster or slower in direct proportion to the draught of the plough. On the same axle with the edged runner is a worm that acts on a cogged wheel, along with which revolves a drum with a speed proportioned to that of the runner; hence a line drawn by a fixed pencil on paper coiled around the drum would for equal lengths of furrow be proportioned to the draught of the plough. But motion is given to the pencil in a direction parallel to the axis of the drum, by a screw cut on the spindle carrying the disc, and the motion in this direction represents the length of furrow drawn; while the two motions combined cause the pencil to describe a diagonal, showing the variations of the draught during the experiment, the line becoming more nearly parallel with the axis of the drum as the draught is less, and *vice versa*. A brass wheel, with its edge graduated, revolves also with the drum, to show the degree of draught in stones, when a determinate length of furrow is drawn. This may be used or not, as may be found most convenient. There are several obvious advantages belonging to the peculiar construction of this instrument. In the first place, no special means are needed to obviate the vibratory motion that ordinarily interferes with other modes of construction; for the power that moves the drum acts uniformly in one direction, and the only effect produced on the drum by variation of draught is simply increase or diminution of speed. Secondly, the draught, with all its variations is registered by the instrument itself, without requiring the attention of

the experimenter. Thirdly, no after calculations of averages are needed. Fourthly, while in ordinary cases averages are calculated from a limited number of observations, the averages registered by this instrument are the same as if calculated from an infinite series, for the additions are made at every instant, from the commencement to the termination of the experiment.




182. Patent Weighing-Machine; — Schonemann. Exhibited by R. & L. R. Bodmer.

The combination of connecting links and stays secures a parallel motion of the moveable parts of the weighing-machine. The beam rests upon a fixed pivot, and can be constructed for any convenient proportion between the weight and load. These weighing-machines occupy only half the space of other platform weighing-machines of the same power, and are more accurate and sensitive.

183. Apparatus for Distinguishing Genuine from Counterfeit Coin; G. Davis.

Over the till a gauge-plate, having a number of slits corresponding with the different coins, is suspended. From the under surface of this plate a bearing is suspended, on which a number of bent levers work nearly at right angles. One arm of each lever passes under each slit, being held up against it by the weight of the other arm, and so adjusted as to counter-balance a genuine coin, but not a spurious one. It will thus be seen that this apparatus enables either a larger or a lighter coin to be detected.

184. Gold Coin Detector, applicable also as a Weighing Scale for Letters; Pierre Savouré. Exhibited by E. Rascol.

There are three openings in the lever, one for the double sovereign, the second for one sovereign, and the third for half-sovereigns. The gold coins are subjected to the double test of weight and gauge. The machine exhibited gives the double testing by one operation. A coin, if good, will go through the opening, and will counterbalance the weight; if too light, the lever will remain unmoved; if too thick, the coin will not go through. The machine may also be adapted as an inkstand, as shown in the article exhibited.

185. The Maynooth Single Fluid Battery; Rev. Nicholas Callan.

This battery consists of cast-iron and amalgamated zinc, excited by any of the following fluids:— First, undiluted muriatic acid, or muriatic acid diluted with a small quantity of water. Secondly, muriatic and sulphuric acid together, diluted with a quantity of water twice, or a little more than twice, as great by measure as that of the sulphuric acid. Thirdly, the common sulphuric acid diluted with about twice its bulk of water, or the strongest diluted with 3 times its bulk of water. Fourthly, the common sulphuric acid mixed with 3 times its bulk of a strong solution of common salt, or the strongest sulphuric acid mixed with $3\frac{3}{4}$ times its bulk of the same solution. The last is preferable to any of the others. When the cast-iron and zinc are very near to each other, this battery circulates more electricity in a given time than any other battery yet made. The inactive part of the iron should be protected against the action of the exciting fluid, by covering it with a substance on which the fluid acts but little, or not at all.—(See *Mechanics' Magazine*, vol. lxii., page 249.)

186. Patent Improvements in Telegraphing; R. Walker.

The peculiarity in this mode of telegraphing is, that the batteries are in constant connection with the conductors, but in such a way that a connection requires to be made between those conductors before the batteries are brought into action, a connection *at any part of the line* having this effect on both batteries. By using a double instrument at the intermediate stations, messages may be sent to the right only, to the left only, or both ways simultaneously. There is a portable indicator, which can be carried in the pocket, and may be connected with the wires at any

part of the line, when a communication with all the stations may be made and acknowledged. By this arrangement, only one current of electricity can be given. This, however, is all that is necessary for either the French or American systems. It is also equally applicable to the bell-wires, which could be used (if arranged on this principle) for giving notice of accidents without interfering with their present use.

186*a*. Index Lightning Conductors for Churches, &c.; J. Wilson.

187. Economico-Sanatory Gas-burner; Rev. W. R. Bowditch.

A Leslie's burner, with outer glass and cup complete, is here exhibited. Instead of allowing *cold* air to rush into the flame with an enormous velocity, the air for combustion is heated nearly to the melting point of tin by passing down between the two glasses, and the current is moderated by the friction to which the air is subjected in its passage. The advantages claimed for this plan are, above 50 per cent. more light from ordinary gas than can be obtained by the common arrangement, and a perfect burning of gas, which otherwise escapes partially unconsumed, and causes headache, &c., in close apartments. The effect of this can be seen by raising the outer glass, after the gas has been burning for half an hour.

188. Gas Burner; W. Young.

189. Tripod Vesta Lamp; W. Young.

190. Patent Bin-Oxydised Lamp; W. Young.

191. Gas Standard; F. Skidmore and Son.

192. Patent Enamelled Gas Shades; F. and W. Whitehead.

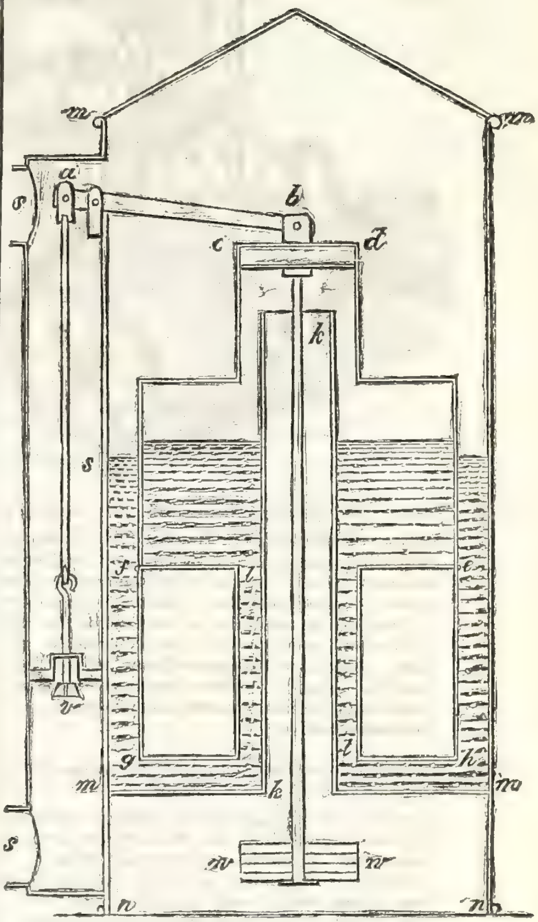
These shades are for consuming gas without a glass chimney, and effecting a saving of 50 per cent. in gas, when compared with the most approved Argand burners, giving at the same time a steadier and purer light. To fit them to the gas-fittings, it is only necessary to unscrew the usual burner, and screw the shade on in its place. Nos. 1 and 2, suited for horizontal fittings. Nos. 3 and 4, for upright fittings. Nos. 5 and 6, for desks, workshops, &c., having a hinge joint, so that the light may be shaded or open.

193. Patent Safety Lamps, for Coal Mines, &c.; F. and W. Whitehead.

These lamps have only one loose joint. They are not liable to accident from blows by the miner's pick or hammer. They cannot be put together so as to be unsafe, and they give ten-fold more light when closed than if opened. No. 1, adapted for ordinary use. No. 2, an exploring lamp, which, by the aid of the tube, can be safely used in any amount of hydrogen or carbonic acid gas, and should the pipe be suddenly detached, no accident would result, as the light would simply go out.

194. Mercurial Regulator, for regulating the supply of gas to the burners; D. Hulett.

195. Patent Self-acting Gas Governor; J. F. Heather, M.A.




The peculiarity of this invention consists in the admission of air into air vessels sealed with a fluid, such air vessels being supported by floats which the pressure of the gas depresses into the fluid, and by the depression the incoming of the gas is regulated. In the annexed figure, *s s* is the gas supply pipe through which the gas flows passing through the valve *v*, which is connected by means of the lever *a b*, with the float *e f g h*. This float carries the air vessel *c d e f*, open to the external air by the air pipe *k k*, which passes through a tube *l l*, in the centre of the float. The air enters the pipe from the chamber *n n*, in which the balance weight, *w w*, moves; and by varying this weight the pressure of the gas passing to the burners is regulated at pleasure; for when the pressure of the gas in the upper parts of the pipe *s s*, and of the vessel *m m*, tends to decrease, the float rises, and opens further the gas passage at the valve *v*; and when the flow of gas would otherwise be too great for the supply of the burners at the regulated pressure, the

increasing pressure on the air vessel depresses the float and closes the gas passage, until the equilibrium is restored. The air, by entering and being driven out through small pipes, checks oscillation in the float, rendering its action steady and the apparatus offers little friction in action.

196. Wet Gas Meter; J. Gray.

197. Patent Portable Atmospheric Blow-pipe; Davis and Son.

A cylindrical bellows, which is distended by means of a spiral spring in its interior, is connected with a flexible tube attached to a blow pipe. The bellows are worked by the foot.

198. Improved Photometer; D. Hulett.

199. Metra; Herbert Mackworth.

The instrument, called "Metra," from its including a variety of measures, is intended for the common use of mining and other engineers, for geologists, scientific travellers, &c. A brass box, $2\frac{3}{4}$ inches square and $1\frac{1}{4}$ inch thick, throws open at top and bottom so as to form a measuring side $5\frac{1}{2}$ inches long. By placing the CLINOMETER level at zero, the strike or level course of a bed of rock may be at once found and read off on the compass (DOUBLE CARD), which is made as large as possible. The bottom of the compass being made of glass, the strike of the roof can be, in like manner, found, and then read off from the under side of the card. The amount of inclination in degrees, or of inches fall per yard, is found by the level. In the above cases the accuracy of reading is to $\frac{1}{2}°$. The level course or inclination of long lines can be taken by the two SIGHTS. For taking the direction of highly inclined lines one of these sights turns down, and the PLUMMET is suspended to a screw at the other end of the instrument; a brass SURVEYING LEG, with adjusting joints, fits into a socket on either side of the instrument. The leg can either go into a joint of stone or brickwork, or screw into a tree, timber, walking stick, sketching stool, or moveable block of wood, according to the purpose for which it is to be applied. In the last case it will answer well for the detail surveying in mines, as low as 15 inches in thickness, all the ordinary filling in of other mining surveys may be done with it. The surveys may be laid down on paper without the aid of anything but a pencil, by first adjusting the north and south line of the plan by the compass, and fastening the paper down by weights. The compass then serves as the PROTRACTOR, and by the scales the distances are measured off. This method saves all calculation, ruling parallel lines, &c., and obviates some instrumental errors. The THERMOMETER needs no remark, but that it is useful in examining ventilation. GONIOMETER.—An arm which can be raised up against the lid enables the eye to measure angles, crystals, cleavage, &c. A MAGNIFYING GLASS is placed in one angle, in the other is a TOURNALINE for destroying the refracted rays of light. It is useful in examining rocks at the bottom of pools, or along coast lines, &c. In the bottom lid is a table of CONSTANTS, suited for the objects of the different classes of persons named. By turning back the elastic band, and lifting out the small arm and sheet of mica, and adjusting the box by the spirit level, a delicate ANEMOMETER without friction is obtained, particularly useful in ascertaining the velocity of the ventilation in the ends of mines. There are several other uses, too long to enumerate, which will suggest themselves in practice.

200. A Folding, Dissecting, or Compound Achromatic Microscope, adapted for travelling or hospital use; S. Highley, F.G.S., F.C.S.

The wood-cuts exhibit the construction of this instrument. Fig. 1 shows the microscope arranged for dissecting animal or vegetable structures. Fig. 2 shows the packing of the lenses, &c. Fig. 3, the instrument folded for the pocket. Fig. 4 shows the arrangement as a compound achromatic microscope.

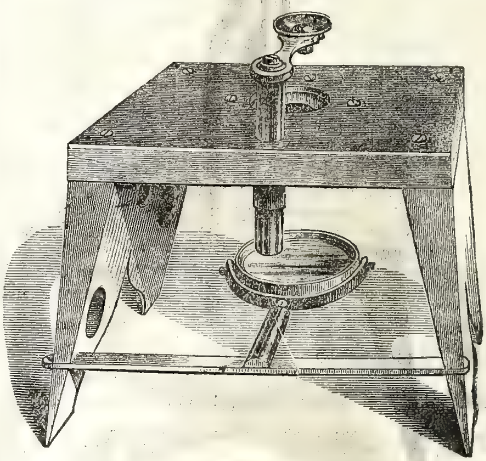


Fig 1.

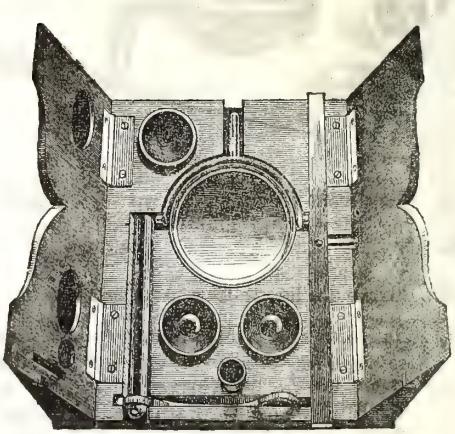


Fig. 2.

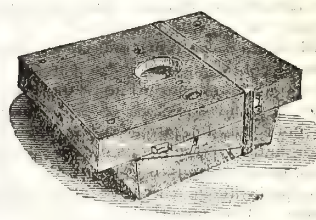


Fig. 3.

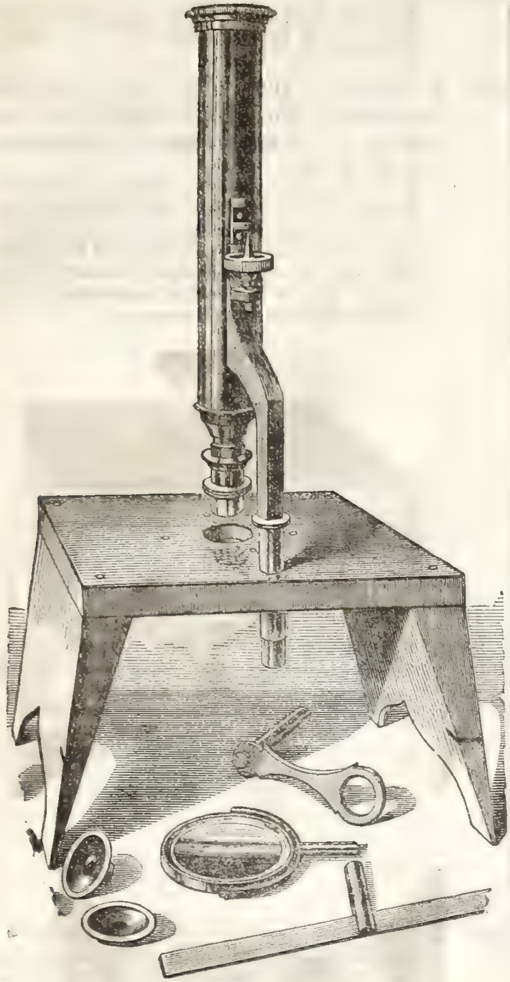


Fig. 4.

201. Improved Prismatic Compass, for Measuring Horizontal and Vertical Angles; A. Yeates.

202. Portable Theodolite; A. Yeates.

203. The Superbola Machine, for striking a newly discovered oval, entitled the Superbola—a form of Curve existing between the Ellipse and the Parabola; J. Augustin Boyle.

This instrument will give to artists a facility for drawing a set of graceful curves for every kind of pattern or design. The proportion of the figure, being mathematically true, will assist with squares, parellograms, triangles, &c. Any description of its oval form can be drawn up to the orange shape. The Superbola Oval will also suit for the arch of skew bridges, being without that dangerous part in the elliptic curve, designated by architects as the "thigh," which renders all oblique bridges liable to fall in when the parts above them become saturated with water. The Superbola, conjoined with another at $\frac{1}{3}$ from its centre axis, gives an area apparently suited for concert rooms, theatres, churches, &c. as the inventor believes it will be found devoid of reverberation, so destructive to hearing.

204. Improvements in Angles, T squares, straight edges, parallel rulers, and other similar instruments employed in drawing; C. T. Guthrie.

205. The Architect's Pocket Companion; F. J. Wilson. Maker, Mr. Adie.

This compact instrument contains a pair of compasses, a level for measuring angles, a penknife, pencil, and ruler.

206. Patent Electrotyped Raised Figures and Electro-Plated Elastic Steel Tape; Cutts, Chesterman, and Bedingfield.

The use of this instrument is twofold, as it adapts itself to either tape or chain. It is made to wind into a case, the same as the oiled tape, and is alike useful in measuring land or other property. The weight of a four pole steel tape, case included, is only one-third the weight of the ordinary chain, and from its elasticity is adapted for circumferential as well as lineal measurement. Every mark, line, or figure, is raised by a chemical operation, so that they become more bright by usage. Should the steel tape become wet, it can be cleaned with a piece of cloth or leather, and can be wound in its case in much less time than the ordinary chain can be folded up. If any accident should occur to any of the divisional lengths of this tape, such lengths can be had to replace them, and can be fastened by the most ordinary mechanic.

207. Patent Photographic Camera, for taking pictures out of doors; T. E. Merritt.

A dark chamber is made so that it may be attached to the back of the camera. This chamber is filled with prepared papers placed between glass or collodion holders. The first paper is brought forward till it drops on a sliding plate by means of a screw, where it is in focus. After sufficient exposure, the sliding plate is pulled back, when the picture falls into a receptacle below the dark chamber.

208. Perambulating Photographic Field Camera for war or other purposes; S. Highley, F.G.S., F.C.S.

This instrument, originally designed for war purposes, is adaptable to any photographic process, and presents the advantage of carrying *all* the apparatus required in the field, allowing the same to be *rapidly* moved from point to point, and brought into action by *one person alone.* The annexed drawings show the general arrangement. By the wheels (4 feet diameter), a piston-rod passing through the axle, and a handle hinged to it, which can be clamped at any angle, every motion desired for bringing an object into view is obtained. Fig 1. The camera is here represented as arranged for saccharised collodion, dry collodion, or albuminised plates. The prepared plates drop into groves in the sides of the box that is closed by a sliding lid. This box fits beneath a corresponding aperture in the bottom of the camera, over which is placed a Newton's sliding rod. On the lid of the plate box being drawn back, the rod is pushed down, clamped to the top of a plate, and drawn up into a focus; after

proper exposure the plate is replaced in its groove, the lid closed, and so on with as many plates as this box is made to hold. Fig. 2 shows the disposal of the plate, and chemical boxes, water-can, &c., about the axle wheel. By a modification of Newton's arrangement, the moist collodion process may be employed.

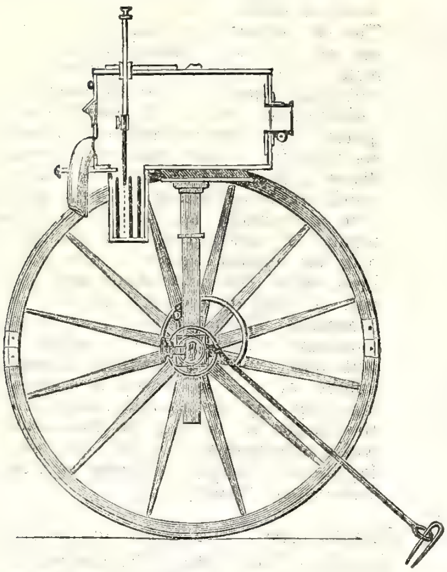


Fig. 1.

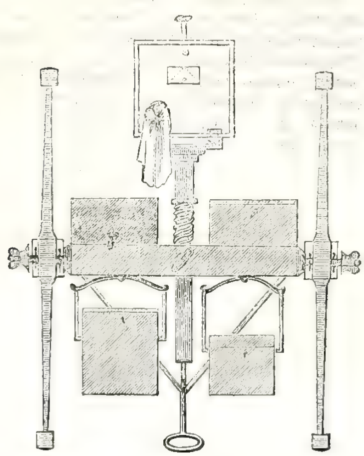
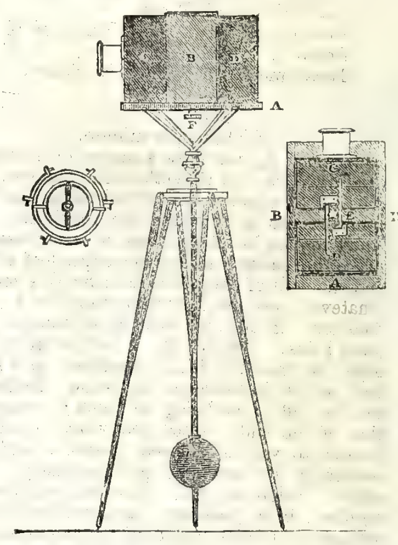


Fig. 2.

## 209. A Photographic Camera for Naval Service; S. Highley, F.G.S., F.C.S.

Fig. 1 represents the camera mounted on a rod, with a heavy counter-balance, and is upheld by a tripod stand, on an arrangement similar to that employed for ships' compass-boxes. The weighted rod that supports the camera always tending towards the centre of gravity, the tripod stand, by means of the universal-motion arrangement, alone follows the ship's motion, and thus rotates round it. As the camera must be equally balanced, to prevent any rocking motion the following compensating arrangement for the result of focusing is adopted:—To the base-board, A, is attached a central wooden frame, B, into which slides the two halves of the camera, C and D, both being of exactly equal weight. In the middle of the base-board, A, is a pinion, E (fig. 2), which acts on racks fixed to C and D; it will be seen that by turning the milled-head, F (fig. 1), that the two portions of the camera, C and D, will be brought to, or thrown from, the centre of balance in exactly the same proportion. Fig. 3 represents the universal-motion support. In focusing—the object must be focused when in the trough of the sea, and the picture taken at the moment the ship has again fallen to the same point, after the manner of ship-gunnery practice.



## 210. Patent Spiral Lever Watch; R. Tunks.

The peculiarity of this invention is the substitution of a worm or spiral for the pinion, as now generally used, for the purpose of transmitting motion from one wheel to another. The advantages gained by this substitution are:—first, greater simplicity of construction, and less liability to wear and derangement; secondly, an increased duration. Watches constructed upon this principle can, without increase of bulk, be made to go with once winding up, over periods of time from one day to one month. The superiority of the spiral over the pinion, may be thus illustrated. An ordinary pinion of seven teeth, in order to make one revolution, takes up seven teeth of the wheel that propels it; while the spiral can be turned one revolution with one tooth of the said wheel, thus effecting a clear saving of six teeth in one revolution. The spiral in this arrangement is attached to the escapement wheel; the escapement wheel of the ordinary lever watch is attached to a pinion of seven teeth; it will thus be seen that, with the spiral arrangement, the escapement wheel is made to effect as much with one tooth of the propelling wheel as in the ordinary pinion arrangement would require seven teeth. By this economy in the number of teeth in the spiral watch, the escapement can be brought into immediate contact with the centre wheel, instead of requiring the third and fourth wheels, as in the ordinary lever watch, by which means

a heavier balance can be driven with a much weaker mainspring. A comparison of the number of teeth required in the ordinary lever watch and the spiral 30 hours' lever watch, will at once show the simplicity of the latter over the former arrangement.

*Ordinary Lever Watch.*

| | | | | |
|---|---|---|---|---|
| Main Wheel | 72 | Teeth. | | |
| Centre ,, | 64 | ,, | Pinion of | 10 |
| Third ,, | 60 | ,, | ,, | 8 |
| Fourth ,, | 54 | ,, | ,, | 8 |
| Escapement | 15 | ,, | ,, | 7 |
| | 265 | | | 33 |

240 beats per minute.

*Spiral 30 Hours' Lever Watch.*

| | | | | |
|---|---|---|---|---|
| Main Wheel | 72 | Teeth. | | |
| Centre ,, | 40 | ,, | Pinion of | 10 |
| Spiral ,, | 18 | ,, | ,, | 6 |
| Escapement | 25 | ,, | With Spiral. | |
| | 155 | | | 16 |

100 beats per minute.

The above figures show a saving of 110 teeth in the wheels, and 17 teeth in the pinions; and in order to equalise the friction on the balance staffholes, so as to make the watch have an equal motion in all positions, it is proposed to make the balance staff-pivots sugar-loaf shape, and the ends of the pivots flat; by this means, whatever position the watch may be in, the ends only of the pivot will be in contact with jewel holes. By this shape of staff-pivot, the objection that has hitherto existed to a slow-train watch is obviated, viz:—the side friction to the staff-pivots being so much greater than that of the end, caused the vibration of the balance to vary in different positions, and consequently the watch to go irregularly. The only condition requisite to cause a watch to go regularly in all positions, is to maintain the same amount of friction under all the circumstances in which it may be placed. This applies especially to the balance staff. In the ordinary lever watch, velocity overcomes this unequal friction. The pivot, as above described, receives the same equal motion in the slow train as is obtained by velocity in the quick train, and with the additional advantage of less wear and tear on the machine. The superiority of the spiral watch is thus evident, in the fewer works and slow train, over the quick action and more complicated arrangement of the ordinary lever. In the spiral lever the escapement wheel becomes the second's wheel, to which the second's hand is attached. The escapement wheel makes two revolutions per minute; the second's hand will, therefore, make one revolution in the half-minute, which will afford equal facilities for counting short periods of time, where the second's hand is required. By taking advantage of the teeth that are saved in the construction of this watch, and disposing of a number in an additional wheel, a watch may be made to go 8, 14, 21, or 31 days, with once winding up, and still not exceed the number of teeth (even in the 31 days' watch) over the number required in the ordinary day lever watch. The principle of the spiral watch will be admirably adapted for drawing-room timepieces. Timepieces with the spiral arrangement may be made to go three months or longer with once winding up, without increasing the number of teeth, which will be a great advantage, requiring less attention, also diminishing the danger of breaking the glass shades with which timepieces are frequently covered, including also less liability to derangement from the less frequent winding up.

211. Patent Suspension Bridge for the Sounding Boards of Pianofortes; W. Shepherd Smith.

The model No. 1, shows the common sounding board, which, being fast at both ends, becomes crippled by the pull and downward pressure of the strings, by which the tone is deteriorated. The model No. 2, shows the patent sounding board, which is free to vibrate. An iron rod is fixed at the back of the framework, counteracting the strain, and helping to secure the glued parts.

# AGRICULTURAL IMPLEMENTS AND SADDLERY.

212. Tank and Cesspool Cleansing Machines; W. Dray and Co.

These are made on four wheels as waggons, or on two wheels as carts. Their mode of operation is by means of a powerful air pump attached to the machine, which raised the cess, or other foul liquid without contaminating the surrounding atmosphere with noxious effluvia. The suction pipe (which is flexible, and may be of any length) is carried through passages of dwelling houses, to back premises, or other places otherwise inaccessible without incommoding the inmates of such dwellings. The Royal Agricultural Society of England awarded Messrs. Dray and Co. a silver medal for this invention.

213. Improved Steel Digging Forks; W. Dray and Co.

These forks are superseding the spade for all digging purposes, being light in the hand, and entering the ground with less labour than the spade.

214. Cottage Allotment Subsoil Fork; F. I. Wilson. Made at the Agricultural Implement Department, Baker-street Bazaar.

The handle is bent about two inches to the foot out of the perpendicular to one side, so as to enable the labourer to stand over his work; a small handle is placed at about the usual distance of a spade handle, thus enabling the labourer to guide it into the ground. The hand is then applied to the long lever handle, bringing an almost irresistible power to bear upon the subsoil. The object of this implement is to loosen the subsoil after the spade or plough has gone over the ground.

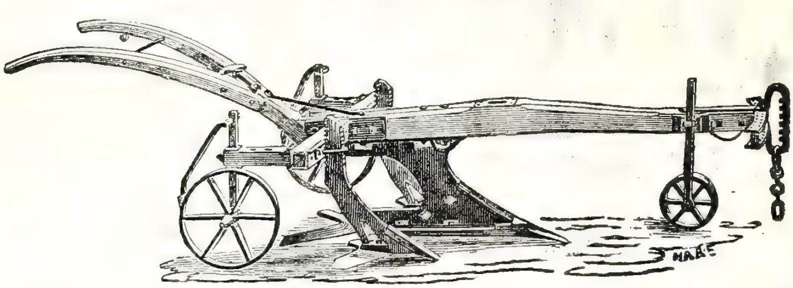
215. The Double-Handled Spade; F. J. Wilson.

The peculiarity is that a second handle is placed at the base. The main shaft is raised about six inches, and runs parallel to it; its length is about a foot; it is fixed into the handle by a cotter. The advantage is—it enables the labourer to do filling work without bending his back unnecessarily.

216. A Hand Spud, called the "Scorpion Spud;" J. Bailey Denton.

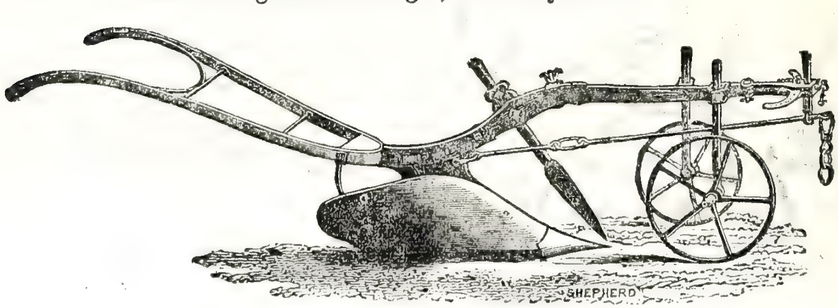
This spud is for killing the root as well as cutting off the heads of weeds by the ejection of destructive liquid on the stump or root of the weed at the time, and by the action of the incision. The principle of distributing liquid to the roots of plants by the agency of the hoe is also applied to the horse-hoe; but in that case the liquid, instead of being destructive, is of a fertilising character, and can be used to all drilled crops, as well as to seeds and permanent pastures.

217. Patent Broad Share and Subsoil Plough; E. H. Bentall.

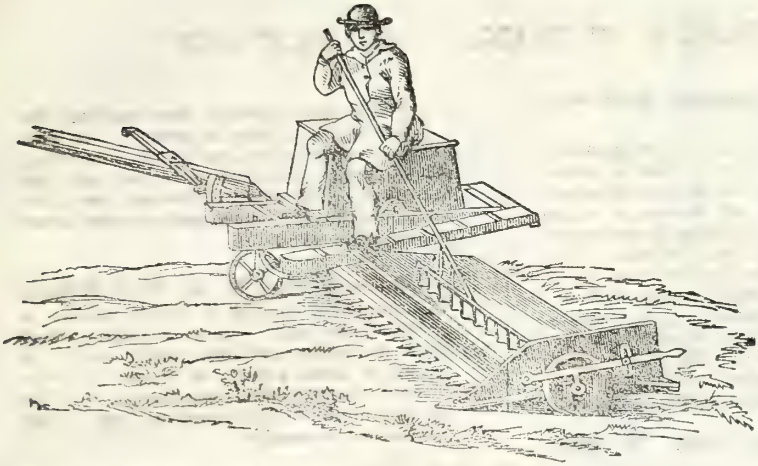


This plough has a long and rigid central beam, and a central frame with a long projecting point; it has also side projecting points; behind these are attached shares of various widths, according to the soil on which it is intended to operate. In all ordinary implements of this character, the breaking up and paring the soil is done in two operations, which in this case is performed in one. The central part can be used as a sub-soil plough.

218. Wrought-Iron Plough; W. Dray and Co.

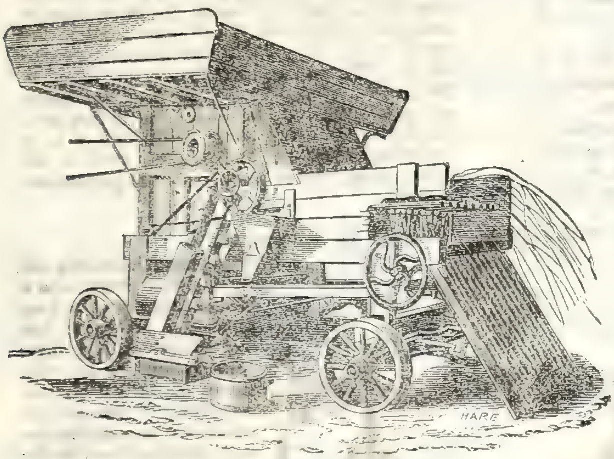


218*a*. Patent Reaping Machine, known as Hussey's improved patent American Reaper; W. Dray and Co.



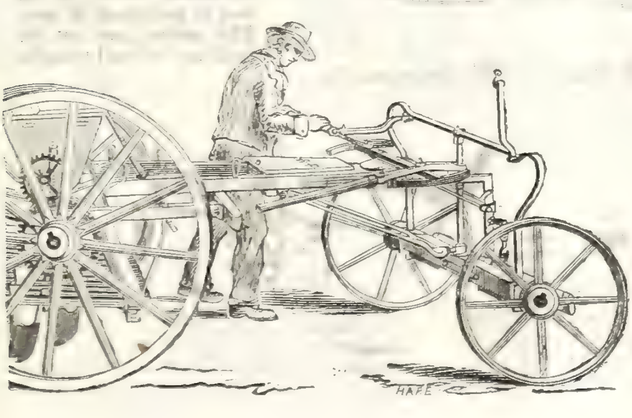
The model shows the recently patented improvements. These consist chiefly of the tipping platform, which delivers the corn in proper condition for binding, and the perforated knives, which prevent the machine from choking when operating on foul or grassy land —an evil to which most other reaping machines are liable. The Royal Agricultural Society of England awarded Messrs. Dray and Co. their prize for this machine.

219. Patent Improvements in Thrashing Machines; R. Garrett.



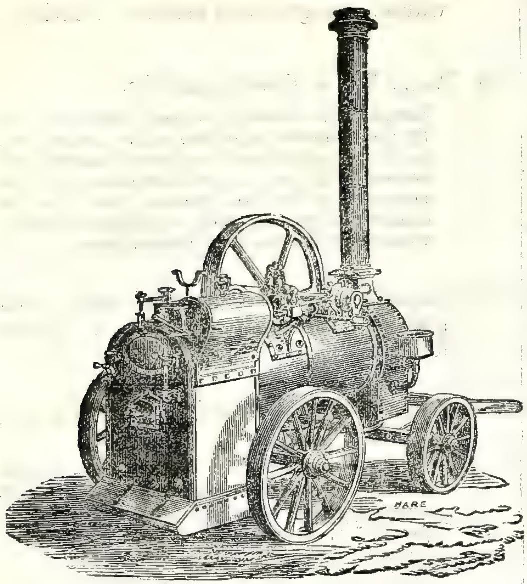

The object of this invention is:—1st. The driving of the axles of the drum of a portable combined thrashing machine. 2d. For the construction and giving motion to the straw-shaker of a thrashing machine.

220. Patent Improvements in Machinery for Drilling Seed and Manure; R. Garrett and R. Garrett, junr.



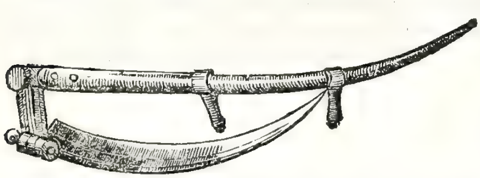

The object of this invention is:—1st. For regulating the liquid manure from drills. 2d. The application of a compound-lever to the forecarriage of drills for facilitating the steerage of the same.

221. Patent Improved Arrangement of Valves for Working Steam Machinery; R. Garrett, junr.



The object of this invention is:—1st. The means for admitting to such engines, when arranged to work expansively, a continuous supply of steam, and cutting off the supply when the engine has attained its ordinary speed. 2d. The mode of actuating the expansive valve.

222. Patent Double-Action or Self-Adjusting Scythe; J. Boyd. Exhibited by W. Dray and Co.



This instrument is capable of being set, on the instant, to any angle which may best suit the operator, be he amateur, gardener, or agricultural labourer. When out of use it may be shut up like a penknife, and carried away without danger.

223. The Weight Scythe; F. J. Wilson.
The improvement is—a weight is placed at the upper end of the scythe handle; when in motion it will assist the blade working through the end of the swarth when the first power is nearly exhausted.

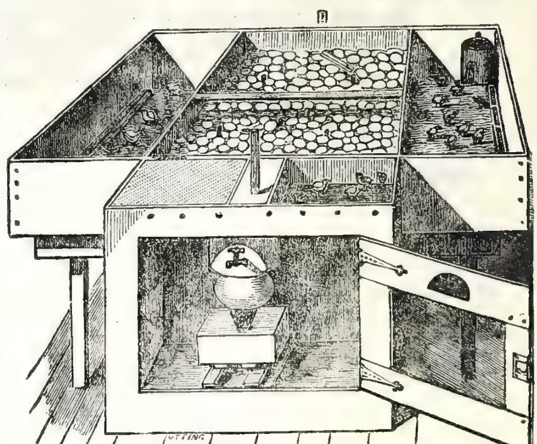
224. Hedge Slasher; F. J. Wilson.
The improvement is—the blade is curved backwards, thus throwing the weight behind, giving a security and steadiness to the blow, and the curve meeting its work at an angle, may literally be said to shave the hedge. It is sharp at both sides, because the flatter the blade the more power is thrown into the stroke; and the back cutter can be used with advantage when the other is accidentally blunt.

225. Portable Farm Railway; W. K. Westly.
This railway is composed of two horizontal series of rails, the one above the other, connected by vertical pillars. The carriages on this railway pass each other, backwards or forwards, on the opposite sides of one and the same rail, and they may be transferred from one track to the other by means of turntables. The carriage may have four wheels, to run in the usual way, but to run on the rail it requires only two on the same side, and a friction pulley to lean against the other rail. The carriage is partially supported by either one of the rails, while it is kept upright by pressing against the other. Instead of two rails, one rail may be constructed to produce, with appropriate carriages, the same effect.

226. Patent Root Pulping, Grating, or Mincing Machine; F. Phillips.
This machine is fitted up either as a barrel cutter or a wheel cutter; in the former case it is furnished with serrated cutters, and in the latter with hooked cutters or claws. The object of this machine is to introduce a more profitable method of feeding fattening animals, by giving them roots mixed with dry food, such as meal, chaff, &c., instead of the old mode of feeding them, sometimes with roots only, and sometime with dry food only. It so pulps or minces turnips or other roots, as that they may be mixed with any dry food, without animals being able to select them out of it.

227. American Churn; W. Dray and Co.
This churn can be had of any size, for churning 3lbs. to 40lbs. It is capable of making butter of the finest quality in about ten minutes.

228. Patent Hydro-Incubator; Carlo Minasi.



This contrivance can be constructed at about one-fourth of the expense formerly required. It produces on the average eighty birds out of every one hundred eggs. The necessary heat is obtained from a naphtha lamp, without a wick, which is so arranged that it may be left to itself for two or three days together, and yet the process of hatching goes on with due regularity and certainty. The eggs are placed on a zinc tray, corrugated at the bottom, through which a stream of hot water is, by means of the naphtha lamp, kept constantly flowing; and, when the chicken comes out of the shell, it is placed

beneath the same zinc tray, which now performs the second duty of the artificial parent. After being kept there the proper time, it is removed to a compartment more suited to its increasing strength, and is ultimately placed in a pen in the open air.

229. Horse Muzzle, for Preventing Crib-biting; T. Clowes.

This muzzle is fitted at the bottom, and at the part where the horse's chin rests, with a number of prickers, or sharp points, which are sheathed when not in action by perforated bars, acted upon by springs; but when the animal attempts to bite or suck his crib, or presses his mouth on to anything hard, the prickers are caused to protrude, and, by acting upon the lips or chin of the animal, will effectually cure him of this objectionable habit. This muzzle may be used either with or without the perforated plate, which is temporarily fitted inside, according as the animal is intended to feed or not.

230. Portable Pocket-sized Horse and Cattle Measure; J. Griffiths.

This measure is half-pistol, half-spyglass, in form. The tube end draws out when fitted for use, like a spyglass. It is contained in a case, 7 inches by 4 inches. The inventor thinks it would be found very useful in the hands of tax-collectors in assessing animals.

231. Patent Safety Lever Bits, adapted for Carriage, Hunting, and Hackney Uses; J. Griffiths.

These bits combine the snaffle and curb in one piece.

232. Patent Elastic Horse Shoe; G. Ross and Co.

The back of this shoe is split, and small wedges of vulcanized india-rubber are introduced, with the view of preventing concussion, curing corns or tender feet, and enabling a horse to tread firmly on any road.

233. Wire Netting or Fencing, made by Patent Machinery, for Fencing-in Poultry, Game, Sheep, Pleasure-grounds, &c.; of various widths, strengths, and meshes; J. Haley.

234. Patent Fuels; Gwynne and Co.

Samples of fuel made from peat, small coal, &c. By these patents the boiling of tar, pitch, &c., in the manufacture of coal fuels is entirely dispensed with, and a much superior article is produced, at half the present cost. In the compressed peat samples, no adhesive matter whatever is used to make them adhere.

235. Patent Fuel, made by machinery, from peat, coal, and other substances; C. Kingsford.

236. Patent Vegetable Charcoal and Manure; W. and J. Longmaid.

This process consists in the saturation of peat sawdust, or other vegetable substances, with dilute sulphuric acid. The materials are they placed in a drying chamber, where the water, particles are driven off, and the perfect charcoal is produced. (See *Journal of Society of Arts*, vol. iii., p. 151.)

237. Patent Deodorising Powder; — White. Exhibited by the Cyanic Manure Company.

238. Patent Cyanic Manure; — White. Exhibited by the Cyanic Manure Company.

239. Disinfecting and Deodorising Powder, for Sewage and all Offensive Organic Matter; Dr. Angus Smith and A. McDougall.

# MISCELLANEOUS, INCLUDING ARTICLES FOR PERSONAL AND DOMESTIC USE.

240. Patent Process for Covering Pills (with Resinous Gums), rendering them Tasteless; A. H. Cox.

The process is applicable to all pills. The pills are coated with a thin film of resinous gums, which are insoluble in water or saliva, and consequently tasteless; but the coating, after a short immersion in water or the stomach, is detached. The pills are dusted over, before they are quite dry, with any innocuous white powder.

241. Impermeable Bibulous Lamb-skin; Dr. Scott Alison.

For wounds and tender surfaces, for the application of water and liquid medicinal agents, such as aconitina, morphia, &c., in solution; mineral waters, &c.; securing their continuous presence by preventing evaporation, through the medium of an agreeable, light, elastic and adhesive substance.

242. Impermeable Bibulous Lamb-skin, Perforated; Dr. Scott Alison.

Having the advantages of the Impermeable Bibulous Lamb-skin, with the additional advantage of permitting the escape of discharge when that is very copious; and of somewhat reducing temperature by permitting a certain amount of evaporation.

243. Impermeable Bibulous Lamb-skin, covered with Black Silk; Dr. Scott Alison.

For ornament when applied wet to the face, &c. May be used dry, or made into muffs, &c., as a preservative of the animal heat, in rheumatism and cold extremities.

244. Ice Bag of Impermeable Bibulous Lamb-skin; Dr. Scott Alison.

For the application of ice and cold water to the head in fever, delirium, &c.; securing a low temperature, and by means of its impermeable coating preventing the trickling of water; and by minute perforations admitting just so much permeation as will keep the outer and bibulous surface in a state of continuous wet. The surface of the wetted skin is exceedingly grateful to the patient, and completely obviates the hardness of ice, when simply contained in muslin, as heretofore.

245. Transparent Impermeable Lamb-skin; Dr. Scott Alison.

For the spreading of plasters. Used as a waterproof bed guard. It is light, transparent, partially elastic, and, unlike oiled-silk, offers a surface capable of holding plaster.

546. Transparent Impermeable Adhesive Plaster; Dr. Scott Alison.

Spread upon the Transparent Impermeable Lamb-skin; it is waterproof, and, without deterioration, admits of the use of the bath. The condition of a wound may be seen through it and its outer surface may be washed upon the patient without detaching it, in this respect unlike ordinary plaster. If necessary it may be perforated to admit of discharge. Is warmed for application.

247. Impermeable Lamb-skin Isinglass Court Plaster; Dr. Scott Alison.

Perfectly waterproof, and softer than ordinary court plaster, the hard edges of which press into the skin and excoriate it.

248. Impermeable Lamb-skin Resinous Court Plaster; Dr. Scott Alison.

Suitable for cuts on the face and hands, and possessing more binding power than isinglass.

249. Sulphuric Acid Obtained from Gypsum (Sulphate of Lime), and Rectified or Distilled in an *Iron* Vessel; R. Von Seckendorff.

250. New Mineral Colours; Emile Kopp. Exhibited by Steiner, Gotty, and Co.

The four samples of colours are combinations of sulphur with antimony, and contain no organic colouring matters. They resist the action of sun, air, and rain, without sustaining any alteration. They also remain unaltered when exposed to the action of sulphuretted hydrogen and diluted acids or alkalies; only strong mineral acids and alkalies will injure them. They are very voluminous, and when the weight is compared with other mineral colours, their colouring power will be found very great. The price at which they can be manufactured is moderate, being from 1 to 2 shillings per pound, according to the shade.

251. Indian Corn Starch, manufactured by a patent process; J. Polson.

No. 1. Ungranulated Starch, (which requires to be boiled), obtained by mechanical separation of the gluten and fibrous matter, without fermentation, or any chemical agency. No. 2. Granulated Starch, (which requires to be boiled), obtained from No. 1 by purifying it by means of caustic alkali. No. 3. Granulated Starch, (which does not required to be boiled,) forming a thick gummy mucilage, similar to *dextrine*, by pouring boiling water over it. This starch is produced by subjecting No. 2 to the action of an acid. No. 4 Meal, consisting of gluten, starchy fecula, and fat, obtained in the process for No. 1. Also Biscuits, composed of two parts of wheaten flour and three parts of this meal. No. 5. Husk and Fibrous Matter, which is also obtained in the process for No. 1. This is highly nutritious food for cattle. No. 6. Starchy Flock, obtained in the purification of No. 1.

252. Patent Argentine, a new Metallic Dye; E. Schisekhar and Prof. F. C. Crace. Exhibited by Akroyd and Son.

253. Improvement in the Printing of Ornamental Fabrics; Patent Double-sided Printed Fabrics; N. M. Caralli.
This invention relates to the manufacture of fabrics of the Zebra class, such fabrics being suitable for all the purposes to which ordinary Zebra goods are applied, with the advantage that they present a different and totally distinct pattern or device on each side. A plain, twilled, or other fabric is used as the material for producing this duplex pattern. Such fabric is printed with the distinct pattern or device in the Zebra or similar style on each side of the cloth, so that one piece shows two dissimilar styles of ornamentation.

254. Improvements in the Production of Surface-Finish, called Watering and "Moiré Antique;" J. W. Crossley.

255. Patent Marsh Mallow and Hollyhock Rope; J. Niven.
The inventor has patented the application of various fibres for the manufacture of paper and textile fabrics.

256. Patent Excelsior Reel; J. P. Clarke.
Heretofore, in the manufacture of reels, they have been solid, and not capable of being seen through — hence the barrels have been often made of large dimensions, and the reels have contained short measure, and the purchaser has had no means of ascertaining that fact until the cotton or thread had been unwound. The improvements consist in making the reels and ends of reels with holes or openings through, in various styles, so that the extent to which the interior of a reel is wound may be seen through the end or ends of the reel, by which fraud will be prevented.

257. Patent Fluted Down Quilt; T. Lawes.
These Quilts supersede all other bed covering: as compared with the best quality of blankets, they produce as much warmth with less than half the weight, and do not cost more.

258. Patent Cement for Leather, as a substitute for stitching; the Patent Leather Cement Company.
The following are the specimens exhibited:—Nos. 1 to 4—Machinery belts. No. 1—The leather prepared for the cement. 2—The leather prepared with *one* coat of the cement. 3—The leather prepared with two coats of the cement. 4—The belt finished. 5—A fur skin joined with the cement. 6—A piece of water hose pipe. 7—A boot repaired; on one side, the patch in process, the leather prepared ready for the application of the cement; the two pieces to be joined together while the cement is wet; after a minute or two the patch will be finished and show as on the other side of the boot; this boot had been partially footed with the cement and worn out. 8—A Wellington boot, without a stitch; it is altogether cemented, and water-tight ¾ of an inch from the sole, and could be made water-tight all over, with a coating of the cement inside. 9—A piece of harness or trace, made without sewing. 10—A bottle of *the cement.*

259. British Shoes and Overshoes; J. Sparkes Hall.

260. Fleecing Gloves, with a thread of one fabric, and another fabric outside; S. S. Stallard.

261. Patent Patriotic Gloves; R. B. Cooley.

262. Mecanique Bonnet; Mrs. C. M. Hill.
This bonnet is made with a drawn front upon a metal frame, the frame being capable of extension so as to form a sun shade.

263. The Caspiato, or Folding Bonnet; J. and E. Smith.
It is packed in a case only one inch and a half deep, thus dispensing with the ordinary bonnet-box; this portability is obtained without in any way interfering with the appearance of the bonnet, which may be made of any of the materials usually employed, and may be trimmed in the highest fashion, agreeable to the taste of the wearer, neither is the cost enhanced.

264. The Socket-hinged Parasol Stick; — Jacobs.
The improvement on the old plan is that the socket is stationary, the hinge being moveable. It has simply to be pulled up and then falls.

265. Patent Safety Brooches; Berkeley W. Fase.
In this brooch the pin slides upon an oval frame, and drops into a groove made to receive it after insertion in the dress, and from which the pin cannot escape until it is raised by the finger from underneath, and the oval frame turned round to the largest diameter of the oval, when the pin drops through and the brooch is undone.

266. Patent Cylindrical Brooch Protector; R. Restell.

267. Patent Suspending Ever-pointed Pencil; J. Butler and Co. Exhibited by E. Nash.
This Pencil is intended to prevent the heads and points getting unscrewed and lost. It contains within the head a clip, which holds the lead and prevents the head from being detached from the body of the pencil case.

268. Printing from Nature, to produce Imitations of Ornamental Woods; Felix Abate.
The fact of the extreme sensitiveness of vegetable substances under the joint action of acids and heat, having attracted the attention of M. Abate, he entered upon a series of experiments, which showed that a small quantity of acid, and an instantaneous application of heat, were sufficient to produce striking effects. The process is as follows:—Suppose a sheet of veneering-wood be the object from which impressions are to be taken; the wood is exposed for a few minutes to the cold evaporation of hydrochloric or sulphuric acid, or it is slightly wetted with either of these acids diluted, and then the acid is well wiped off from the surface. Afterwards it is laid upon a piece of calico, or paper, or common wood, and by a stroke of the press an impression is taken, which is, of course, quite invisible, but by exposing this impression, immediately after, to the action of a strong heat, a most perfect and beautiful representation of the printing wood instantaneously appears. (See *Journal of the Society of Arts*, Vol. II., p. 539.)

269. Waterproof Paper, for Lining Damp Walls, &c., and for Packing-Cases, instead of Tin; T. Furse.

The joint is made waterproof in this specimen by means of a heated flat-iron run along, causing the cement to ooze out.

270. Patent Graining Instrument, for producing instantaneous imitations of Woods and Marbles, either on paint work or plain deal or other woods; I. Bellamy.

By this invention a great saving of time is effected, and inferior workmen are enabled to produce first-class work. The deleterious and prolonged process of painting is superseded, and the natural grain of the deal wood is preserved, and made to produce, in connection with the graining colour, an imitation of the desired fancy wood; and by the aid of varnish, a face is given to the work equal to that obtained by the use of oil paint.

271. Specimens of New Oak Stained with Writing Inks; J. Hawthorne.

By this process the wood is stained without filling up the grain, and the colour cannot be chipped or knocked off by a bruise or scratch, as the dye sinks into the wood. No previous preparation is required, and a boy, with a flannel and pail, can stain many feet of work in a day at a small cost. Any shade of colour can be produced by a mixture of yellow, black, red, and violet inks. The specimens exhibited are stained and slightly oiled, but they could be varnished or French polished without injuring the colour.

272. Ornamental and Coloured Glass; Tony Petitjean. Exhibited by E. Rascol.

The merit of this invention consists in the cheapness of the manufacture, the various shades of this glass being obtained at a less expense than for a single drawing—by simple block-printing.

273. Pulp made from waste newspapers, chemically purified of printers' ink; C. M. Archer.

274. Envelopes; J. J. Aston.

In these envelopes the tongue of the seal flap enters a slit in the other three flaps, and is folded back upon itself, the gummed underside of the tongue being made to adhere to the insides of the four flaps.

275. Penholders and Inkstands; W. Mill.

276. Patent Portable Letter Copying Press; G. B. Goodman.

By one simple action, which requires hardly any exertion, a pressure of upwards of 3 cwt. can be obtained, and as perfect an impression will be produced as by any other copying press now in use. It is acted upon by a vertical lever, with a camb-like head, there is no necessity to have it fixed, or to go to the further cost of having stands made for its support, but it can be used upon a desk, table, &c., &c., and removed from one office to another.

277. The Post-Office London Directory for 1855, showing the Application of Colour to the Edges of Books; J. and J. Leighton.

278. Patent Mechanical Letter, Invoice, and Music Binder; G. B. Goodman.

A metal case placed within the back of the cover, contains springs which act upon a metal binding rule. This rule runs along 3, 4, or 5 binding needles, and in groves cut in the case. When a paper has to be filed, the binding rule is drawn to the right-hand edge of the case, where it is retained by a catch. The papers to be filed are then placed between the binding rule and the needles, and the catch being released the binding rule is pressed by the springs in the case.

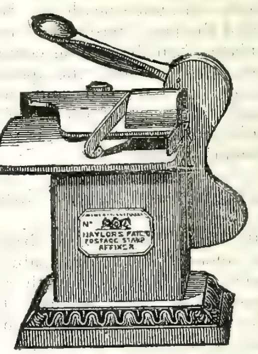
279. Elastic Bands; T. H. Ingall.

280. Sand Glass, which records its having run out by Striking a Bell; F. Le Mesurier.

281. Patent Letter Clip; G. Ayres. Exhibited by E. Nash.

This clip consists of a vertical spiral spring attached to a stand. The letters are inserted between the coils of the spring.

282. Patent Postage Stamp Affixer; Naylor and Meeks.



This consists of an upright metal box, in which are two reservoirs, one occupied by a sponge well saturated with water, and the other containing a supply of 120 postage stamps. The letter is first pressed under a roller, which brings it in contact with the sponge, and moistens the corner; it is then transferred by a slight lateral motion to the stamp box. The depression of a small lever brings up the box to the required point, and at the same time affixes a stamp on the letter.

283. Registered Pocket Stamp Box and Damper; H. M. Naylor.

This is constructed to hold 20 stamps, the first of which is inserted in the slit in the roller when the whole strip is wound round the roller, a portion of the last stamp remaining on the thumb-plate. In practice one stamp is withdrawn, torn off, and placed on the damp sponge, when it is ready for the purpose required.

284. Postage and Receipt Stamp Damper; A. G. Barham.

285. Patent Printing Types, cast by machinery; J. R. Johnson. Exhibited by J. H. King and Co.

286. Patent Suspension Reading Desk; J. Hammond.

This desk enables the reader to place the book in such a position, that it may be read with ease in a reclining or recumbent position, either on a bed or couch. It is, however, equally applicable to a perfectly erect position on a chair, and the reader need not lean forward as is sometimes required when the book is on the table. It can be attached to any ordinary table.

287. Patent Magnetic Music Page Turner; Druce and Co. Exhibited by G. B. Goodman.

This invention consists principally of a light lever, or rod. which is centered over a frame under the ledge of the reading-desk. At the extremity of the rod is a magnet, and a small disc of iron is fitted by points into the lower corner of the right-hand page of the music. By acting upon a pedal in connexion with the lever, it is thrown over to the right hand side, and the magnet drops upon the iron disc. with which it remains in contact by virtue of the magnetic attraction. On releasing the pedal, the lever moves back to its ordinary position on the other side of the book, the magnet drawing the page with it. At a certain point of the position, a small stem, attached to the lever by a spring, escapes from underneath the desk, and getting behind the page, pushes it smoothly down into its place when the rod has completed its movement. In this state the apparatus is ready to take up the next leaf, and the entire process, which is the work of a touch of the pedal by the pianist or other performer, is completed in a few moments of time.

288. Portable Easel; H. T. Williams.

289. Photographic Colors: J. Newman.

The colors are in an impalpable powder, and are merely to be laid on with a soft brush, the excess being blown off with the India-rubber blower, the plate requiring no breathing on or other preparation.

290. The Umbrella Camp Stool; F. J. Wilson.

291. A Machine for Setting Drawings; F. J. Wilson.

292. Application of Photography for readily producing perspective representations of Carriages—to scale if required—1st specimen coloured; 2nd untouched; Hooper and Co.

293. The In Statu Quo Chess Board; I. Jaques, jun.

In this invention, by pressing a pair of small buttons on the outer rim of the board, the pieces are secured firmly on whatever squares they may happen to be: while a counter pressure on a button on the inside immediately releases them.

294. Patent Self-acting Balance Wine Decanter; T. Challinor.

The following advantages are claimed for this decanter:—1. That the opening and closing are effected without the aid of springs. 2. That by means of the reservoir formed by the covering of the lip, a certain and regular stream of wine is obtained, and the danger of overflowing, by reason of a too elevated or rapid movement of the decanter prevented. 3. That the force required in pouring from an ordinary decanter is reduced by the use of a balance-handle, the position of the handle being such as to give the bottle a tendency to fall into its position for pouring.

295. Self-Acting Tie for Mechanical Straps, or other Similar Purposes; E. Rascol.

296. Pocket Watch and Purse Protector; G. North.

297. Caps and Stoppers to Bottles; R. Pinkney.

298. Syphon Corks to Ink Bottles; R. Pinkney.

298*a* Patent Air-tight Stoppers; W. Young.

298*b* Caps and Stoppers to Bottles; W. Young.

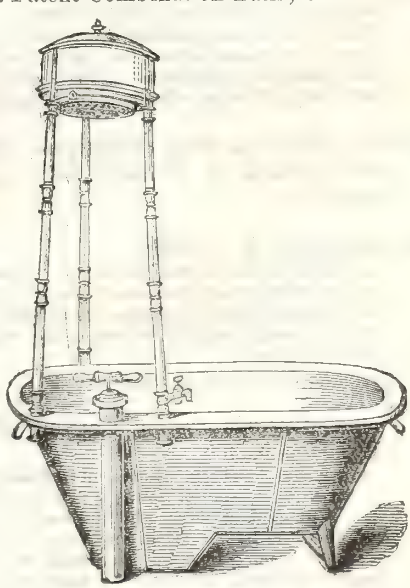
299. Patent Permanent Capsules, for Bottles, &c.; Cooke and Crawley.

The peculiarity in this capsule consists in its being lined with cork on its inner side or circumference; the inner top being protected from the action of acids, salts, &c., by a coating of gutta percha, shell-lac, or other materials.

300. The Numbered Street Lamp; F. J. Wilson.

By painting the number of the house on the upper part of the street lamp, opposite to it; it will enable the cabman to find the number of the house a few yards off, which from the darkness is at present difficult, and as the number is painted on the upper part of the lamp, it does not much affect the rays of light.

300*a*. Patent Combination Bath; G. M. Hantler.



This bath combines a warm, shower, hip, foot, and sponging bath in one article. For a warm bath less water is required than those of the ordinary kind, and it has the advantage of enabling the bather to preserve a sitting posture, which is preferable for the purposes of ablution. The bath can also be constructed with furnace attached to be heated by gas or by ordinary fuel.

301. Patent Safety Apparatus for facilitating the cleaning of Windows externally; F. Westbrook.
A small platform of timber, having on its upper surface a metal chair-like framework, is supported outside the window by means of claws and screws.

302. Apparatus for Suspending Looking Glasses; Mrs. Williams.

303. Patent Cramp Screw, for Swing Looking Glasses; J. Beall.
In this invention the binding screws are connected by means of a stiff wire, which passes through the standards and behind the glass.

304. Patent Portable Perambulator, for Children; C. Burton.

305. Patent Pinerium or Aerated Sarsaparilla; T. W. Gibson.

306. Compound of Chocolate, Cocoa, and other Ingredients, for Breakfast and Occasional Beverages; Jesse Ross. Manufactured by Ross, Brothers, and Co.

307. The Sickbed Signal for the totally Helpless; and the Invalids' Bell and Whistle Stand; a Lady, S.S. Maker, G. Southern.
To an upright standard is attached a moveable arm, at the end of which are fixed, 1, a bell-pull—the bell itself being suspended on the top of the standard—2, a whistle, and 3, an elastic tube, having a whistle end.

308. Patent Safety Night Lamp with Alarum combined; E. Simons.

309. Opaque Glass and other Tubes, for Shaving Soap, Brushes, and Dressing-Cases; — Shipley.

310. Registered Tooth Brush Guard or Case; Gay and Son.
This is an anti-corrodible metallic case, enclosing the head of the tooth brush, without the handle, thereby keeping the brush thoroughly clean, and preventing it from coming in contact with any articles among which it may be placed.

311. The Sponge-bag Dressing Case; F. J. Wilson.

312. Improved Bedsteads for Hospital Use; H. Lawson.

# LIST OF EXHIBITORS.

*N.B.—The figures after the names refer to the numbers in the Catalogue.*

Erratum.—Page 17, column 2, for "74. Self *Keeping* Railway Chair," read, "74. Self *Keying* Railway Chair."